UNIVERSITY OF THE PACIFIC
LIBRARY
1851
STOCKTON, CALIFORNIA

WITHDRAWN

Digitized by the Internet Archive
in 2025

https://archive.org/details/bwb_S0-AVW-028

REMINGTON'S
PRACTICE OF PHARMACY

A TREATISE

ON THE MAKING, STANDARDIZING, AND DISPENSING, OF OFFICIAL, UNOFFICIAL, AND EXTEMPORANEOUS PHARMACEUTICAL PREPARATIONS, WITH DESCRIPTIONS OF MEDICINAL SUBSTANCES, THEIR PROPERTIES, USES, AND DOSES, AND SUCH OTHER PROFESSIONAL SERVICE IN CONNECTION WITH COMMUNITY HEALTH AS THE PHARMACIST MAY BE CALLED UPON TO RENDER

INTENDED

FOR THE USE OF PHARMACISTS AND PHYSICIANS

AND

AS A TEXTBOOK FOR STUDENTS

OVER EIGHT HUNDRED ILLUSTRATIONS

SEVENTH EDITION

BY

E. FULLERTON COOK, P.D., PH.M.

CHAIRMAN OF THE COMMITTEE OF REVISION OF THE PHARMACOPŒIA OF THE UNITED STATES OF AMERICA; PROFESSOR OF OPERATIVE PHARMACY, AND DIRECTOR OF THE PHARMACEUTICAL LABORATORIES, AND DIRECTOR OF THE BUSINESS ADMINISTRATION COURSES OF THE PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE; MEMBER OF THE COMMITTEE OF REVISION OF THE N. F.; MEMBER OF THE COMMITTEE ON GALENICALS OF THE SECOND INTERNATIONAL CONFERENCE FOR THE UNIFICATION OF POTENT REMEDIES (BRUSSELS, 1925), ETC.

AND

CHARLES H. LAWALL, PH.M., PHARM.D., SC.D., F.R.S.A.

DEAN OF PHARMACY, AND PROFESSOR OF THEORY AND PRACTICE OF PHARMACY OF THE PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE; MEMBER OF THE GENERAL COMMITTEE OF REVISION; MEMBER OF THE EXECUTIVE COMMITTEE OF REVISION, AND CHAIRMAN OF THE SUBCOMMITTEE ON CHEMICAL REAGENTS OF THE PHARMACOPŒIA OF THE UNITED STATES OF AMERICA; MEMBER OF THE COMMITTEE OF REVISION OF THE N. F.; PHARMACEUTICAL EDITOR OF THE UNITED STATES DISPENSATORY, ETC.

WITH THE FOLLOWING COLLABORATORS

Professional Pharmacy
WILLIAM L. CLIFFE, PH.G., PH.M.
SAMUEL L. HILTON, PHAR.D., PH.M.
AMBROSE HUNSBERGER, PH.M.
J. LEWIS NEBINGER, PH.G.
LEONARD A. SELTZER, PH.C.
WILLIAM ALANSON HALL, PH.B.
ADLEY B. NICHOLS, PH.G., PHAR.D.

Manufacturing Pharmacy
CHARLES E. VANDERKLEED, B.S., A.C., PHAR.D.
CHARLES S. HERRON, P.D.
L. T. ANDREWS
FRANCIS J. STOKES, B.A.

Drug Milling
A. JOHN SCHWARZ, B.Sc.

Pharmaceutical and Assay Chemistry
IVOR GRIFFITH, P.D., PH.M.
JOS. W. E. HARRISSON, P.D., PH.M.
EDWARD J. HUGHES, P.D.

Biological Assays
PAUL S. PITTENGER, PH.C., PH.M., PHAR.D.

Biological Products
F. M. HUNTOON, M.D.
ROBERT H. HUTCHINSON, A.B., M.S.
ARTHUR D. HOLMES, PH.D.

Sterilization and Sterile Solutions
GILBERT L. HARVEY

Surgical Aids
FRED. B. KILMER, PH.M.

Therapeutics, Poisons and Antidotes
HORATIO C. WOOD, JR., M.D.

Pharmaceutical Latin
RALPH L. CALVERT, PH.G.

Homeopathic Pharmacy
JOHN A. BORNEMAN, P.D.

Perfumery
PHILIP E. CHALEYER

Pharmaceutical and Commercial Laws
HOWARD KIRK, ESQ.
HENRY C. CHRISTENSEN, PH.M., PH.C.
J. M. DORAN
CLIFTON E. YOUNG, M.D.
LEVI G. NUTT
FRANCIS E. STEWART, PH.M., M.D., PHAR.D., F.A.C.P.

Business Administration
ROBERT P. FISCHELIS, B.Sc., PHAR.D.
HAROLD J. LAWALL
EDWIN P. McLEAN
PAUL C. OLSEN, A.M.

Editorial Assistants
E. G. EBERLE, A.M., PH.M.
MILLICENT R. LAWALL, P.D.
BEULAH H. TULLAR
MARGUERITE S. COOK, B.A.

PHILADELPHIA AND LONDON
J. B. LIPPINCOTT COMPANY

WITHDRAWN FROM THE

Pharmacy
Ref
RS
91
R38
1926

Entered according to Act of Congress, in the year 1885, by
JOSEPH P. REMINGTON
In the Office of the Librarian of Congress, at Washington

Copyright, 1889, by JOSEPH P. REMINGTON
Copyright, 1894, by JOSEPH P. REMINGTON
Copyright, 1905, by JOSEPH P. REMINGTON
Copyright, 1907, by JOSEPH P. REMINGTON
Copyright, 1917, by JOSEPH P. REMINGTON
Copyright, 1926, by J. B. LIPPINCOTT CO.

ALL RIGHTS RESERVED

LIBRARY
AUG 11 1967
UNIVERSITY OF THE PACIFIC

171101
Pharmacy

The use in this volume of certain portions of the text of the United States Pharmacopœia, Tenth Revision, is by virtue of permission received from the Board of Trustees of the United States Pharmacopœial Convention. The said Board of Trustees is not responsible for any inaccuracy of quotation nor for any errors in the statements of quantities or percentage strengths.

Permission to use for comment parts of the text of the National Formulary, Fifth Edition, in this volume has been granted by the Committee on Publication by authority of the Council of the American Pharmaceutical Association.

Authority to use the New and Non-Official Remedies, 1925 Edition, has been granted by the American Medical Association.

THIS BOOK MAY BE KEPT
YOU CAN KEEP IT
NOT US

ELECTROTYPED AND PRINTED BY J. B. LIPPINCOTT COMPANY, PHILADELPHIA, U. S. A.

AUTHORS' PREFACE TO THE SEVENTH EDITION

THE authors of the Seventh Edition of "Remington's Practice of Pharmacy" became associated with its editorial staff in 1901, when Joseph P. Remington started work on the Fourth Edition. Both E. Fullerton Cook and Charles H. LaWall had, only a few months before (August, 1900), been appointed assistants to Dean Remington in the faculty of the Philadelphia College of Pharmacy.

In April, 1901, E. Fullerton Cook became the personal and intimate assistant of Joseph P. Remington who was at that time the editor of the Practice of Pharmacy, the pharmaceutical editor of the U. S. Dispensatory, and a few weeks later, following the death of Dr. Charles Rice, the Chairman of the Revision Committee of the Pharmacopœia of the United States. These and many other activities of Professor Remington made his office and laboratory the center of intense pharmaceutical activity, which continued up to the time of his death in 1918. During all of this same period, Charles H. LaWall was also constantly collaborating with Professor Remington in various phases of literary and educational work and it may be rightly said that over almost two decades both Cook and LaWall served a continuous apprenticeship in preparation for this Seventh Edition.

In the past quarter of a century the practice of pharmacy and pharmaceutical education have undergone revolutionary changes. Fortunately both authors have been intimately familiar with every pharmaceutical development of this period and especially active in the remarkable growth in pharmaceutical education, and consequently they feel themselves in a position to present a summary and guide to modern pharmaceutical services and activities, which in their opinion fully justifies the claim of pharmacy to professional recognition. The properly trained and professionally active pharmacist is an important factor in the community in the protection and maintenance of public health and in the care of disease, when he is fully coöperating with the physicians of the neighborhood in their application of scientific medicine.

When the summary was published a year ago of a study made by American pharmacists for the Commonwealth Fund, dealing with the needs of pharmaceutical education, a research conducted under the direction of Dr. W. W. Charters of the University of Chicago (see page 2), it was indeed gratifying to learn that the outline of the "New Remington", as it had already been planned, met most completely the ideals there expressed.

It was therefore with stimulated confidence in the rather ambitious plan which had been outlined that the revision was undertaken.

The authors had long recognized the futility of attempting so extensive a presentation without calling to their assistance specialists in many departments, and with the adoption of that policy no effort was spared to secure the help of experts wherever it was needed. Thirty-nine collaborators are listed on the title page, but the authors are indebted to innumerable other sources of information for valuable suggestions or facts and here gratefully acknowledge the contributions from friends and associates who have freely discussed many problems and thus added to the completeness of the text.

The inclusion of much information concerning the characteristics and therapeutics of the newer materia medica, from the 1925 edition of the New and Non-Official Remedies, was authorized by the American Medical Association and will be most acceptable information for many professional pharmacists.

The United States Pharmacopœia, Tenth Revision (U. S. P. X), the National Formulary, Fifth Edition (N. F. V), and the 1925 edition of the New and Non-Official Remedies (N. N. R.), have been made the basis for this edition, although other important therapeutic agents and unofficial preparations have been included. A glance at the contents of the Seventh Edition will reveal something of the greatly enlarged scope. The opportunities of the pharmacist as a chemist and analyst have been recognized; the continual call upon him for information relative to community health and welfare, including the control of pests and the use of disinfectants, has been made a feature; the necessity has been met for having at hand correct and very complete knowledge concerning the handling of surgical supplies and modern biological products, a chapter on antidotes to poisons was added that this might be available in emergency, and also other technical and professional information.

An addition which meets a definite need is the Chapter on "The Responsibility of the Pharmacist Under the Law", and the Chapters on Scientific Business Methods and Control, will, it is hoped, render an important service to the practicing pharmacist, even though his activities may be largely professional.

A more specific reference to the collaborators who have so earnestly and loyally assisted in the revision is necessary here. For many months it was possible for a small group to meet weekly to discuss every phase of the revision as it developed. These conferences will long be remembered, because of the earnestness and unanimity of purpose of each, their value in settling the many questions which came up, and their stimulation of new ideas. In these regular conferences were always found the authors, with Ivor Griffith, Adley B. Nichols and Edward J. Hughes. Others were frequently called into special sessions.

In Part I, Charles H. LaWall prepared the historical section and those parts which place before the student and pharmacist his obligations under the professional codes which are as old as the medical profession. It was felt that the beginner should immediately be initiated into the seriousness of the duties and responsibilities of pharmacy and be thus prepared to assume the correct attitude toward the technical operations which follow.

A chapter on pharmaceutical arithmetic has been added to Part II by Ivor Griffith. This represents practical experience in the needs of the pharmacist and many years of teaching the subject to pharmacy students. While elementary in many details it is exactly what is needed by the student, and frequently also by the dispensing and manufacturing pharmacist. Part II has been completely rewritten in the light of modern apparatus and processes, and the illustrations only present that which the authors personally know to be up-to-date and practicable.

Part III contains all formulas official in the U. S. P. X and N. F. V, with alternative weights and measures. This latter feature was continued at the earnest request of many users of the book and only after a careful survey of the conditions in American pharmacy. Many formerly official or otherwise useful formulas have been included under each class of preparations, the "Formulary" of earlier editions being omitted.

A notable feature of this section is a list of titles of classes of official and unofficial pharmaceutical preparations. This was compiled by Charles H. LaWall and presents, it is believed, a more complete list of titles of pharmaceutical preparations, together with their definitions, than is found in any other pharmaceutical textbook.

In Parts IV and V, Professor LaWall presents a discussion of the theory of inorganic and organic chemistry in a condensed and simple form, which will be greatly appreciated by many pharmacy students. In these sections the official chemicals, those recognized by the N. N. R., and many others, are discussed from the standpoint of their standards, manufacture, and use. Prof. Edward J. Hughes has contributed much to the information presented here, especially with reference to reactions, general chemical statements, and manufacturing processes.

The statements throughout the book concerning the therapeutic uses of drugs, preparations, and chemicals have been prepared by Dr. Horatio C. Wood, Jr.

No attempt has been made in Part VI to include an extensive treatise on the perfumery art, but it is believed that what has been included will be found of value to many who are interested in this fascinating subject. The material presented has been used in a brief course in perfumery and cosmetics at the Philadelphia College of Pharmacy and Science, and the authors are indebted to Philip E. Chaleyer, director of the perfumery laboratories of the Burton T. Bush Company of New York, for many other helpful suggestions.

In preparing the material for Part VI on the responsibility of the pharmacist under the Law, the services of a number of experts have been enlisted. The discussion on commercial law has been prepared by Howard Kirk, a member of the Philadelphia Bar, who has lectured on law before the students of the Philadelphia College of Pharmacy and Science for a number of years, and in consequence has studied and advised on practically every legal problem the pharmacist encounters.

It was not considered practicable to present the state law of any one commonwealth, because of its limited application, but the model pharmacy law, prepared a few years ago by a committee of the A. Ph. A., has been included with the hope that it may be more readily available as a model when new legislation is proposed in any state. Henry C. Christensen, Secretary of the National Association of Boards of Pharmacy has supplied information for the presentation of this material. The aid of governmental departments has been secured in connection with the several Federal Laws which require records and which constantly raise questions in the minds of pharmacists, namely, the Harrison Narcotic Act and the Volstead Prohibition Act.

The section dealing with the Narcotic Act was prepared by Levi G. Nutt. Colonel Nutt is a registered pharmacist, and has had about twenty-five years of experience in the Internal Revenue Service. He is now head of the Narcotic Division, Bureau of Internal Revenue, Washington, D.C., is in charge of the enforcement of the Harrison Act and Secretary of the Federal Narcotic Control Board, so that his discussion is authoritative and should be helpful to all pharmacists who operate under a narcotic permit.

The section dealing with the National Prohibition Act was prepared jointly by Dr. J. M. Doran, Head of the Industrial Alcohol and Chemical Division, Prohibition Unit, Bureau of Internal Revenue, Washington, D.C., and Dr. Clifton E. Young, Assistant Head of the same Division. This presentation is based upon the general principles underlying the Act, omitting detailed regulations, as these are subject to frequent revision.

A statement was also prepared by the Bureau of Chemistry on the requirements of the Food and Drugs Act. A brief discussion on the question of patents and trademarks is included, Dr. F. E. Stewart, internationally known as an expert on trademarks, having collaborated with Mr. Kirk on this section.

No apologies are necessary in this day of scientific business efficiency for the inclusion of Part VIII. The result of more than twenty-five years of study of business methods as applied to pharmacy, in the business administration department of the Philadelphia College of Pharmacy and Science, was made the basis for these chapters.

The assistance of Dr. R. P. Fischelis was secured in the compilation of the vast amount of material available. The authors are greatly indebted to Doctor Fischelis for its excellent presentation and for much added material, especially in that section dealing with merchandising, including advertising and selling. Doctor Fischelis was for a number of years in charge of the business courses of the Medico-Chirurgical College of Pharmacy and more recently and at the present time, Special Lecturer in Business Pharmacy and Pharmaceutical Journalism at the Philadelphia College of Pharmacy and Science.

The many contributions and the critical review of this entire section by Paul. C. Olsen, Instructor in Merchandising, Wharton School of Finance and Commerce of the University of Pennsylvania, and Lecturer on Business Administration at the Philadelphia College of Pharmacy and Science, and also by

Edwin P. McLean, President of the W. B. McLean Manufacturing Company, and student of merchandising economics and business analysis, have added greatly to the business administration section. In the accounting chapter the advice and practical illustrations in bookkeeping received from Harold J. LaWall, accounting expert and statistician, will be found helpful by many who face the necessity of keeping business records.

The analysis and value of accounts for the control of business has been especially presented. Especially valuable help in this has been received from Mr. McLean, who has constructively analysed more than five hundred drug stores within the last few years, and by Mr. Olsen, who is constantly handling drug store accounts and analysing the drug business from the standpoint of business efficiency.

Special acknowledgment is made to Dr. H. A. B. Dunning and also to the officers of the Liggett Corporation for placing at the disposal of the authors many facts and valuable methods used successfully by their organizations.

In Part IX, the student of pharmacy and the professional pharmacist who has the opportunity to enter the analytical field will find a presentation of valuable information. Each section has been prepared by an individual who is engaged in practical analytical work and who is convinced of the commercial practicability of such work for the pharmacist.

Professor LaWall, who for many years has conducted a successful analytical laboratory and who has been the official chemist of the Bureau of Foods of the Pennsylvania Department of Agriculture for more than twenty years, has written the introductory chapter; Prof. Ivor Griffith, after handling thousands of urine samples, has not only written the chapter on urinalysis in his inimitable style but has illustrated it with his own original drawings. Edward J. Hughes, Assistant Professor of Chemistry at the Philadelphia College of Pharmacy and Science has explained the chemical assays of the U. S. P. and N. F.; Jos. W. E. Harrisson, analytical chemist of large experience, associated with Professor LaWall and an assistant chemist of the Pennsylvania Bureau of Chemistry and Foods, has explained the official Proximate Assays, and Dr. Paul S. Pittinger, Instructor in Biologic Assaying at the Philadelphia College of Pharmacy and Science and member of the Bio-Assay Subcommittee of the U. S. P. Committee of Revision has prepared the Chapter on Biological Standardization.

Part X deals with large manufacturing operations in pharmacy. The presentation here considers chiefly the control methods required for large scale processes and has been prepared by Prof. Charles E. Vanderkleed, Lecturer on Chemical Control in the Philadelphia College of Pharmacy and Science. Professor Vanderkleed has had more than thirty years of experience as the director of large manufacturing pharmaceutical laboratories.

Many valuable suggestions in detailed manufacturing operations found elsewhere in the book, such as percolation, distillation, tablet making, tablet and pill coating, ointment manufacture, etc., have been contributed by

Charles S. Herron, graduate pharmacist and manufacturing pharmacist of large experience, L. T. Andrews of New York, manufacturing pharmacist and chemist with extensive training and many original ideas, and Mr. Francis J. Stokes, manufacturer and operator of manufacturing machinery and equipment. The section on drug milling was completely rewritten by A. John Schwarz, pharmacognocist and botanist, from his large experience in controlling the crude drug supplies of a large pharmaceutical manufacturer.

Recognizing that the prescription pharmacist, in the final analysis, contributes the most important professional service offered by pharmacy, probably more effort has been concentrated on Part XI than on any other section of the book. Especial emphasis has been placed upon the ethical basis which must inspire this service if it is to be acceptable and efficient.

To insure the inclusion of the latest and more efficient dispensing methods, a number of professional pharmacists were invited to collaborate. Among these are names so well known to most American pharmacists that they need no comment: William L. Cliffe, Philadelphia, Pa., Samuel L. Hilton, Washington, D.C., Ambrose Hunsberger, Philadelphia, Pa., J. Lewis Nebinger, (special instructor in Dispensing at the Philadelphia College of Pharmacy and Science and director of a retail prescription department in Philadelphia where from four to five hundred prescriptions are compounded daily), Leonard A. Seltzer, and William Alanson Hall, well-known professional pharmacists of Detroit, Michigan, and Prof. Adley B. Nichols, Assistant Professor of Operative Pharmacy at the Philadelphia College of Pharmacy and Science. As has already been indicated many other prescription pharmacists have been consulted and their ideas included, but only a general acknowledgment can be made. Years of accumulated information from hundreds of sources are represented and are acknowledged in the text whenever their origin is definitely known.

The section on sterilization and sterile products presents the methods of the N. F. V, but much added material is given through the coöperation of Samuel L. Hilton and Gilbert L. Harvey, each of whom has had extensive experience in the preparation of sterile solutions.

Part XII on Homeopathic Pharmacy has been prepared by John A. Borneman, who is an authority in this field, being Professor of Pharmacy at Hahnemann Medical College in Philadelphia and a manufacturer of homeopathic products for many years.

It is hoped that Part XIII will aid the pharmacist in answering many of the questions concerning the elimination of such household parts as fleas, rats, flies, etc. Accurate information is also included on the use of disinfectants and the proper treatment of infectious material in cases of contagious disease. This material is abstracted or quoted from popular bulletins on these subjects as issued by the Public Health Service of the United States or by the Bureau of Chemistry, Washington, D.C. Permission was granted for the use of this material.

In Part XIV is presented a systematic consideration of those biological products which have received the approval and are manufactured under the control of the Hygienic Laboratory of the U. S. Public Health Service.

Dr. F. M. Huntoon, Medical Director of H. K. Mulford Company and in charge of research in immunology and bacteriology in that laboratory, and Robt. H. Hutchinson, Director of the Professional Service Bureau of the H. K. Mulford Company have collaborated in this section. The information is sufficiently detailed and illustrated to provide a comprehensive knowledge of those biological products which have received general approval and which are being largely used by the medical profession. The pharmacist with this information available, can intelligently handle and discuss with physicians these important modern therapeutic agents.

Dr. Horatio C. Wood, Jr., Professor of Pharmacology and Therapeutics in the University of Pennsylvania and Professor of Materia Medica at the Philadelphia College of Pharmacy and Science, has prepared Part XV on Toxicology and Antidotes. It is recognized that the pharmacist is called upon to give only first aid treatment in cases of poisoning and that is the viewpoint from which this Chapter is prepared. It, however, places much valuable information at the ready disposal of the pharmacist for such emergency conditions as may at any time arise.

The outline of a laboratory course in manufacturing pharmacy represents the experience of Professor Cook in teaching this subject and is offered with the hope that it may aid in standardizing the teaching in this branch. The Pharmaceutical Syllabus is taken as a basis but with further extensions and details.

Two glossaries are appended. The one including unusual pharmaceutical terms has long been a valuable feature of the book and has been further elaborated. The glossary of medical terms was added to aid the student in his study of the therapeutic uses of drugs, where the meaning of a medical term used in this book is not understood and a dictionary is not available.

In conclusion the authors wish to gratefully acknowledge the assistance of a number of others who have rendered special aid in various parts of the revision. Prof. Eugene G. Eberle, Professor of Pharmacy for many years in Baylor University, College of Pharmacy, and a nationally known pharmacist and writer, read all proofs and offered many helpful suggestions, especially of an editorial character; Ralph L. Calvert, Instructor in Pharmaceutical Latin at the Philadelphia College of Pharmacy and Science, has carefully checked all statements concerning the use of Latin in prescription filling. Dr. Arthur D. Holmes, Director of Research in the E. L. Patch Company, has prepared the statements concerning cod liver oil and its assay. The very complete sections on plasters, surgical dressings, first aid outfits, and sutures and ligatures have been prepared by Dr. Fred B. Kilmer, the director of the Scientific Departments of Johnson and Johnson. Millicent R. LaWall, Marguerite S. Cook and Beulah H. Tullar have assisted editorially through the book in many capacities such as in the compilation of information and the

reading of proof, and to Mrs. Tullar has fallen the task of preparing the extensive index upon which the value of the book so largely depends.

The authors are indebted to Mr. Arthur H. Thomas, to Whitall Tatum Company, and a number of other manufacturers for the use of illustrations. The line drawings which have been added were made by Mr. B. C. Kolb.

In a work so comprehensive and involving so large an amount of labor many other associates have aided and to these the authors wish to express their appreciation, and finally present this volume as a contribution to the profession of pharmacy, with the hope that it may serve its day and meet the needs of this generation as fully as did the first volume when presented by its illustrious author, Joseph P. Remington, in 1885.

PHILADELPHIA, MAY 1, 1926.

PREFACE TO THE FIRST EDITION

THE rapid and substantial progress made in Pharmacy within the last decade has created a necessity for a work treating of the improved apparatus, the revised processes, and the recently introduced preparations of the age.

The vast advances made in theoretical and applied chemistry and physics have much to do with the development of pharmaceutical science, and these have been reflected in all the revised editions of the Pharmacopœias which have been recently published. When the author was elected in 1874 to the chair of Theory and Practice of Pharmacy in the Philadelphia College of Pharmacy, the outlines of study which had been so carefully prepared for the classes by his eminent predecessors, Professor William Procter, Jr., and Professor Edward Parrish, were found to be not strictly in accord, either in their arrangement of the subjects or in their method of treatment. Desiring to preserve the distinctive characteristics of each, an effort was at once made to frame a system which should embody their valuable features, embrace new subjects, and still retain that harmony of plan and proper sequence which are absolutely essential to the success of any system.

The strictly alphabetical classification of subjects which is now universally adopted by pharmacopœias and dispensatories, although admirable in works of reference, presents an effectual stumblingblock to the acquisition of pharmaceutical knowledge through systematic study; the vast accumulation of facts collected under each head being arranged lexically, they necessarily have no connection with one another, and thus the saving of labor effected by considering similar groups together, and the value of the association of kindred subjects, are lost to the student. In the method of grouping the subjects which is herein adopted, the constant aim has been to arrange the latter in such a manner that the reader shall be gradually led from the consideration of elementary subjects to those which involve more advanced knowledge, whilst the groups themselves are so placed as to follow one another in a natural sequence.

The work is divided into six parts. Part I is devoted to detailed descriptions of apparatus and definitions and comments on general pharmaceutical processes.

The Officinal Preparations alone are considered in Part II. Due weight and prominence are thus given to the Pharmacopœia, the National authority, which is now so thoroughly recognized.

In order to suit the convenience of pharmacists who prefer to *weigh solids* and *measure liquids*, the officinal formulas are expressed, in addition to parts by weight, in *avoirdupois weight* and *apothecaries' measure*. These equivalents are printed in *bold type*, near the margin, and arranged so as to fit them for quick and accurate reference.

Part III treats of Inorganic Chemical Substances. Precedence is of course given to officinal preparations in these. The descriptions, solubilities, and tests for identity and impurities of each substance are systematically tabulated under its proper title. It is confidently believed that by this method of arrangement the valuable descriptive features of the Pharmacopœia will be

more prominently developed, ready reference facilitated, and close study of the details rendered easy. Each chemical operation is accompanied by equations, whilst the reaction is, in addition, explained in words.

The Carbon Compounds, or Organic Chemical Substances, are considered in Part IV. These are naturally grouped according to the physical and medical properties of their principal constituents, beginning with simple bodies like cellulin, gum, etc., and progressing to the most highly organized alkaloids, etc.

Part V is devoted to Extemporaneous Pharmacy. Care has been taken to treat of the practice which would be best adapted for the needs of the many pharmacists who conduct operations upon a moderate scale, rather than for those of the few who manage very large establishments. In this, as well as in other parts of the work, operations are illustrated which are conducted by manufacturing pharmacists.

Part VI contains a formulary of Pharmaceutical Preparations which have not been recognized by the Pharmacopœia. The recipes selected are chiefly those which have been heretofore rather difficult of access to most pharmacists, yet such as are likely to be in request. Many private formulas are embraced in the collection; and such of the preparations of the old Pharmacopœias as have not been included in the new edition, but are still in use, have been inserted.

In conclusion, the author ventures to express the hope that the work will prove an efficient help to the pharmaceutical student as well as to the pharmacist and the physician. Although the labor has been mainly performed amidst the harassing cares of active professional duties, and perfection is known to be unattainable, no pains has been spared to discover and correct errors and omissions in the text. The author's warmest acknowledgments are tendered to Mr. A. B. Taylor, Mr. Joseph McCreery, and Mr. George M. Smith for their valuable assistance in revising the proof sheets, and to the latter especially for his work on the index. The outline illustrations, by Mr. John Collins, were drawn either from the actual objects or from photographs taken by the author.

J. P. R.

Philadelphia, October, 1885.

CONTENTS

PART I

INTRODUCTION, HISTORY, PHARMACOPŒIAS, FORMULARIES AND OTHER STANDARD BOOKS

		PAGE
CHAPTER I	Scope and History of Pharmacy	1
CHAPTER II	Pharmacopœias and other Standard Books on Pharmacy	14

PART II

TECHNICAL OPERATIONS IN PHARMACY

CHAPTER III	Metrology. Weight and Measure.	26
CHAPTER IV	Specific Gravity	55
CHAPTER V	The Arithmetic of Pharmacy	72
CHAPTER VI	Operations Requiring the use of Heat	92
CHAPTER VII	Uses of Heat	109
CHAPTER VIII	Vaporization	120
CHAPTER IX	Distillation	131
CHAPTER X	Sublimation	146
CHAPTER XI	Desiccation	148
CHAPTER XII	Comminution	151
CHAPTER XIII	Solution	171
CHAPTER XIV	Colloids and Dialysis	184
CHAPTER XV	Separation of Fluids from Solids	189
CHAPTER XVI	Filtration	196
CHAPTER XVII	Clarification and Decoloration	211
CHAPTER XVIII	Separation of Immiscible Liquids	214
CHAPTER XIX	Precipitation	216
CHAPTER XX	Crystallization, Granulation, and Exsiccation	218
CHAPTER XXI	Expression	225
CHAPTER XXII	Extraction by Maceration and Digestion	231
CHAPTER XXIII	Extraction by Percolation	233

PART III

GALENICAL AND OTHER PHARMACEUTICAL PREPARATIONS

CHAPTER XXIV	Aqueous Solutions	247
CHAPTER XXV	Aqueous Solutions containing Sweet or Viscid Substances	261
CHAPTER XXVI	Glycerin Solutions	300
CHAPTER XXVII	Alcoholic Solutions	305
CHAPTER XXVIII	Chloroform Solutions	342
CHAPTER XXIX	Ethereal Solutions	343
CHAPTER XXX	Oleaginous Solutions or External Applications	345
CHAPTER XXXI	Aqueous Liquids made by Percolation or Maceration	357
CHAPTER XXXII	Alcoholic Liquids made by Percolation or Maceration	364
CHAPTER XXXIII	Glycerin Preparations made by Percolation or Maceration	443
CHAPTER XXXIV	Oleoresinous Liquids made by Percolation	445
CHAPTER XXXV	Oily Preparations made by Maceration	448
CHAPTER XXXVI	Acetous Liquids made by Percolation or Maceration	449
CHAPTER XXXVII	Solid Preparations made by Percolation, etc.	451
CHAPTER XXXVIII	Solid Official Preparations made without Percolation or Maceration.	474

PART IV

INORGANIC CHEMICAL COMPOUNDS

CHAPTER XXXIX	Theory of Inorganic Chemistry	527
CHAPTER XL	Hydrogen, Oxygen, Water, and Nitrogen	544
CHAPTER XLI	The Inorganic Acids	552
CHAPTER XLII	Preparations of the Halogens. Chlorine, Bromine, Iodine, and Fluorine.	567
CHAPTER XLIII	Sulphur and Phosphorus	580

		PAGE
CHAPTER XLIV	Carbon, Boron, and Silicon	588
CHAPTER XLV	The Alkali Metals and their Compounds	595
CHAPTER XLVI	The Potassium Salts	596
CHAPTER XLVII	The Sodium Salts	617
CHAPTER XLVIII	The Lithium Salts	644
CHAPTER XLIX	Ammonium	649
CHAPTER L	Magnesium, Calcium, Radium, Barium, and Strontium	661
CHAPTER LI	Zinc, Aluminum, Thorium, Cerium, and Cadmium	690
CHAPTER LII	Manganese, Iron, Chromium, and Uranium	706
CHAPTER LIII	Nickel, Cobalt, and Tin	735
CHAPTER LIV	Lead, Copper, Silver, and Mercury	737
CHAPTER LV	Antimony, Arsenic, and Bismuth	761
CHAPTER LVI	Gold and Platinum	777

PART V

ORGANIC CHEMISTRY AND ORGANIC CHEMICAL SUBSTANCES

CHAPTER LVII	Theory of Organic Chemistry	779
CHAPTER LVIII	The Cellulose Group	794
CHAPTER LIX	Benzoic Acid, its Compounds and Derivatives	832
CHAPTER LX	Coloring Principles—Natural and Artificial	840
CHAPTER LXI	Organo-Metallic Compounds and Organic-Halogen Compounds	855
CHAPTER LXII	Amylaceous and Mucilaginous Principles and their Products	882
CHAPTER LXIII	Sugars and Saccharine Substances	893
CHAPTER LXIV	Alcohols and their Derivatives, including a Discussion of Yeast, Fermentation, and Enzymes	902
CHAPTER LXV	Aldehyde, its Derivatives and Preparations	929
CHAPTER LXVI	Products of the Action of Ferments upon Acid Saccharine Fruits	941
CHAPTER LXVII	Volatile Oils	948
CHAPTER LXVIII	Official Drugs and Products containing Volatile Oil with Soft Resin	995
CHAPTER LXIX	Official Drugs and Products containing Volatile Oil associated with Bitter Principle or Extractive	1007
CHAPTER LXX	Resins, Oleoresins, Gum Resins, and Balsams	1018
CHAPTER LXXI	Fixed Oils, Fats, Soaps and Petroleum Products	1032
CHAPTER LXXII	Drugs containing Glucosides or Neutral Principles, with their Preparations	1062
CHAPTER LXXIII	Alkaloids	1101
CHAPTER LXXIV	Vitamins	1168
CHAPTER LXXV	Products from animal substances	1170

PART VI

PERFUMERY AND COSMETICS

CHAPTER LXXVI	The Art of Perfumery	1207
CHAPTER LXXVII	Manufactured Perfume Products	1227

PART VII

THE RESPONSIBILITY OF THE PHARMACIST UNDER THE LAW

CHAPTER LXXVIII	Commercial Law	1245
CHAPTER LXXIX	Specific Laws Governing the Practice of Pharmacy	1250

PART VIII

THE BUSINESS REQUIREMENTS OF PHARMACY

CHAPTER LXXX	Business Administration	1267
CHAPTER LXXXI	The Store or Place of Business	1302
CHAPTER LXXXII	The Service and Commodities offered for Sale	1327
CHAPTER LXXXIII	Methods of Exchanging Commodities	1357
CHAPTER LXXXIV	Accounting and the Necessity for Proper Accounts	1391

PART IX

THE PHARMACIST AS AN ANALYST

CHAPTER LXXXV	The Qualifications of a Pharmacist as an Analyst	1427
CHAPTER LXXXVI	Urinalysis	1433
CHAPTER LXXXVII	Chemical Assay Methods	1449
CHAPTER LXXXVIII	Proximate Assays	1485
CHAPTER LXXXIX	Biologic Assays	1503
CHAPTER XC	General Tests of the U. S. P. and N. F.	1512

PAGE

CHAPTER XCI Physical Constants 1524
CHAPTER XCII Reagents and Test Solutions 1528
CHAPTER XCIII Diagnostical Reagents and Clinical Tests 1568

PART X

THE MANUFACTURING PHARMACIST

CHAPTER XCIV Chemical and Mechanical Control in Manufacturing Pharmacy 1577

PART XI

THE PROFESSIONAL AND PRESCRIPTION PHARMACIST

CHAPTER XCV Magistral Pharmacy 1587
CHAPTER XCVI Filling the Prescription 1600
CHAPTER XCVII Incompatibility 1627
CHAPTER XCVIII Extemporaneous Solutions and Mixtures 1651
CHAPTER XCIX Emulsions and Emulsifications 1655
CHAPTER C The Dispensing of Liquids 1662
CHAPTER CI Extemporaneous Powders 1672
CHAPTER CII Capsules and Cachets 1678
CHAPTER CIII Masses, Pills, and Troches 1690
CHAPTER CIV Tablets 1701
CHAPTER CV Coating Pills and Tablets 1720
CHAPTER CVI Suppositories 1733
CHAPTER CVII Solid Extemporaneous Preparations used Externally 1745
CHAPTER CVIII Plasters and Papers 1751
CHAPTER CIX Surgical Dressings 1756
CHAPTER CX First Aid Dressings 1764
CHAPTER CXI Ligatures and Sutures 1766
CHAPTER CXII Sterilization and Sterile Solutions 1779
CHAPTER CXIII Medicinal Foods 1820

PART XII

CHAPTER CXIV Homeopathic Pharmacy 1825

PART XIII

THE PHARMACIST IN COMMUNITY HEALTH SERVICE

CHAPTER CXV Household Pests and their Elimination 1833
CHAPTER CXVI The Attitude that Pharmacist should hold toward Venereal Disease Control and the Assistance that could be rendered Health Authorities 1864
CHAPTER CXVII Disinfection 1865

PART XIV

BIOLOGICAL PRODUCTS

CHAPTER CXVIII The Scientific Basis and Classification of Biologicals 1891
CHAPTER CXIX Biological Products used for Passive Immunization 1900
CHAPTER CXX Biological Products used for Active Immunization 1912
CHAPTER CXXI Proteins and Protein Therapy 1925
CHAPTER CXXII Biological Products used as Diagnostic Agents 1932

PART XV

TOXICOLOGY AND ANTIDOTES

CHAPTER CXXIII 1939

PART XVI

A LABORATORY COURSE IN MANUFACTURING PHARMACY AND DISPENSING

CHAPTER CXXIV 1945

PART XVII

CHAPTER CXXV Glossary of Uncommon Pharmaceutical and Technical Names, Terms, or Substances 1965
CHAPTER CXXVI Glossary of Medical Terms 1979
NAMES AND ADDRESSES OF MANUFACTURERS 1985
INDEX 1989

LIST OF ILLUSTRATIONS

FIG.		PAGE
1.	Æsculapius	3
2.	Ebers Papyrus	3
3.	Hippocrates	4
4.	Galen	5
5.	Graduated medicine glass	29
6.	Metric diagram	32
7.	Position of knife edges	43
8.	Manner of holding scales	43
9.	Counter scales in glass box	44
10.	Scale with graduated parallel beam	44
11.	Ball scale	45
12.	Manufacturing laboratory scale	45
13.	Troemner's prescription balance	46
14.	Troemner's prescription balance	46
15.	Torsion prescription balance	47
16.	Frame for torsion balance	47
17.	Frame with wire	47
18.	Common avoirdupois weights	48
19.	Block weights	49
20.	Cylindrical weights	49
21.	Cup troy weights	49
22.	Metric weights (iron)	49
23.	Metric weights (block)	49
24.	Troy prescription weights	50
25.	Aluminum wire weights	50
26.	Aluminum grain weights	50
27.	Aluminum grain weights	50
28.	Copper measures	51
29.	Metric measures	51
30.	Special copper measure	51
31.	Copper measure with outlet	51
32.	Conical metric graduate	52
33.	Conical apothecaries graduate	52
34.	Cylindrical graduate	52
35.	Reading meniscus	53
36.	Graduate hook	53
37.	Minim pipette	53
38.	Specific gravity bottle with tare	57
39.	Specific gravity bottle with thermometer	57
40.	Specific gravity hydrometer	58
41.	Baumé hydrometer for heavy liquids	58
42.	Baumé hydrometer for light liquids	58
43.	Scale of specific gravity hydrometer for heavy liquids	62
44.	Scale of specific gravity hydrometer for light liquids	62
45.	Hydrometer jar	62
46.	Hydrometer with elongated bulb	62
47.	Squibb's urinometer	63
48.	Alcoholometer	63
49.	Nicholson's hydrometer	65
50.	Lovi's beads	65
51.	Westphal specific gravity balance	65
52.	Nicol's specific gravity tube	66
53.	Rousseau's densimeter	66
54.	Taking the specific gravity of a solid	67
55.	Graduated specific gravity tube	67
56.	Specific volume bottle	69
57.	Pharmaceutical furnace, sectional view	93
58.	Portable furnace	94
59.	Spirit lamp	94
60.	Pocket alcohol stove	95
61.	Alcohol stove	95
62.	Russian blast lamp	95
63.	Alcohol blast lamp	95
64.	Gasoline stove	96
65.	Wickless blue flame coal oil stove	96
66.	Wickless blue flame coal oil stove	96
67.	Benzene blast lamp	96
68.	Gas flame	98
69.	Bunsen burner	98
70.	Micro burner	99
71.	Meker burner	99
72.	Fisher burner	99
73.	Comparison of Fisher and Bunsen burners	99
74.	Fletcher's radical burner	99
75.	Adjustable Bunsen burner	100
76.	Gas stove	100
77.	Solid top gas stove	100
78.	Gas furnace	100
79.	Hot water heater	100
80.	Small electric stove	101
81.	Electric stove	101
82.	Electric stove	101
83.	Immersion heater	101
84.	Centigrade thermometer	102
85.	Fahrenheit thermometer	102
86.	Paper scaler thermometer	102
87.	Comparison of thermometers	102
88.	Beckmann-type thermometer	105
89.	Clinical thermometer	105
90.	Special thermometer	106
91.	Taking a melting point	107
92.	Bensemann's method of collecting fusible body	107
93.	Bensemann's method of collecting fusible body	107
94.	Forms of blowpipes	109
95.	Gas blowpipe	109

FIG.		PAGE
96.	Foot bellows	110
97.	Hessian crucible	110
98.	Fletcher's gas crucible furnace	110
99.	Electric crucible furnace	110
100.	Platinum crucible	110
101.	Crucible tongs	111
102.	Gas muffle furnace	111
103.	Electric muffle furnace	111
104.	Electric muffle furnace	112
105.	Sand bath	112
106.	Water bath	113
107.	Water bath	113
108.	Gas heated, water-jacketed air bath	114
109.	Electrically-heated and regulated air bath	114
110.	Open steam bath	115
111.	Steam distributor	115
112.	Live steam to tank without noise	115
113.	Use of steam under pressure	116
114.	Steam boiler	117
115.	Steam boiler, sectional view	117
116.	Gas-heated boiler	117
117.	Steam kettle	117
118.	Steam kettle, sectional view	117
119.	Steam kettle on trunnions	117
120.	Tilting steam kettle with stirrer	117
121.	Enameled steam kettle	118
122.	Glass-lined steam kettle	118
123.	Kettle with steam coil	118
124.	Zig-zag steam coil	118
125.	Horizontal steam coil	118
126.	Upright steam coil	118
127.	Steam kettle for use over naked fire	118
128.	Boiling point test	122
129.	Mercurial barometer	122
130.	Wet and dry thermometer	123
131.	Sling psychrometer	124
132.	Evaporation by boiling	124
133.	Evaporating below boiling point	124
134.	Evaporating below boiling point	124
135.	Porcelain evaporating dish	125
136.	Glass evaporating dish	125
137.	Enameled cast iron dishes	125
138.	Agate ware evaporating dish	125
139.	Glass-lined open crystallizing pan	125
140.	Stirrers	126
141.	Small vacuum still	126
142.	Vacuum still	126
143.	Apparatus for recovering alcohol from exhausted drugs	127
144.	Vacuum dryer	127
145.	Evaporating sulphuric acid	128
146.	Flask evaporation	128
147.	Drying closet	128
148.	Drying closet with trays on portable frames	129
149.	Graduated evaporating dish	129
150.	Measuring evaporation	129
151.	Hood	130
152.	Fume closet	130
153.	Grommet	130
154.	Alembic	131
155.	Japanese lambik	131
156.	Plain retort	132
157.	Tubulated retort	132
158.	Distilling flask	132
159.	Soxhlet apparatus	133
160.	Special form of glass condenser	133
160*a*.	Trap bulb	134
161.	Tube properly bent	134
162.	Tube unequally heated	134
163.	Tube hastily bent	134
164.	Holding the tube	134
165.	Well drawn tube	135
166.	Tube unevenly heated	135
167.	Tube carelessly drawn	135
168.	Cork borers	135
169.	Rat tail file	135
170.	Rasp and file	135
171.	Bladder joint	136
172.	Bladder joint	136
173.	Rubber joint	136
174.	Plain receiver	137
175.	Tubulated receiver	137
176.	Tubulated and quilled receiver	137
177.	Mode of using quilled receiver	137
178.	Adapters	137
179.	Use of adapter	137
180.	Funnel tubes	138
181.	Improvised funnel tube	138
182.	Charging a plain retort	138
183.	Safety tube	138
184.	Retort stand	138
185.	Retort ring clamp	138
186.	Portable retort stand	139
186*a*.	Funnel stand	139
187.	Ring with split sections of rubber tubing	139
188.	Clamp extension	139
189.	Clamp holder	139
190.	Various forms of Leibig condensers	140
191.	Flask distillate	140
192.	Tube condenser in use	140
193.	Pinchcock	140
194.	Pinchcock	140
195.	Metallic worm condenser	141
196.	Glass worm condenser	141
197.	Remington still	141
198.	Stokes' automatic water still	142
199.	Barnstead water still	142
200.	Receiving distilled water from an automatic still	143
201.	Regnault still	143
202.	Redistilling outfit with rectifying column	144
203.	Effect of vacuum and pressure	144

FIG. PAGE
204. Subliming apparatus ... 146
205. Drying closet ... 149
206. Desiccator ... 149
207. Trituration ... 151
208. Spiral track of the pestle ... 151
209. Mortar for trituration ... 151
210. Pestle with hard rubber handle ... 152
211. Wedgwood mortar and pestle ... 152
212. Triturating with a loaded pestle ... 152
213. Porcelain mortar and pestle ... 153
214. Power mortar ... 153
215. Balanced handled spatula ... 153
216. Balanced handled spatula ... 153
217. Spatula with rubber coated blade ... 154
218. Solid hard rubber spatula ... 154
219. Slab and muller ... 154
220. Elutriating apparatus ... 154
221. Trochiscator ... 155
222. Contusion mortar and pestle ... 155
223. Rotary grater ... 156
224. Tobacco cutter ... 157
225. Roller knife ... 157
226. Rotary cutter ... 157
227. Single jar mill ... 158
228. Double jar mill ... 158
229. Large jar mill ... 159
230. Pot mill ... 159
231. Buhrstone mill ... 159
232. Buhrstone ... 160
233. Chasers (curved grinding surface) ... 160
234. Grooved rollers ... 161
235. Grooved roller (cross section) ... 161
236. Raymond roller mill (cross section) ... 161
237. Enterprise drug mill ... 162
238. Electrically driven mill ... 162
239. Quaker City F. No. 4 mill ... 162
240. Hance mill ... 164
241. Hance mill (lower plate) ... 164
242. Hance mill (upper plate) ... 164
243. Hance mill (base) ... 164
244. Max mill ... 164
245. The limited pulverizer ... 165
246. Vibrator feeder ... 165
247. Breaker feeder ... 165
248. The Wiley mill ... 166
249. Raymond roller mill with receiver ... 166
250. Mead's disintegrator (cross cut blank screen) ... 167
251. Mead's disintegrator (cross cut perforated screen) ... 167
252. Mead's disintegrator ... 167
253. Mead's disintegrator revolving disk and screens ... 167
254. Jones' mixer and sifter ... 168
255. Enclosed sifter ... 168
256. Scoop sifter ... 168
257. Scoop sifter (end view) ... 168
258. Hunter's mixer and sifter ... 168

FIG. PAGE
259. Rotex sifter ... 169
259 *a*. Diagrammatic representation of the Rotex cloth cleaning system ... 169
260. Portable glass-lined tank ... 172
261. Portable agitator ... 172
262. Circulatory solution ... 173
263. Woulff's bottle ... 182
264. Wash bottle for gases ... 182
265. Gas generator ... 183
266. Comparison in size of colloidal particles and molecules ... 185
267. Dialyzer ... 187
268. Dialyzer ... 187
269. Glass dialyzer ... 188
270. Spritz bottle ... 189
271. Continuous washing ... 189
272. Continuous washing apparatus ... 190
273. Use of the guiding rod ... 190
274. Syphon diagram ... 191
275. Syphon with lateral tube ... 192
276. Syphon with starter ... 192
277. Syphon in bottle ... 192
278. Syphon ... 192
279. Self-starting syphon ... 193
280. Hippocrates sleeve strainer ... 193
281. Pattern for Hippocrates' sleeve ... 193
282. Use of strainer ... 193
283. Cotton cloth strainer ... 194
284. Strainer and frame (tenaculum) ... 194
285. Hard-rubber strainer ... 194
286. Careless straining ... 194
287. Plain filter ... 197
288. Double plain filter ... 197
289. Rother's filter (first step) ... 197
290. Rother's filter ... 197
291 to 301. Folding a plaited filter ... 199
302. Plaited filter, parallel folds ... 199
303. Plaited filter, inside view ... 199
304. Arrangement of funnel in filtration ... 200
305. Filtering into a bottle (proper method) ... 200
306. Filtering into a bottle (improper method) ... 200
307. Plain funnel ... 200
308. Ribbed funnel ... 200
309. Tinned copper funnel with square neck ... 201
310. Tinned copper funnel ... 201
311. Hard rubber funnel ... 201
312. Funnel stand ... 201
313. Valve funnel ... 202
314. Kiefer glass tray filter ... 202
315. Buchner funnel ... 202
316. Filtration of volatile liquids ... 203
317. Monopad filter ... 203
318. Candle filter (Berkefeld type) ... 204
319. Alundum filter ... 204
320. Hot filtration ... 205

FIG.		PAGE
321.	Jacketed hot water funnel	205
322.	Funnel in coil	206
323.	Glass filter pump	206
324.	Brass filter pump	206
324*a*.	Chapman's pump	206
325.	Richard's pump	206
326.	Method of using filter pump	207
327.	Vacuum filter	207
328.	Vacuum pump	207
328*a*.	Gooch crucible arranged for vacuum	207
329.	Stone crock for filtration	208
330.	International filter	208
331.	Monocell filter	208
332.	U. S. Drum filter	208
333.	U. S. Drum filter with gravity feed	209
334.	U. S. Drum filter with pump feed	209
335.	Filter press	209
336.	Vallez filter	210
337.	Multiple pulp filter	210
338.	Sharples centrifugal filter	210
339.	Graduated pipette	214
340.	Measuring pipette	214
341.	Pipette (sheet rubber top)	214
342.	Glass syringe	214
343.	Open separatory funnel	214
344.	Pear shaped separator	214
345.	Mitchell's separator	215
346.	Florentine receiver	215
347.	Receiver for light and heavy oils	215
348.	Precipitating jar	216
349.	Cube	219
350.	Octahedron	219
351.	Truncated cube	219
352.	Truncated octahedron	219
353.	Right square or dimetric prism	219
354.	Dimetric octahedron	219
355.	Square prism, pyramidal summits	219
356.	Square prism, pyramidal summits	219
357.	Rhombic prism	219
358.	Rhombic octahedron	219
359.	Rhombic prism, pyramidal summits	219
360.	Rhombic octahedron (partially truncated)	219
361.	Hexagonal prism	220
362.	Double hexagonal pyramid	220
363.	Hexagonal prism (truncated)	220
364.	Hexagonal prism, pyramidal summits	220
365.	Monoclinic prism	220
366.	Monoclinic octahedron	220
367.	Monoclinic prism (partly truncated)	220
368.	Monoclinic prism (pyramidal summits)	220
369.	Triclinic prism	220
370.	Triclinic octahedron	220
371.	Triclinic prism (truncated)	220
372.	Triclinic octahedron (partly truncated)	220
373.	Gigot's press	225
374.	Gigot's press	225
375.	Single screw press	226
376.	Porcelain press	226
377.	Enterprise press	226
378.	Double screw press	227
379.	Wedge press	227
380.	Hydraulic press	228
381.	Hand laboratory centrifuge	229
382.	Covered laboratory centrifuge	229
383.	Self-balancing centrifuge	229
384.	Small centrifuge	229
385.	Official percolator	234
386.	Official percolation	234
387.	Plain percolator	235
388.	Oldberg percolator	235
389.	Conical percolator	235
390.	Narrow percolator	235
391.	Ordinary percolator	235
392.	Conical percolator	235
393.	Pan for moistening powders	236
394.	Power moistener for drugs	236
395.	Notched cork	237
396.	Scored paper	237
397.	Packer	237
398.	Imperfect packing	238
399.	Proper packing	238
400.	Percolating weight	238
401.	Sheet rubber cover	238
402.	Stopper for percolation control	240
403.	Well tube percolator	241
404.	Double tube percolator	241
405.	Percolators supported from the floor	242
406.	Percolator suspended from the ceiling	242
407.	Copper percolator of Colton	243
408.	Lloyd extractor and concentrator	243
409.	Percolator with circulating menstruum	243
410.	Pressure percolator (Suits)	244
411.	Lewin's hot extraction apparatus	244
412.	Hardesty vanilla percolator	244
413.	Percolator stand	245
414.	Graduated receiving bottle	245
415.	Receiving bottle for percolates	245
416.	Hardesty sugar percolator	263
417.	Alsop's infusion jar	358
418.	Squire's infusion mug	358
419.	Infusion mug (home-made)	358
420.	Infusion bottle	359
421.	Block-tin decoction vessel	362
422.	Brass water bath	362
423.	Percolator for volatile liquids	445
424.	Stopper wrench	552
425.	Carboy inclinator	552
426.	Acid dropper	553
427.	Patent top citrate bottle	667
428.	Metal cap citrate bottle	667
429.	Bottle capping machine	668
430.	Preparing solution of magnesium citrate	668

FIG. PAGE

431. Caustic cone mold ... 746
432. Squibb's mercurial shaker ... 749
433. Stereochemic formulas ... 780
434. Products from the destructive distillation of wood ... 799
435. Products from the destructive distillation of coal ... 810
436. Distillation of volatile oils ... 950
437. Soap boiling kettle, crutcher and frame ... 1050
438. The manufacture of toilet soap ... 1051
439. The making of powdered milk ... 1179
440. Professional Pharmacy, Hynson, Westcott and Dunning ... 1310
441. An efficient sales and wrapping counter ... 1312
442. A drug store layout by the Wilmarth Showcase Company ... 1317
443. A center door layout by the W. B. McLean Manufacturing Co ... 1317
444. A corner door layout by McLean ... 1318
445. A typical Liggett drug store ... 1318
446. The front of Hynson, Westcott and Dunning ... 1319
447. The Powers and Reynolds Pharmacy 1319
448. The pharmacy of Rees C. Roberts ... 1320
449. Combination of drug and wrapping counter ... 1320
450. Combined cigar and candy departments in the pharmacy of Rees C. Roberts ... 1321
451. Sundries and fancy goods in the pharmacy of Rees C. Roberts ... 1321
452. Soda booths and drug department in the pharmacy of Rees C. Roberts ... 1322
453. The pharmacy of Adamson Drug Co. 1322
454. The prescription department of Hynson, Westcott and Dunning ... 1323
455. The use of the Schwartz Sectional System in the prescription department of Fred Howard ... 1323
456. The Schwartz system in the prescription department ... 1324
457. Sectional case for small packages ... 1324
458. Typical prescription case ... 1324
459. Steel Furniture in the prescription department of Frank E. Morgan and Sons ... 1325
460. Prescription book case and steel furniture used by Frank E. Morgan and Sons ... 1325
461. Bronze graduate rack, mortar closet sink in the pharmacy of Frank E. Morgan and Sons ... 1326
462. Record of purchases ... 1329
463. Pricing code ... 1332
464. Pricing codes ... 1332

FIG. PAGE

465. Illustration of the N. A. R. D. inventory aid ... 1353
466. Illustration of inventory sheets of the American Druggists' Fire Insurance Company ... 1354
467. Table for determining the cost of fractions of a dozen ... 1355
468. Illustrations of brush lettering ... 1384
469. Single stroke, stump letters ... 1385
470. The Roman Alphabet ... 1386
471. Various styles of figures ... 1387
472. Various styles of letters and figures ... 1387
473. Illustrations for pen lettering ... 1388
474. Typical price card ... 1388
475. Typical show card ... 1389
476. Cash Register ... 1391
477. Daybook or blotter ... 1392
478. Charge slip ... 1393
479. Credit slip ... 1393
480. Credit memorandum ... 1394
481. Personal ledger (single or double entry) ... 1402
482. Billing ledger ... 1403
483. The journal ... 1404
484. The journal ... 1404
485. The journal ... 1405
486. Cashbook ... 1406
487. Cashbook ... 1406
488. Cashbook ... 1406
489. Cashbook ... 1406
490. The ledger ... 1408
491. The ledger ... 1408
492. The ledger ... 1408
493. The ledger ... 1408
494. The ledger ... 1409
495. The ledger ... 1409
496. The ledger ... 1409
497. The ledger ... 1409
498. Statement of profit and loss ... 1410
499. Statement of assets and liabilities ... 1410
500. Adding Machine ... 1411
501. Daily Record ... 1412
502. Daily Record ... 1413
503. Daily cash balance slip ... 1414
504. Invoice Record ... 1415
505. Monthly Record ... 1416
506. Monthly Record ... 1417
507. Yearly summary ... 1418
508. Yearly summary ... 1419
509. Druco (census of business costs) ... 1422
510. Laboratory cabinet ... 1430
511. Troemner analytical balance ... 1430
512. Chainomatic analytic balance ... 1431
513. Troemner's analytical weight ... 1431
514. Model urinalysis report ... 1433
515. Label for urine sample ... 1434
516. Spencer microscope ... 1435
517. Urinometer ... 1437

FIG.		PAGE
518.	Albuminometer	1440
519.	Ureometer	1442
520.	Casts	1445
521.	Cylindroids	1446
522.	Epithelial cells	1446
523.	Pus cells	1446
524.	Sediments from acid urine (pathologic)	1447
525.	Sediments from alkaline urine (pathologic)	1447
526.	Indicator bottle	1450
527.	Ordinary burette	1451
528.	Glass-valved burette	1451
529.	Dropping device for burette	1451
530.	Burette Stand	1452
531.	Burette Stand	1452
532.	Burette Stand with stock of V.S. and filter	1452
533.	Cassia flask	1483
534.	Mechanical shaker	1486
535.	Mechanical shaker	1486
536.	Automatic extraction apparatus for alkaloids	1487
537.	Construction of funnel tube for automatic extraction apparatus	1488
538.	Glass dish	1490
539.	Platinum dish	1490
540.	Percolator recommended for Type Process B	1495
541.	Arsenic test apparatus	1512
542.	Nicrometer	1517
543.	Sampler for drugs in bales	1521
544.	Reagent bottle	1544
545.	Volumetric flask	1552
546.	Tablet Department	1582
547.	Requisition for supplies from stockroom	1583
548.	The layout of a small pharmaceutical laboratory	1584
549.	Tare can	1594
550.	Tincture-mouthed shelf bottle (round)	1603
551.	Salt-mouthed shelf bottle (round)	1603
552.	Tincture-mouthed shelf bottle (square)	1603
553.	Salt-mouthed shelf bottle (square)	1603
554.	Syrup bottle	1603
555.	Oil bottle	1603
556.	Syrup in an ordinary bottle	1603
557.	Poison closet	1604
558.	Prescription memorandum form	1605
559.	Check for prescription	1606
560.	Prescription label	1606
561.	Prescription check and stub	1606
562.	Composite order form	1607
563.	Typical modern prescription	1608
564.	Typical modern prescription	1608
565.	Metric prescription	1609
566.	Metric prescription	1609
567.	Narcotic prescription	1609
568.	Narcotic prescription	1609
569.	Numbering machine	1610
570.	Rubber dating machine	1611
571.	Prescription label for special box	1611
572.	Label for narcotic prescription	1611
573.	Prescription label without border	1612
574.	Prescription label with copy	1612
575.	Prescription label, handwritten	1612
576.	Labels in strips for typewriting	1613
577.	Prescription label	1613
578.	Label for narcotic prescription	1613
579.	Average prescription prices	1617
580.	Sullivan transfer file	1618
581.	Acme prescription book	1619
582.	Crane's prescription file	1619
583.	"Safeway" prescription file	1620
584.	"Safeway" prescription cabinet	1621
585.	Fancy, obscure, and pretentious label	1621
586.	Plain, old-fashioned and inexpensive label	1622
587.	Typical modern label	1622
588.	Use of McCourt label cabinet	1624
589.	Label dampener	1624
590.	Making an emulsion	1656
591.	Drink mixer for emulsions	1659
592.	Emulsifier	1659
593.	Clipper emulsifier	1659
594.	Mixing machine	1659
595.	Homogenizer	1660
596.	Cross section of homogenizer	1660
597.	Lenox bottle brush	1662
598.	"Practical" prescription bottle	1662
599.	Diamond I prescription bottle	1662
600.	Various sizes of Diamond I prescription bottles	1662
601.	Screw cap prescription bottle	1663
602.	The old method of blowing bottles	1663
603.	The old method for finishing the necks of bottles, using a hand tool	1663
604.	The "vacuum" type bottle-blowing machine	1664
605.	The "gob" feed bottle-blowing machine	1665
606.	Poison bottle	1666
607.	Turntable rinser	1666
608.	Bottle washing and drying machine	1666
609.	U. S. "Santo" bottling outfit	1667
610.	Bottle-filling machine	1667
611.	Bottle-filling machine	1667
612.	Supply filter, and bottle filter	1668
613.	Graduate with hard rubber base	1668
614.	Graduate, chipped and broken base	1668
615.	Dropping from shop bottle	1668
616.	Dropping bottle	1668
617.	Bottle with dropper	1668

FIG.		PAGE
618.	Cork press	1668
619.	French cork press	1669
620.	Lochmann's cork press	1669
621.	Patent bottle cap	1669
622.	Bottle cap open	1669
623.	Typical seals and delivery taps	1670
624.	Hunt's bottle cap	1674
625.	Capping bottles	1675
626.	Tying the cap	1676
627.	Gauge for cutting paper	1672
628.	Gauge for cutting paper	1672
629.	Paper package	1673
630.	Twine reel	1673
631.	Twine holder	1673
632.	Gummed paper roll	1674
633.	Seidlitz powder measure	1674
634.	Adjustable powder measure	1674
635.	Prescription sieve	1674
636.	Powder spatula	1675
637.	Powder spatula	1675
638.	Arrangement for powder papers	1675
639.	Folding the powder	1675
640.	Making the end creases	1676
641.	Creasing with a spatula	1676
642.	Powder folder	1676
643.	Powder folder	1676
644.	Pill and powder boxes with hinged lids	1677
645.	Pill and powder boxes with slip lids	1677
646.	Hard gelatin capsules showing capacity	1679
647.	Ihrig capsule filler	1680
648.	Colton capsule filler	1680
649.	Sharpe and Dohme capsule filler	1681
650.	Screw cap homeopathic vial	1681
651.	Soft elastic capsule molds and filling rack	1682
652.	Soft elastic capsule molds	1682
653 to 655.	Pearl or globule mold A. B. C.	1683
656.	Colton's pearl or globule leaf making machine	1684
657.	Manufacture of cachets	1685
658.	Bottles for sealing cachets	1686
659.	Limousin's cachet board	1686
660.	Cachet wetter, cachet funnel, cachet containing powder and finished cachet	1686
661.	Sealing the cachet	1686
662.	German cachet apparatus	1687
663.	Konseal apparatus	1688
664.	Konseals (exact size)	1688
665.	Dry seal cachet	1688
666.	Dry seal cachet apparatus	1688
667.	Pill pestle	1690
668.	Colton's mass mixer	1691
669.	Pill mass rollers	1691
670.	Excipient bottle	1693
671.	Pill tile	1693
672.	Pill spatula	1694
673.	Pill machine	1695
674.	Pill finisher	1695
675.	Pill finisher	1695
676.	Pill sifter	1695
677.	Colton's modern pill plant	1695
678.	Hinged-lid pill box	1697
679.	Slocum's lozenge board	1698
680.	Lozenge punch	1698
681.	Lozenge punch (steel cutter)	1698
682.	Lozenge cutter, with die	1699
683.	Lozenge cutter	1699
684.	Lozenge cutter (end view)	1699
685.	Lozenge cutter	1699
686.	Colton's lozenge cutting machine	1700
687 and 688.	Tablet triturate machine	1701
689.	Colton's No. 1 triturate machine	1702
690.	Colton's No. 2 triturate machine	1703
691.	Colton's automatic triturate machine	1703
692.	Hand tablet compressor	1704
693.	Colton's granulation mixer and moistener	1706
694.	Hance mill	1707
695.	Stokes' granulator	1707
696.	Colton's granulator	1708
697.	Eureka tablet machine	1709
698.	Enlarged view of punches and die	1709
699.	Single punch tablet machine	1710
700.	Stokes' rotary tablet machine	1710
701.	Gelatin coating machine	1720
702.	Silver coater	1721
703.	Coating and polishing plant	1723
704.	Shapes of suppositories (exact size)	1734
705.	Shapes of suppositories (exact size)	1735
706.	Casserole	1736
707.	Individual suppository molds	1738
708.	Divided suppository molds	1738
709.	Hinged suppository mold	1739
710.	Two-size suppository mold	1739
711.	Brady's suppository mold	1739
712.	Brady's suppository mold on ice	1739
713.	Colton's glycerin suppository mold	1739
714.	Stokes' suppository molds	1740
715.	Filling Merrell suppository mold	1740
716.	Ejecting suppository from Merrell Mold	1740
717.	Applebaum suppository machine	1741
718.	Whitall Tatum suppository machine	1741
719.	Colton's suppository machine	1742
720.	Board for cutting suppositories	1742
721.	Shaping suppository point	1743
722.	Colton's power suppository machine	1743
723.	Suppositor	1743
724.	Suppositor	1743
725.	Suppository capsules	1743
726.	Bougie-mold	1743
727.	Suppository box	1744
727*a*.	Ointment mill	1746

FIG.		PAGE
728.	Porcelain jar	1746
729.	Ointment jar (amber glass)	1746
730.	Ointment pot	1746
731.	Ointment pot	1746
732.	Sterling ointment pot	1747
733.	Upressit pot (to close)	1747
734.	Upressit pot (to open)	1747
735.	Collapsible tubes	1748
736.	Special tips for collapsible tubes	1748
737.	Tube closed with clip	1749
738.	Tube filling machine	1749
739.	Tube filling and closing machine	1750
740.	Alper's ointment filler	1750
741.	Ointment finisher	1750
742.	Finishing ointment	1750
743.	Tensile strength machine	1752
744.	Cutting plaster paper	1753
745.	Spreading a plaster	1753
746.	Plaster iron	1753
747.	Left ear plaster	1754
748.	Right ear plaster	1754
749.	Breast plaster pattern	1754
750.	Breast plaster	1754
751.	Shoulder plaster	1754
752.	Back plaster	1754
753.	Side plaster	1754
754.	Chest plaster	1754
755.	Mesh of principal grades of gauze	1757
756.	Thread counter	1758
757.	Twisted silk	1767
758.	Diagram showing layers of intestine	1768
759.	Preparing catgut	1770
760.	Catgut size scale	1770
761.	Hand spring scale	1773
762.	Catgut in tubes	1773
763.	Catgut in envelopes	1774
764.	Flaming a tube before opening	1776
765.	Removing ligature for testing sterility	1777
766.	Dry heat sterilizer (gas heated)	1781
767.	Dry heat sterilizer (electrically)	1781
768.	Arnold steam sterilizer	1782
769.	"National" aluminum high pressure sterilizer	1783
770.	"Pressure cooker"	1783
771.	"National" autoclave	1783
772.	Vertical autoclave	1884
773.	Horizontal autoclave	1784
774.	Candle filter	1787
775.	Filtering under pressure	1788
776.	Varieties of ampuls	1790
777.	Ampul vial	1790
778.	Bulk container for sterile liquids	1790
779.	Filling ampuls	1790
780.	Apparatus for sterilizing solutions by passing them through a Berkefeld-type filter	1793
781.	Apparatus for filtering sterile solutions	1793
782.	Fermentation tube	1794
783.	Horse used for production of Diphtheria Antitoxin	1892
784.	The modern method of vaccination against smallpox	1893
785.	Flasks on shelf in incubator showing growth of Diphtheria Bacilli in the production of Diphtheria Toxin	1901
786.	Relative difference in volume between unconcentrated antitoxic serum A, B, C	1902
787.	Filtering crude serum to remove broken cells, shreds of fibrin, etc.	1905
788.	Showing action of agglutinating serum	1907
789.	Vaccinating calf	1913
790.	Close-up of the vaccine vesicles which develop on skin of the calf	1913
791.	Pulp, removed from vesicles shown in Fig. 790, is being ground in glycerin to produce a smooth homogeneous suspension	1914
792.	Illustrating steps in the process of making bacterial vaccine	1917
793.	Large incubator room where constant temperature of 37°C. is maintained to promote growth of quantities of bacterial organisms for the production of bacterial vaccines	1919
794.	Filling bacterial vaccine into containers	1921
795.	Laboratory animals used in testing bacterial vaccines and serums to determine their freedom from contaminating pathogenic bacteria and absence of toxic property	1922
796.	Growing tubercle bacilli in mass cultures for the production of Tuberculins	1923
797.	Showing ragweed pollen grains in nasal secretion from hay fever patient	1926
798.	Pollen grains of the Absinth Wormwood	1928
799.	Pollen grains of the Marsh Elder	1928
800.	Pollen grains of the Black Walnut	1930
801.	Showing skin tests with hay fever	1932
802.	Series of cutaneous tests on leg of hay fever patient, showing three strongly positive reactions; to June grass, Sweet Vernal Grass and Timothy	1934
803.	Form for reporting manufacturing operations	1946
804.	Receipt for minimum list of loaned apparatus	1947
805.	Specific gravity bottle, counterpoise, and case	1954

REMINGTON'S PRACTICE OF PHARMACY

PART I

INTRODUCTION, HISTORY, PHARMACOPŒIAS, FORMULARIES, AND OTHER STANDARD BOOKS

CHAPTER I

SCOPE AND HISTORY OF PHARMACY

PHARMACY is the science which treats of medicinal substances. It embraces not only a knowledge of medicines and the art of preparing and dispensing them, but also their identification, selection, preservation, combination, analysis, and standardization. The discovery of new medicinal drugs and the synthesis of organic compounds of therapeutic value are important functions of scientific pharmacy.

The word Pharmacy is also used to designate the place where medicines are sold.

Compounding consists of the skilful blending of two or more ingredients. In *dispensing* the pharmacist transfers from one container to another. These acts legally distinguish the practice of pharmacy from mere merchandising, there being drug stores which are not legally classed as pharmacies.

For convenience in study, Pharmacy may be divided into two major classes: *Theoretical Pharmacy* and *Practical Pharmacy*.

Theoretical Pharmacy—Inasmuch as all Nature, animate and inanimate, has been laid under contribution to provide remedies for the alleviation of disease, it follows that those sciences which embrace a knowledge of substances obtained from the vegetable, mineral, and animal kingdoms, as well as those which treat of the laws governing them, are called upon to supply important facts which form the basis of the science of Pharmacy.

Botany, the science of plants, *Mineralogy*, that of inorganic substances found in or on the earth, *Biology*, the science which treats of life, and *Zoölogy*, the science which treats of animals, are, however, less important than *Chemistry* and *Physics;* for upon these two Pharmacy is most dependent for its greatest development and its highest degree of usefulness.

Physics or *Natural Philosophy* is that branch of science which describes and explains the changes produced in bodies, by which their specific identity is not destroyed, while *Chemistry* treats of those changes which affect the specific identity of the bodies.

Materia Medica (medicinal materials) is a term applied to designate the substances which are used in the cure of disease; it is most intimately connected with *Pharmacognosy*, the science which treats of crude drugs. The specific definition of Pharmacy limits the latter to the consideration of the preparations made from drugs.

In schools and colleges of pharmacy, it is usual to divide General Pharmacy into three departments—Chemistry, Botany and Materia Medica, and Theory and Practice of Pharmacy.

Toxicology, the science of poisons, *Microscopy*, the science requiring optical instruments called microscopes, *Bacteriology*, a natural science which treats of micro-organisms, and *Serology*, dealing with serum products, form valuable collateral and special subjects of study. *Biological Assay* or *Physiological Standardization*, formerly known as *Pharmacodynamics*, deals with the action of drugs upon healthy animal organs. *Posology* is the science of doses for medicinal substances.

Pharmacology is broadly defined as the science of drugs. Unfortunately the name has also been used by specialists to indicate the action of drugs on living organisms and is employed synonymously with pharmacodynamics.

Practical Pharmacy is that branch of Pharmacy which treats of the operations, processes, and methods used in applying the principles of theoretical pharmacy. It is sometimes known as *Operative Pharmacy*.

During 1924 and 1925 the Educational Research Committee of the Commonwealth Fund, under the direction of W. W. Charters, conducted a study of pharmacy to determine the educational and training requirements for one who is to become a competent professional pharmacist. The conclusion of this portion of their report presents such a comprehensive view of pharmaceutical service that it is copied in full.

"In conclusion, then, we present this picture of the typical pharmacist which the college of pharmacy is to train. He is a man with interests and obligations outside of his profession; his personality and character should be of a high degree of competence. In his profession he buys and sells a wide variety of products, he fills prescriptions and manufactures those products which it is advisable not to purchase. He assists in the control of insects, fungi, and germs. He is a valuable source of information on public and private health and on other scientific matters. As a pharmacist he intelligently reads the authoritative treatises of his profession; he endeavors to understand and obey the laws of his country and he continually labors to keep abreast of his profession."

This guide book for the pharmacist endeavors to provide technical assistance in all of the varied activities and services recognized in the Commonwealth study.

HISTORICAL INTRODUCTION

Pharmacy, the art of identifying, selecting, preserving, and combining drugs of animal, plant or mineral origin, and medicine, the art of restoring or preserving health by the administration of these substances, are closely related professions, which are indistinguishable in their early history because of the fact that their practice was combined in one and the same individual who was frequently the priest or religious leader as well.

The beginnings of both medicine and pharmacy are so closely interwoven with superstition and fable that it is difficult to separate the real from the mythical. Disease was at first believed to be caused by evil spirits, hence incantations, noises, and odors were as frequently employed as remedies of a more material and efficacious character.

Isis and Osiris of Egypt are among the earliest of the mythical personages to whom have been attributed the origin of the healing arts. The Egyptian Thoth, also called Hermes, appears in this connection, although more particularly with relation to the beginning of alchemy or chemistry. Bacchus, Apollo, and Ammon of the Greeks, and Zoroaster of the Persians, claimed a share in these traditions. The most prominent of all of these mythical personages was Æsculapius (Fig. 1), the son of Apollo and pupil of

Chiron. It is he whose emblem, the *caduceus* (the serpents twining on a staff) originally carried by Hermes, is still seen in connection with medical insignia. His untimely end by a thunderbolt from Jove for having presumed to develop his art so far as to raise the dead to life, led to an interesting series of complications which are entertainingly described in any work on mythology. Æsculapius is credited with having had a number of children of whom the most notable was Hygeia, representing health, and Panacea, representing medicine.

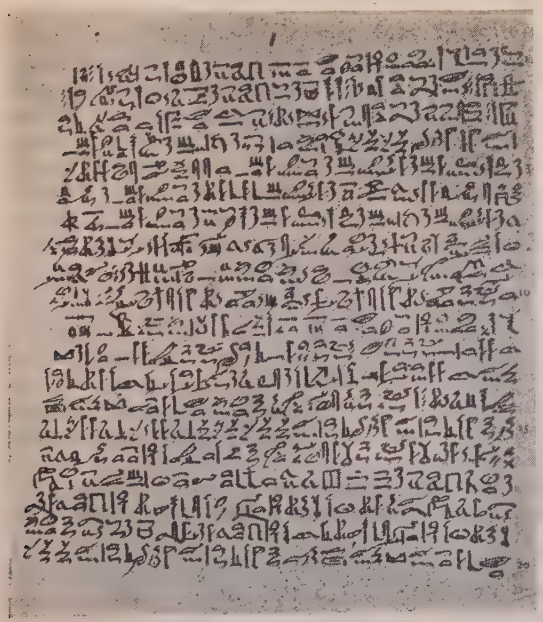
Fig. 1

ÆSCULAPIUS
(A statue at Naples)

Cosmas and Damien, who are still regarded with veneration as patron saints of Pharmacy in some European countries, were not mythological characters, but their history is such a jumble of fact and fancy that they properly belong to the mythology rather than to the history of the profession. They were victims of the Diocletian persecution in the fourth century and for centuries their tomb at Cyrus in Syria was worshiped as a shrine. Churches have been built in their honor in Constantinople and also in Rome, and their memory has been celebrated for many centuries by physicians and pharmacists of Catholic Europe on September 27th of each year.

The first real manuscript or literature pertaining to pharmacy and medicine is the papyrus, or scroll, called the *Papyrus Ebers* (Fig. 2), because it was discovered and partly translated by the noted Egyptologist of that name. It is a continuous roll of manuscript about 12 inches wide and over 250 feet in length and dates from about the sixteenth century before Christ, which is shortly prior to the time of Moses. It contains chapters not only on remedial agents and their methods for compounding, but also on means of conjuring away diseases. Many of the drugs enumerated are in common use today.

Fig. 2

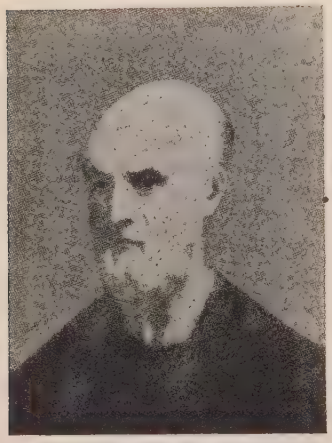


FIRST PAGE OF EBER'S PAPYRUS
(From The Evolution of Modern Medicine, by Sir William Osler)

Polypharmacy, or the prescribing of a multiplicity of ingredients in one compound seems to have been the practice of that early day. Some of the formulas contain as many as thirty-five ingredients. The writing of the Papyrus is in black ink, but the chapter heads and weights and measures are written in red ink. Evidence that the formulas were used is found in the fact that opposite many of them some commentator, or possibly an ancient apothecary, has written on the margin, "good".

Scientific pharmacy and medicine, until separated from mythology, really began with Hippocrates (Fig. 3), who was born on the Island of Cos in 460 B. C. Hippocrates was a keen observer, accurate thinker, and a clear and concise writer. He said among many other wise things, "Life is short, opportunity fleeting, judgment difficult, treatment easy, but treatment after thought is proper and profitable." In the writings of Hippocrates nearly 400 drugs are named as medicines and a large number of these are still used. He directed and employed preparations belonging to the classes of poultices, gargles, pills, ointments, collyria, and inhalations. He is best known as the author of that noble and idealistic code called the "Hippocratic Oath", which is the foundation of medical ethics and which is still administered in many medical colleges. The *Hippocratic Oath* is as follows:

FIG. 3



HIPPOCRATES
(Painting in the College of Physicians and Surgeons, Philadelphia, by Fanny Darrach)

"I swear by Apollo, the physician, and Æsculapius, and Hygeia, and Panacea, and all the gods and all the goddesses—and I make them my judges—that this mine oath and this my written engagement I will fulfil as far as power and discernment shall be mine.

"Him who taught me this art I will esteem even as I do my parents; He shall partake of my livelihood, and, if in want, shall share my goods. I will regard his issue as my brothers and will teach them this art without fee or written engagement if they shall wish to learn it.

"I will give instruction by precept, by discourse, and in all other ways to my own sons, to those of him who taught me, to disciples bound by written engagements and sworn according to medical law, and to no other person. So far as power and discernment shall be mine, I will carry out regimen for the sick and will keep them from harm and wrong. To none will I give a deadly drug, even if solicited, nor offer counsel to such an end; likewise to no women will I give a destructive suppository; but guiltless and hallowed will I keep my life and mine art. I will cut no one whatever for the stone, but will give way to those who work at this practice.

"Into whatsoever houses I shall enter I shall go for the benefit of the sick, holding aloof from all voluntary wrong and corruption, including venereal acts upon the bodies of females and males, whether free or slaves. Whatsoever in my practice or not in my practice I shall see or hear amid the lives of men which ought not be noised abroad—as to this I will keep silence, holding such things unfitting to be spoken.

"And now if I shall fulfil this oath and break it not, may the fruits of life and art be mine, may I be honored of all men for all time; the opposite if I shall transgress or be forsworn."

There was much experimentation along empirical lines in those early times and no opportunity for a systematic training except under a preceptor or master of an art or profession.

At the beginning of the Christian Era there were several Greeks and Romans whose names stood out prominently. Celsus, a Roman, was really a compiler of an encyclopedic collection of knowledge rather than a practitioner. Dioscorides, a physician, was especially noted for his work on Materia

Medica, and was the recognized authority in that subject for over 1600 years. Pliny, a Roman physician, whose specialty was natural history, was also the author of an encyclopedic work including medicine and pharmacy. Galen (Fig. 4) was a Greek who attained to Roman citizenship and made his reputation under the Cæsars. He was both a pharmacist and a physician. He originated so many preparations of vegetable drugs that such preparations are called "galenicals" or "galenical preparations" even at the present time. One of the commonly used articles originated by him and which has come down to us almost unchanged for nearly 2000 years, is the toilet preparation known as "cold cream".

FIG. 4

GALEN
(From Les Collections Artistiques de la Medecine de Paris)

The first six centuries of the Christian Era are what are known as the Dark Ages because of the lack of progress of civilization and all that pertains to it during this long period. There are really no names up to the twelfth or thirteenth centuries, except those of Arabic origin, which have anything to do with the development of medicine or pharmacy. The Arabs, who had attained the zenith of their success during this period, utilized works of Hippocrates, Galen, Dioscorides, and others, to the fullest extent.

Pharmacies, as separate places where drugs were compounded and sold, were first instituted during this Arabic period. The Arabians who attained the greatest fame in medicine, pharmacy, and alchemy were Geber and Mesue, of the eighth century, and Rhazes and Avicenna of the ninth century. The most famous of the Arabic figures in medicine and pharmacy, however, was Maimonides, who was the author of another contribution having an influence upon pharmaceutical ethics. It is known as the *Oath and Prayer of Maimonides* and is as follows:

"Thy Eternal Providence has appointed me to watch over the life and health of Thy creatures. May the love for my art actuate me at all times; may neither avarice, nor miserliness, nor thirst for glory, or for a great reputation engage my mind; for the enemies of Truth and Philanthropy could easily deceive me and make me forgetful of my lofty aim of doing good to Thy children.

"May I never see in the patient anything but a fellow creature in pain.

"Grant me strength, time and opportunity always to correct what I have acquired, always to extend its domain; for knowledge is immense and the spirit of man can extend infinitely to enrich itself daily with new requirements. Today he can discover his errors of yesterday and tomorrow he may obtain a new light on what he thinks himself sure of today.

"O God, Thou hast appointed me to watch over the life and death of Thy creatures; here am I ready for my vocation.

"And now I turn unto my calling:"

O stand by me, my God, in this truly important task;
Grant me success! For—
Without Thy loving counsel and support,
Man can avail but naught.
Inspire me with true love for this my art
And for Thy creatures,
O, grant—

That neither greed for gain, nor thirst for fame, nor vain ambition,
May interfere with my activity.
For these I know are enemies of truth and love of men.
And might beguile one in profession,
From furthering the welfare of Thy creatures.
O strengthen me.
Grant energy unto both body and the soul
That I might e'er unhindered ready be
To mitigate the woes,
Sustain and help
The rich and poor, the good and bad, enemy and friend,
O let me e'er behold in the afflicted and the suffering,
Only the human being.

In the eleventh century the period of the Crusades began, and this had a stimulating influence upon all scientific and professional knowledge. During the period of the Arabic domination, great schools of learning had been established at Salerno, Cordova, Seville, and Toledo. These were followed by others at Montpelier, Padua, and Leyden. In these schools pharmacy was taught as a part of the study of medicine. The first undoubted record of the separation of medicine and pharmacy is found in a decree of the Emperor Frederick II of Sicily, who in 1233, just after the close of the Crusades, issued an edict regulating the practice of pharmacy in his kingdom. This law mentions the "apotheca" as being the warehouses where drugs and medicines were stored. The compounders were called *confectionarii* while the sellers of simple medicines were called *stationarii* and the shops were called *stationes*. Physicians were neither permitted to conduct pharmacies nor to derive any profit from the sale of medicine by clandestine arrangements with any confectionarius. The confectionarii in their turn, were required to take an oath to prepare all medicines according to the formulary of the Salernian School. The prices which they were permitted to charge were regulated by law and were so graduated as to permit greater proportional profits upon those substances which were less frequently called for.

Pharmacies were permitted only in the principal cities and then under restrictions as to management and responsibility. This undoubtedly was the origin of the restriction of the practice of pharmacy. This restriction is still maintained in many European countries.

At this time the physician used no other drugs than those recommended by the ancients. As most of these came from far off lands, they were both rare and costly. Many herbs and plants were required to be gathered when the sun and planets were in certain constellations and certificates of their proper origin were needed. All this was impossible without a distinct employment of those who dealt in drugs and compounded them and it was found convenient to permit the dealers in drugs gradually to acquire monopolies.

The preparation of medicines was becoming more difficult and expensive. The invention by the Arabs of distillation, sublimation, and other chemical processes necessitated laboratories, furnaces, and costly apparatus, so it was thought proper that those who devoted themselves to pharmacy, which also included the practice of chemistry or alchemy, as it was then called, should have indemnification by an exclusive trade and thus they could be kept under close and effective supervision. Pharmacists were also allowed at that time to deal in sweetmeats and confections, which were then great luxuries.

The first organized body of pharmacists originated in Bruges, Belgium, in 1297. It was in the nature of a secret society and possessed a hall, constitution and by-laws, and an official seal. This was the period at which guilds, as professional and trade organizations were called, were very common. Other guilds

or organized bodies of apothecaries were soon formed in different parts of Europe and were the prototypes of the pharmaceutical organizations of the present time.

The word "apothecary" is derived from the Latin root "apothec" meaning a warehouse for drugs and medicines. The apothecary was originally a wholesaler. The word "apothecary" as translated in the Bible, should, in all probability, be translated "perfumer" as there is no clear record of the practice of the art of the apothecary as such among the early Hebrews, nor are there references to the administration of internal remedies in Biblical literature.

The perfumer, on the other hand, was intimately associated with religious practices, in that the preparation of the incense and of the anointing oils required a person skilled in compounding such ingredients.

The word "pharmacy" comes to us from the Greek root "*pharmakon*" which originally meant to mix and later meant a drug, medicine, or poison. The words drug and druggist are of more modern origin; the latter originally signified one who dealt in dry herbs.

Chemistry, through alchemy, is a word of Arabic origin, the original name being "Khem", the ancient name of Egypt. The prefix "al" is the common Arabic prefix meaning "the". Alchemy, however, originally referred to the practices of the Egyptians who were skilled as metal workers and in the art of glass making and other industries which have chemical knowledge as a basis.

From the 15th to 17th centuries, pharmacy probably reached the zenith of its success as a mysterious art. The rarity and cost of the raw materials, the many difficult and tedious operations which had to be undertaken to prepare even the simplest medicines, all combined to make the pharmacist a person not only of great technical skill but one who was absolutely indispensable to the success of the physician. In some countries, during the 17th century, particularly in England and France, the pharmacists were allied with the grocers, final separation of the groups being effected by the establishment of guilds of apothecaries under royal sanction.

As pharmacy and medicine were intimately associated during the earlier period, so pharmacy and alchemy, likewise were associated during the later period immediately preceding the birth of chemistry as an exact science. In this period lived a character who had a greater influence upon pharmacy and medicine than any individual since the beginning of the Christian Era. His real name was Philipus Aureolus Theophrastus Bombastus von Hohenheim, but he called himself Paracelsus, and by that name he is best known.

The early history of chemistry or alchemy had been influenced by the futile search for two mythical or imaginary substances,—the *Philosopher's Stone* and the *Elixir of Life*. The former was credited with the power of changing baser metals into gold, and the latter with conferring upon its possessor and user perpetual youth. Many fruitless years were spent by the wisest and the greatest of investigators in this futile quest, the by-products of the investigations being the discovery of many substances useful to mankind and the establishing of certain fundamental principles which led to the development of chemistry as a true science instead of an empiric and mysterious art.

Paracelsus condemned the uselessness of the search for these non-existent substances and was the founder of what came to be known as the iatrochemical school of medicine, in which chemical salts came for the first time to be used internally in the treatment of disease. Paracelsus, after having made some revolutionary changes in scientific thought, died in 1541. One of his successors, J. B. Van Helmont, who discovered carbon dioxide and who coined the word "gas", and Johann Rudolph Glauber, a German pharmacist and chemist, who

originated and studied the properties of the substance still known as Glauber's salt applied themselves particularly to the adaptations of chemistry to pharmacy and medicine.

Carl Wilhelm Scheele was a distinguished pharmacist of the eighteenth century. Scheele is credited with having made more important discoveries covering a wider range of subjects than any other investigator before or since. Trommsdorf of Germany and Dover and Fowler of England were prominent pharmacists of the eighteenth century. The names of Dover and Fowler are attached to pharmaceutical preparations still widely used in prescription practice.

For the guidance of physicians and pharmacists, books called pharmacopœias, or dispensatories, had appeared. One of the earliest of these was originated by Valerus Cordus, in 1524. The Pharmacopœia of Augsberg, known as the Pharmacopœia Augustana, which was issued in 1601 was probably the first book of standards given official authority by a city or community. Following close after that was the first London Pharmacopœia of 1618, which was largely based upon the older formularies of the Arabians and of Galen. The first Paris Pharmacopœia was issued in 1639. Pharmacopœias were at that time not nationally issued but were sponsored by communities or cities. The pharmacopœias of London, of Edinburgh, of Dublin, of Paris, of Nuremberg, and of many other European cities were often conflicting in the formulas for similiar preparations.

The first national pharmacopœia was that of France, known as the French Codex (*Codex Medicamentarius Gallicus*), which was issued in 1818. The second of the national pharmacopœias to appear was the United States Pharmacopœia, which was first issued in 1821. The first British Pharmacopœia did not replace the Pharmacopœias of London, Edinburgh, and Dublin until 1864, and the first German Pharmacopœia appeared in 1872.

Pharmaceutical education had developed in Europe to a considerable extent before any college appeared in America. The Philadelphia College of Pharmacy, now the Philadelphia College of Pharmacy and Science, was the first college of pharmacy instituted in the United States.[1] This was followed soon after by colleges in New York, Massachusetts, and Baltimore, and at present there are upwards of fifty colleges of pharmacy in the United States, many of which are departments of state universities and the majority of which are in agreement as to entrance requirements, curricula, and degrees.

The practice of pharmacy so far as its external appearance is concerned has changed markedly during the historic periods so briefly described, especially in the past few decades. It is, however, primarily concerned with the compounding, dispensing, and sale of remedial agents, and registration in the various states is based upon evidence of scientific and professional ability.

The development of pharmacy during the nineteenth century was along more scientific lines. The discovery of the alkaloids brought into prominence many names, among which were Vauquelin, Sequin, Derosne, Serturner, Pelletier, and Caventou. The origin and development of percolation added the names of Real, Robiquet, and Boullay. Now for the first time American names begin to appear in the scientific and educational literature of the profession. Parrish, Procter, Maisch, Remington, Wilbert, Daniel B. Smith, Alfred B. Taylor, and Kraemer of Philadelphia; Bedford, Rice, Squibb, Coghall, and Milhau of New York; William J. M. Gordon of Cincinnati; Grahame, Hancock, and Charles E. Dohme, of Baltimore; George W. Sloan, Eli Lilly, and Eliel of Indiana; Frederick Stearns of Detroit; Prescott and

[1] See "The First Century of the Philadelphia College of Pharmacy".

Schlotterbeck of Ann Arbor; Sheppard and Markoe of Boston; Hallberg, Oldberg, and Ebert of Chicago; Enno Sanders and Good of St. Louis; Scheffer and Diehl of Louisville; William S. Thompson of Washington; Searby of California; William Simpson of North Carolina; and William Saunders of Ontario, are but a few of the illustrious names of those who worked unceasingly for the advancement of pharmacy during the period immediately preceding the present era.

The successive revisions of the United States Pharmacopœia, each one an advance in scientific knowledge over its predecessor, the development of pharmacy laws in the various states, and the passage of the Federal Food and Drugs Act in 1906, have combined to increase the importance of the professional side of pharmacy.

The pharmacist has great responsibilities under the law, and toward the public. He is held accountable for his scientific knowledge and his registration is dependent upon proof of this fact. He is given certain privileges in return for his acceptance of these responsibilities and the sum total of his duties, responsibilities, and privileges, as is similarly true of other professions, is embodied in the ethical codes which have been adopted from time to time by various organized bodies of pharmacists.

Since 1921 a unified code of ethics has been adopted by the various national pharmaceutical organizations and by the colleges of pharmacy. This code of ethics gives the best insight into the professional responsibilities of the pharmacist that can be furnished, and it is quoted here in full:—

Principles of Pharmaceutical Ethics

I

The Duties of the Pharmacist in Connection with his Services to the Public

Pharmacy has for its primary object the service which it can render to the public in safeguarding the handling, sale, compounding, and dispensing of medicinal substances.

The practice of pharmacy demands knowledge, skill, and integrity on the part of those engaged in it. Pharmacists are required to pass certain educational tests in order to qualify under the laws of our States. The States thus restrict the practice of pharmacy to those persons who, by reason of special training and qualifications, are able to qualify under regulatory requirements, and grant to them privileges necessarily denied to others.

In return the States expect the pharmacist to recognize his responsibility to the community and to fulfil his professional obligations honorably and with due regard for the physical and moral well being of society.

The pharmacist should uphold the approved legal standards of the United States Pharmacopœia and of the National Formulary for articles which are official in either of these works, and should, as far as possible, encourage the use of these official drugs and preparations and discourage the use of objectionable nostrums. He should sell and dispense only drugs of the best quality for medicinal use and for filling prescriptions.

He should neither buy, sell, nor use substandard drugs for uses which are in any way connected with medicinal purposes.

The pharmacist should be properly remunerated by the public for his knowledge and skill when used in its behalf in compounding prescriptions, and his fee for such personal work should take into account the time consumed and the great responsibility involved as well as the cost of the ingredients.

The pharmacist should not sell or dispense powerful drugs and poisons to

persons not properly qualified to administer or use them, and should use every proper precaution to safeguard the public from poisons and from all habit-forming medicines.

The pharmacist, being legally entrusted with the dispensing and sale of narcotic drugs and alcoholic liquors, should merit this responsibility by upholding and conforming to the laws and regulations governing the distribution of these substances.

The pharmacist should seek to enlist and merit the confidence of his patrons and when this confidence is won it should be jealously guarded and never abused by extortion or misrepresentation or in any other manner.

The pharmacist should consider the knowledge which he gains of the ailments of his patrons and their confidences regarding these matters as entrusted to his honor, and he should never divulge such facts unless compelled to do so by law.

The pharmacist should hold the health and safety of his patrons to be of first consideration; he should make no attempt to prescribe or treat diseases or strive to sell drugs or remedies of any kind simply for the sake of profit.

He should keep his pharmacy clean, neat, and sanitary in all its departments and should be well supplied with accurate measuring and weighing devices and other suitable apparatus for the proper performance of his professional duties.

It is considered inimical to public welfare for the pharmacist to have any clandestine arrangement with any physician in which fees are divided or in which secret prescriptions are concerned.

The pharmacist should primarily be a good citizen, and should uphold and defend the laws of the state and nation. He should inform himself concerning the laws, particularly those relating to food and drug adulteration and those pertaining to health and sanitation, and should always be ready to coöperate with the proper authorities having charge of the enforcement of the laws.

The pharmacist should be willing to join any constructive effort to promote the public welfare and he should regulate his public and private conduct and deeds so as to entitle him to the respect and confidence of the community in which he practices.

II

The Duties of the Pharmacist in His Relations to the Physician

The pharmacist, even when urgently requested so to do, should always refuse to prescribe or attempt diagnoses. He should under such circumstances, refer applicants for medical aid to a reputable, legally qualified physician. In cases of extreme emergency, as in accident or sudden illness on the street in which persons are brought to him pending the arrival of a physician, such prompt action should be taken to prevent suffering as is dictated by humanitarian impulses and guided by scientific knowledge and common sense.

The pharmacist should not, under any circumstances, substitute one article for another, or one make of an article for another in a prescription, without the consent of the physician who wrote it. No change should be made in a physician's prescription, except such as is essentially warranted by correct pharmaceutical procedure, nor any that will interfere with the obvious intent of the prescriber, as regards therapeutic action.

He should follow the physician's directions explicitly in the matter of refilling prescriptions, copying the formula upon the label, or giving a copy of the prescription to the patient. He should not add any extra directions or

caution or poison labels without due regard for the wishes of the prescriber, providing the safety of the patient is not jeopardized.

Whenever there is doubt as to the interpretation of the physician's prescription or directions, he should invariably confer with the physician in order to avoid a possible mistake or an unpleasant situation.

He should never discuss the therapeutic effect of a physician's prescription with a patron nor disclose details of composition which the physician has withheld, suggesting to the patient that such details can be properly discussed with the prescriber only.

Where an obvious error or omission in a prescription is detected by the pharmacist, he should protect the interests of his patron and also the reputation of the physician by conferring confidentially upon the subject, using the utmost caution and delicacy in handling such an important matter.

III

The Duties of Pharmacists to Each Other and to the Profession at Large

The pharmacist should strive to perfect and enlarge his professional knowledge. He should contribute his share toward the scientific progress of his profession and encourage and participate in research, investigation, and study.

He should associate himself with pharmaceutical organizations whose aims are compatible with this code of ethics and to whose membership he may be eligible. He should contribute his share of time, energy, and expense to carry on the work of these organizations and promote their welfare. He should keep himself informed upon professional matters by reading current pharmaceutical and medical literature.

He should perform no act, nor should he be a party to any transaction which will bring discredit to himself or to his profession or in any way bring criticism upon it, nor should he unwarrantedly criticise a fellow pharmacist or do anything to diminish the trust reposed in the practitioners of pharmacy.

The pharmacist should expose any corrupt or dishonest conduct of any member of his profession which comes to his certain knowledge through those accredited processes provided by the civil laws or the rules and regulations of pharmaceutical organizations, and should aid in driving the unworthy out of the calling.

He should not accept agencies for objectionable nostrums nor allow his name to be used in connection with advertisements or correspondence for furthering their sale.

He should courteously aid a fellow pharmacist who may request advice or professional information or who, in an emergency, needs supplies.

He should not aid any person to evade legal requirements regarding character, time, or practical experience by carelessly or improperly endorsing or approving statements relating thereto.

He should not imitate the labels of his competitors nor take any other unfair advantage of merited professional or commercial success. When a bottle or package of a medicine is brought to him to be refilled, he should remove all other labels and place his own thereon unless the patron requests otherwise.

He should not fill orders which come to him by mistake, being originally intended for a competitor.

He should deal fairly with manufacturers and wholesale druggists from whom he purchases his supplies; all goods received in error or excess and all undercharges should be as promptly reported as are shortages and overcharges.

He should earnestly strive to follow all proper trade regulations and

rules, promptly meet all obligations, and closely adhere to all contracts and agreements.

In the fourth paragraph in the Principles of Pharmaceutical Ethics the words "objectionable nostrums" appear. An objectionable nostrum is considered to be one which does not comply with the minimum requirements for such preparations as drafted by a committee of the American Pharmaceutical Association.

Extract from the Report for the Committee of the A. Ph. A. on Proprietary Remedies[1]

Minimum Requirements with which Proprietary Remedies Should Comply in Order to Render Them Safe for Direct Sale to the General Public

The following declarations are provisional and subject to repeal, modification, or expansion, as the Commission may later decide.

1. Prescription Fakes, Concealment of Proprietary Character—The preparation must not be named or advertised in such a way as to conceal its proprietary character and lead the purchaser to believe that it is a simple chemical or vegetable drug ordinarily purchasable in small quantities instead of a proprietary mixture or substance.

2. Methods of Marketing—The preparation must be one which is regularly offered to the public through the usual trade channels, *i.e.*, through regular wholesale and retail dealers in ready-made medicines, and thus subject to inspection by the authorities charged with the enforcement of state food and drug laws.

3. Alcohol Content—If the preparation contains alcohol, it must be sufficiently medicated to prevent its use as an intoxicating beverage and in addition to this requirement, the proportion of alcohol present must not be greater than is properly necessary to hold in solution in permanently active condition the essential constituents of the preparation, and to protect the preparation against freezing, fermentation, or other deleterious change.

4. Content of Habit-forming Narcotic Drugs—If the preparation is one which is capable of being used internally, whether recommended for internal use or not, it must not contain cocaine, nor shall it contain opium or any of its alkaloids or their derivatives, in greater proportions than those specified in Section Six of the Federal Law commonly known as the Harrison Act, and it shall also contain other active drugs in such proportion that the use of the preparation will not be likely to create a drug habit, nor satisfy such a habit when previously existing.

5. Remedies for Children's Use—If intended for administration to infants or children, the preparation must not contain cocaine, or opium or its alkaloids, or their derivatives in any proportion whatever.

6. Activity of the Preparation, Cautions Against Misuse—The preparation must be of such character that it will not be liable to endanger life or health when used in accordance with the accompanying instructions, and if the preparation is one which is liable to occasion injury when improperly used or when used to excess, the accompanying literature must bear instructions tending to guard against such improper or excessive use.

7. Immoral or Illegal Purposes—The preparation must not be intended for use as an abortifacient nor for use for any other immoral or illegal purpose, nor must it be advertised or recommended either directly or indirectly as an abortifacient or for any immoral or illegal purposes.

---

[1] Journal of the A. Ph. A. 1915.

8. Incurable and Contagious Diseases—The preparation must not be advertised or recommended as a cure for diseases or conditions which are generally recognised as incurable by the simple administration of drugs, or for the cure of contagious or acute diseases the treatment of which properly requires the supervision of a qualified medical attendant.

9. Conformity to the Federal Food and Drugs Act—Neither the label on the package nor any of the accompanying literature shall bear or contain any statement in conflict with the misbranding provisions of the Federal Food and Drugs Act.

10. Advertising Not Accompanying the Package—Advertising not accompanying the package shall conform substantially to the statements on the label, carton, or in the accompanying circulars as to the origin, composition or character of the preparation, or concerning its curative or remedial value.

The foregoing outline, brief though it is, will serve to acquaint the prospective student in pharmacy with the high lights in the history of the profession. The student who wishes to pursue this interesting subject further may find profitable and entertaining reading in any of the following books, which deal more specifically with the history of Pharmacy: Wooton's *Chronicles of Pharmacy*, Peters' *Pictorial History of Pharmacy*, Bolton's *Follies of Science*, Schelenz' *Geschichte der Pharmacy*, and Berendes' *Das Apothekenwesen*, all of which will be found in any well equipped pharmaceutical library. The Proceedings and the Year Books of the American Pharmaceutical Association contain much material bearing upon the history of pharmacy, and current pharmaceutical literature also contributes to this phase of the study of pharmacy.

CHAPTER II

PHARMACOPŒIAS AND OTHER STANDARD BOOKS ON PHARMACY

A *pharmacopœia* (from the Greek *pharmakon*, "a drug medicine", and *poieo*, "make"), in the modern acceptation of the word, is a book containing a list of medicinal substances, with descriptions, tests, and formulas for preparing the same, selected by some recognized authority. The historical development of pharmacopœias is described on page 8. The necessity for legalized standards to define the character, establish the purity, and regulate the strength of medicines is recognized by all civilized nations; and although all of the nations of the globe have not yet formally adopted national standards, in nearly every case where this has not been done it will be found that the standards of some other country are in use. The most important pharmacopœias, with the dates of their latest issues, are as follows:

Official Pharmacopœias

Nation	Date of Issue	Title
1. United States	1926	Pharmacopœia of the United States of America, Tenth Decennial Revision[1]
Spanish Edition	1926	
Chinese Edition (U.S.P.IX)	1923	
2. Great Britain and Ireland and Colonies	1914	British Pharmacopœia combining the Indian and Colonial Addendum
3. Germany	1910	Arzneibuch fur das Deutsche Reich (Pharmacopœa Germanica, editio V)
4. France	1908	Codex Medicamentarius Gallicus (Pharmacopée Française)
Supplement—April 1, 1920		
Additions and Modifications—April 5, 1922		
Additions and Modifications—Sept. 24, 1923		
Additions and Modifications—May 13, 1925		
5. Austria	1906	Pharmacopœia Austriaca, editio octava
6. Belgium	1906	Pharmacopœa Belgica, editio tertia
7. Chile	1886	Farmacopea Chilena
8. Croatia-Slavonia	1888	Pharmacopœa Croatico-Slavonica
9. Denmark	1907	Pharmacopœa Danica
10. Greece	1924	Ἑλληνικὴ Φαρμακοποιΐα (Second Edition)
11. Hungary	1909	Pharmacopœa Hungarica, editio tertia
12. Italy	1920	Farmacopea ufficiale del regno d'Italia, quarta edizione
13. Japan	1921	Pharmacopœa Japonica (Fourth Edition)
14. Mexico	1904	Nueva Farmacopea Mexicana, cuarta edicion
15. Netherlands	1905	Pharmacopœa Nederlandica, editio quarta
First Supplement—1910		
Second Supplement—1914		
Third Supplement—1918		
16. Norway	1913	Pharmacopœa Norvegica, edito quarta
17. Portugal	1876	Pharmacopœa Portugueza
18. Roumania	1893	Pharmacopœa Romana, editio tertia
19. Russia	1910	Pharmacopœa Rossica, sixth edition.
20. Servia	1908	Pharmakopœa Serbica, editio secunda
21. Spain	1905	Farmacopea oficial Española, septima edicion
22. Sweden (Tenth Edition)	1926	Pharmacopœa Svecica (Svenska Farmakopén)
23. Switzerland	1907	Pharmacopœa Helvitica, editio quarta
24. Venezuela	1898	Farmacopœa Venezolana, I
25. Argentina	1898	Ph. Arg. I, Farmacopea Nacional Argentina, primera edicion
26. Finland	1914	Ph. Fenn. V, Pharmacopœa Fennica, editio quinta

[1] In quoting this title, it is customary to abbreviate it to "U.S.P. X." It is advisable to adhere to this form so as to preserve uniformity. The "tenth revision" means, of course, the same as "eleventh edition". Formerly it was customary to use the year in which the Decennial Convention met to designate the Pharmacopœias, thus "U.S.P. 1890"; much confusion resulted from this practice because it now requires three or four years to revise such an authority and hence the "U.S.P. 1890" would have been more appropriately termed the "U.S.P. 1893". In the last two revisions this was corrected by omitting a date upon the back of the book and using the words "Ninth Decennial Revision" and "Tenth Decennial Revision".

The U. S. Pharmacopœia is now used officially in Porto Rico and the Philippine Islands and has been recognized as the official Pharmacopœia of Cuba, every drug store in Cuba since 1910 having been compelled by law to have a copy. A Spanish Edition of the U. S. P. VIII was issued in 1909, the Spanish Edition of the U. S. P. IX appeared in 1919, and the Spanish Translation of the U. S. P. X will be issued early in 1926.

A Chinese Edition of the U. S. P. IX was published in 1923 by the Chun Hwa Book Co., Shanghai, China. This was entirely a private enterprise but its appearance was welcomed by the many European and American trained physicians and pharmacists of China.

The official pharmacopœias are all issued under the authority of the respective governments, with the exception of the United States Pharmacopœia, which has, however, been accepted by the government and the individual states through the national and state food and drugs acts. Efforts are being constantly put forth to secure the adoption of an International Pharmacopœia. If these efforts should prove successful a great advance will be made in bringing about a uniformity in the strength of preparations; yet it may well be doubted whether such a work would be as generally useful as the present pharmacopœias, which have been proved by long experience to be best adapted to the varying needs of the different nations. A practical plan of securing the chief advantages possessed by an International Pharmacopœia has been inaugurated by the establishment of the "International Conference for the Unification of Potent Remedies", which first met in the city of Brussels in September, 1902, and for a second time in September, 1925. This body in the final *protocol* of 1902 agreed upon standards of strength for potent preparations which they requested the various pharmacopœias of the world to adopt. In 1906, representatives from nineteen governments met at Brussels and, with certain reservations, formally signed the agreements drawn up in 1902 and also formulated details for further unification. The United States Pharmacopœia (Eighth Revision) was the first national pharmacopœia to adopt some of these recommendations. The U. S. P. IX and the U. S. P. X have inserted the Latin title adopted by the International Conference followed by the letters "P. I.", below the official title of those preparations which conform to the standards of the protocol. The letters P. I. mean "Protocol Internationale".

The Pharmacopœia of the United States, Tenth Decennial Revision, was prepared by a committee appointed by the National Convention for revising the Pharmacopœia, which met in Washington, D. C., May 11, 1920. Thirty-eight medical bodies, seventy-seven incorporated pharmaceutical organizations and the Medical Departments of the Army and Navy, the U. S. Public Health Service, the U. S. Department of Agriculture, the U. S. Treasury (Customs Service), the American Medical Association, the American Pharmaceutical Association, the American Chemical Society, the National Dental Association, the Association of American Dairy, Food and Drug Officials, the National Wholesale Druggists' Association, the National Association of Boards of Pharmacy, the National Association of Retail Druggists, and the American Drug Manufacturers' Association, sent delegates to this Convention, which selected from those present fifty members, with the President of the Convention a member *ex-officio*, making the total fifty-one. These were designated as the "General Committee of Revision of the Pharmacopœia of the United States of America". Of this number twenty-one were physicians, twenty were pharmacists and chemists, six were chemists, and four botanists and pharmacognosists. At the Eighth Decennial Convention, in 1900, several important

changes in the plan of the work were made. The business portion was separated from that of actual revision by creating a Board of Trustees whose duty it was to make contracts, attend to the finances, and place the book on sale. The Convention was also incorporated at that time, and it now carries on its work under a charter issued at Washington under the laws of the District of Columbia. The Convention of 1910 changed the number of members on the Committee of Revision from twenty-six to fifty-one and also authorized the formation of an Executive Committee. The Convention of 1920 made no change in the organization of the Committee of Revision, and the General Committee, as soon after its election as possible, met, elected officers, and the chairman organized the work of revision, appointing fifteen Sub-committees to report upon the several divisions of the work. These Sub-committees were: 1. Scope (Admissions and Deletions). 2. Therapeutics and Pharmacodynamics (Posology). 3. Biological Assays. 4. Biological Products and Diagnostical Tests. 5. Botany and Pharmacognosy. 6. Proximate Assays. 7. Inorganic Chemicals. 8. Organic Chemicals. 9. Reagents and Test Solutions. 10. Volatile Oils. 11. Extracts, Fluidextracts, and Tinctures. 12. Waters, Solutions, Spirits, Syrups, and Elixirs. 13. Cerates, Ointments, and Miscellaneous Galenicals. 14. Tables, Weights, and Measures. 15. Nomenclature.

When these appointments were ratified by the General Committee of Revision and the Board of Trustees, each Sub-committee organized and elected its own Chairman.

These Sub-committee Chairmen, through appointment by the General Chairman and election by the General Committee and Board of Trustees, formed the Executive Committee of Revision, with the Chairman of the General Committee also as Chairman of the Executive Committee, and the actual work of revision began. According to the By-laws of the Convention, the "Executive Committee shall execute such orders or resolutions as have been assigned to it by the Convention, the General Committee of Revision, or the Board of Trustees, and have entire charge of the preparation of the manuscript and reading of proof for the revised Pharmacopœia". The General Committee of Revision represents geographically various parts of the United States, and it is necessary to conduct the revision largely by mail. During the Tenth Revision two meetings of the entire General Committee were held and also a number of Sub-committee conferences. The Board and Committee remain in office until the next decennial convention, or until their successors are appointed.

Permission to use the text of the Pharmacopœia is granted upon application to the Chairman of the Board of Trustees under certain regulations which are necessary to guard the copyright. As the U. S. Pharmacopœia will be largely quoted in this treatise, its plan and the outlines of its main features should be thoroughly understood at the outset.

Six hundred and thirty substances, including chemicals, crude drugs, and preparations have been deemed of sufficient importance to merit a place in the U. S. Pharmacopœia. A number of these substances are not in themselves of therapeutic value but have been admitted as pharmaceutic necessities, being employed in manufacturing other official products. The Pharmacopœia provides standards for all ingredients used in formulas.

Under the Federal Food and Drugs Act, the United States Pharmacopœia and the National Formulary establish the standards for medicines in the United States and its provinces and violations are punishable by fine or other penalty.

Nomenclature

The names of the various substances are indicated—1. By the OFFICIAL LATIN TITLE, which is always in the Latin language. 2. By the OFFICIAL ENGLISH TITLE. 3. By the ABBREVIATED TITLE. 4. By the SYNONYM. 5. By the BOTANICAL NAME (in the case of plants). 6. By the SYMBOLIC FORMULA (in the case of chemicals). Each of these names has a special use.

The following extracts from the Pharmacopœia are given in illustration:

CANTHARIS	[Official Latin title]	**UNGUENTUM PHENOLIS**
Cantharides	[Official English title]	**Ointment of Phenol**
Canthar.	[Official Abbreviated title]	**Ung. Phenol.**
[SPANISH FLIES, RUSSIAN FLIES]	[Synonym]	[OINTMENT OF CARBOLIC ACID]
POTASSII BITARTRAS	[Official Latin title]	**SPIRITUS ÆTHYLIS NITRITIS**
Potassium Bitartrate	[Official English title]	**Spirit of Ethyl Nitrite**
Pot. Bitart.	[Official Abbreviated title]	**Sp. Æth. Nitrit.**
[CREAM OF TARTAR, POTASSIUM ACID TARTRATE]	[Synonym]	[SWEET SPIRIT OF NITRE]
$KHC_4H_4O_6$	[Symbolic formula]	$C_2H_5NO_2$

1. The Official Latin Title—Example, **LIQUOR AMMONII ACETATIS.** The official Latin title is thoroughly distinctive, and is intended to be used in designating the drug or preparation where precision is required, and is used, mostly in its abbreviated form, in writing prescriptions, in labelling store furniture, specimens, etc. Latin is selected for the official title because it is universally used and understood as the language of science, and is not liable to change, as is the case of a living tongue. Although the official titles are usually abbreviated in practice, the proper terminations and full titles should be known and observed carefully, and the habit of using the Latin abbreviations in English conversation should be strictly guarded against as not only inelegant, but vulgar.[1] A vast amount of careful consideration, extending over many years, has been expended in perfecting a system of pharmacopœial nomenclature which is at once brief, simple, expressive, distinctive, and convenient. The following may be cited as models: Acacia, Camphora, Opium, Rheum, Sapo, etc., the full pharmacopœial definition of these titles being, respectively, **Acacia.** "Acacia is the dried gummy exudation from the stems and branches of *Acacia Senegal* Willdenow, or of some other species of *Acacia* (Fam. *Leguminosæ*)." **Camphora.** "A dextrorotatory ketone [$C_9H_{16}CO$] obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*)." **Opium.** "Opium is the air-dried, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné or its variety *album* De Candolle (Fam. *Papaveraceæ*). Opium in its normal, moist condition yields not less than 9.5 per cent of anhydrous morphine." **Rheum.** "Rhubarb consists of the dried rhizome and roots of *Rheum officinale* Baillon or of *Rheum palmatum* Linné, and the var. *tanguticum* Maximowicz (Fam. *Polygonaceæ*), and probably other species of *Rheum* grown in China and Thibet, deprived of most of the bark tissues and carefully dried." **Sapo.** "Soap prepared from olive oil and sodium hydroxide." The *generic*, or genus name (the first part of the botanical name), was generally chosen for the official Latin title, as, **Krameria**, for "the dried root of *Krameria Triandra*" (botanical name). In the case of some old and very well known drugs, this rule could not be adopted with-

[1] Example of what should be avoided in conversation: "I mixed the *Pulv. Pip. Nig.* with the *Pot. Carb.* and the *Muc. Trag.*, but could not form a mass."

out causing confusion and the *specific* or species name (the second part of the botanical name) was retained, as **Ipecacuanha,** the official Latin title for "the dried rhizome and root of *Cephaëlis Ipecacuanha*". The official Latin title obviously cannot retain the simplicity of a single word where two parts of the same plant are official. Thus, for example, the leaves and root of Belladonna both must be defined by affixing the Latin name of the particular part of the plant intended, as *Belladonnæ Folia* for Belladonna Leaves; and *Belladonnæ Radix* for Belladonna Root; nor can a single word be chosen for either official title where the specific names of two or more plants of the same genus differ. The generic name of the two official mints is Mentha, and to distinguish them it is necessary to use the full botanical name for each one. Thus, *Mentha piperita* (Peppermint), *Mentha Viridis* (Spearmint).

There are a very few exceptions to the above principles of nomenclature, as in the case of *Kino* and *Prunus Virginiana*, derived, according to the most recent and reliable authorities, respectively from *Pterocarpus Marsupium* and *Prunus serotina*. These drugs are largely used and the old names have become so well established that it would lead to confusing and possibly embarrassing mistakes to change them now. In the case of compound medicines, such official titles were selected as would usually express the composition of the preparations as fully as possible, indicating the principal ingredients without sacrificing the important consideration of brevity and convenience in abbreviation, as *Mistura Cretæ*, *Pulvis Ipecacuanhæ et Opii*, and *Tinctura Opii Camphorata*. In some cases it is desirable to indicate in the title the medical properties or use of the preparation, as in *Antitoxinum Diphthericum* and *Antitoxinum Tetanicum*, but titles indicating therapeutic use have been generally discarded in official books because of their tendency to induce self-medication. Where the number of important ingredients in a preparation is too great to admit of a selection, the participial adjective *compositus* (meaning compound) is added, the feminine (*composita*) or neuter (*compositum*) termination being used respectively where the noun is feminine or neuter, as Spirit*us* Aurantii Composit*us* (masc.), Tinctur*a* Lavandulæ Composit*a* (fem.), Extract*um* Colocynthidis Composit*um* (neut.).

2. The Official English Title—Example, **Solution of Ammonium Acetate.** The English title should be used when a drug or preparation is mentioned in ordinary conversation, in commercial transactions, in writing orders for supplies, and in all cases where the use of the Latin official title could be justly criticized as an ostentatious display of erudition. In the U. S. Pharmacopœia, 1880, a large number of English titles used in former Pharmacopœias were changed, the old vernacular names being either dropped altogether or inserted as synonyms. This advanced step was rendered necessary by the increase in articles used in the materia medica and by a desire for greater accuracy and better methods in nomenclature. The confusion which always exists in different localities concerning the common names of drugs is also avoided, as the anglicized Latin name is distinctive. Such English names as *Bloodroot*, *Calabar Bean*, *Male Fern*, and *Yellow Jasmine*, for instance, were replaced by *Sanguinaria*, *Physostigma*, *Aspidium*, and *Gelsemium*.

On the other hand, some of the common English names were so fixed by usage that it was not deemed judicious to alter them; besides, a change would often have necessitated the use of a longer and less convenient word. The retention of the English names *Clove*, *Mustard*, and *Ginger* sufficiently illustrates this.

In the U. S. Pharmacopœia, 1890, a very important change was made in the English names of the chemical substances, the basylous or metallic

component being given the first place; for instance, *potassium citrate*, *ammonium bromide*, and *zinc sulphate*, replace the former names *citrate of potassium*, *bromide of ammonium*, and *sulphate of zinc*. This change required many alterations in nomenclature. In the U. S. P. of 1890, the salts of iron and mercury were for the first time differentiated by the use of the terms *ous* and *ic*, respectively, to designate lower and higher states of oxidation; for example, ferr*ous* sulphate and ferr*ic* sulphate, mercur*ous* iodide and mercur*ic* iodide, replaced the names sulphate of iron and iodide of mercury; the compounds of mercury, on account of the differences in dose existing among them, were further distinguished by the use of the adjectives "corrosive", "mild", "red", "yellow". For the scale salts of iron, which are of complex composition and not true chemical salts, notwithstanding the fact that the metallic component exists in them in the ferric state, the term "iron" was used in order to emphasize the fact of their defective chemical construction for they are not definite double salts. This nomenclature is retained in the Tenth Decennial Revision of the Pharmacopœia.

The Pharmacopœial names of chemical substances do not always represent their chemical composition. The enormous multiplication of synthetic remedies, and the length of the systematic names of these bodies, have compelled the use of shorter terms which are more conveniently employed in prescriptions and in commercial transactions. Thus, "metadihydroxybenzene" is a more cumbersome word than "resorcinol", phenyldimethylpyrazolon" than "antipyrine". If we turn to unofficial substances, a better example is afforded by the use of "analgen", which is dignified by the systematic name of "orthoethyloxyanamonobenzoylamidochinoline". In recent revisions of the Pharmacopœia it has been desirable to introduce a number of synthetic remedies having long scientific names, and trade or proprietary names could not be used as titles in a standard book of this character unless permission was obtained from the owners, hence the long names had to be shortened, and "diaminodihydroxyarsenobenzene hydrochloride" became "Arsphenamine", "2-phenylquinoline 4 carboxylic acid" became "Cinchophen", and "Quaternary oxymethyl oxymethelene dihydro-isoquinoline chloride" became "Cotarnine Chloride". The value of a long chemical name lies in the fact that the name indicates its composition, but some of the most useful modern remedies are very complex in their chemical composition, hence the inconvenience. The custom of abbreviating the official Latin titles in writing prescriptions is universal among physicians, and the new official names, which are long, will not cause great inconvenience in practice. Thus "Phenobarbitalum" has been abbreviated to "Phenobarb".

3. Abbreviations—The U. S. Pharmacopœial Convention of 1910 recommended that there should be inserted after each article used by physicians in prescriptions a carefully considered abbreviated name. These were to be known as the official abbreviations, in order that uniformity might be established throughout the country, with the object of preventing mistakes in reading and compounding prescriptions, and further, to serve as authorized abbreviations in labelling the store furniture of the pharmacist. Such abbreviated titles were also adopted by the N. F. IV, and the British Pharmacopœia (1914) and have been continued in the U. S. P. X and N. F. V.

4. The Synonym—Example, [Basham's Mixture]. In the Pharmacopœia the definition of the term synonym is restricted to an equivalent name in common use, which is usually antiquated and derived from an unscientific source, and which should really be abandoned, but which common custom and long usage demand shall not be entirely ignored. The synonyms should be rarely

or never used by pharmacist, yet it is necessary to be familiar with them in order to recognize their equivalent official Latin or English names when they are used by customers. Common names, as snakeroot, dock, Indian hemp, balm, etc., have varying and often opposite meanings in different localities, and confusion and even loss of life have resulted from the unfortunate use of these common names. In the U. S. P. X synonyms are placed below the official English title in smaller type. After the passage of the Food and Drugs Act, the increased importance of synonyms, which were sometimes used to evade the standards, led the Conventions of 1910 and 1920 to recommend that all important synonyms be printed in the text of the Pharmacopœia immediately after the English name of the substance. The Committee of Revision also passed the following resolution which had been adopted by the Convention: "Substances labelled with an official synonym must comply with the same standards, tests, and requirements as are demanded for the official article under the official title."

5. The Botanical Name—By this is meant the systematic name recognized by botanists for plants, which serves in pharmacopœial nomenclature as the basis of the official name. The botanical name usually consists of two Latin words, the first indicating the genus and the second the species to which the plant belongs. *Capsicum frutescens* is the botanical name for the particular variety of capsicum or Cayenne pepper which the Pharmacopœia designates. Here the generic, or first name, is chosen for the official title, and if no description followed the title it would be inferred that any part of any plant in the genus "Capsicum" could be officially used for making preparations; but the specific name, "frutescens", limits the use of this species, while the description which follows shows the *part* of the plant which must be employed: "the dried, ripe *fruit* of *Capsicum frutescens* Linné (Fam. *Solanaceæ*), grown in Africa". Now, *Capsicum baccatum* and *Capsicum annuum* are different species and are active members of the genus, but their claims are unrecognized and the fruit from these species is not official. The specific name does not begin with a capital letter, except when it has been at some previous time itself a generic name, as in *Atropa Belladonna*, or when it is derived from the name of a person, as in *Garcinia Hanburii*, or when the word is indeclinable, as in *Theobroma Cacao*, or when it is a combination of a noun and an adjective, as in *Xanthoxylum Clava-Herculis*. The name of the author follows the botanical name, as, *Capsicum frutescens* Linné, and after this the Family to which the plant belongs is indicated in italics, and the whole enclosed in parenthesis, as (Fam. *Solanaceæ*). The term Natural Order (Nat. Ord.) was replaced in the U. S. P. VIII by the word Family (Fam.), to accord with modern usage among botanical authorities. It must be apparent that the botanical name need not be employed either in writing or in speaking in ordinary pharmaceutical work, but its use is absolutely necessary in establishing the identity of any drug authorized by the Pharmacopœia, and hence it is important to know the botanical names.

6. The Symbolic Formula—The use of certain arbitrary symbols to represent chemical elements provides a most convenient and useful method of expressing the composition of a chemical with the utmost brevity and exactness. *Plumbi Oxidum* and *Lead Oxide* are both much longer terms than "PbO" and not so definite. *Sodium Sulphate* does not always contain the same proportion of water of crystallization, and if the symbolic formula, Na_2SO_4. $10H_2O$, were not appended to the official title there might be doubt as to which sulphate was intended; the added $10H_2O$, however, accurately defines it. In the Molecular Weight Table will be found figures following the symbolic formulas. These indicate the *molecular weight* (the sum of the

weight of the atoms) of the chemical. Thus, in $MgSO_4 . 7H_2O = 246.49$, the atomic weight of Magnesium, Mg. 24.32, is the first factor; this added to Sulphur, S, 32.06, makes 56.38; Oxygen, O, 16.00, multiplied by 4, gives 64.00; then hydrogen having the atomic weight of 1.008, if multiplied by 2 and this by 7, gives 14.112, and seven times O (16.00) is 112.00; then $56.38+64.00+14.112+112.00=246.492$, the molecular weight of magnesium sulphate.

The Official Definition—In order that no question shall arise as to the exact meaning of the official Latin title, or any other name by which an official substance is known, it is necessary to state explicitly what kind or variety of the substance should be used. In the case of drugs this has been already noted (see page 17); for chemicals an illustration may be given in Creosote, which is defined as "A mixture of phenols, principally guaiacol [$C_6H_4(OH)(OCH_3)$ 1: 2] and creosol [$C_6H_3(CH_3)(OH)(OCH_3)$ 1: 2: 3] obtained from wood tar". Again, *Sevum Preparatum*, Prepared Suet, is officially defined as "The internal fat of the abdomen of the sheep, *Ovis aries* Linné (Fam. *Bovidæ*), purified by melting and straining". This excludes beef suet and all other kinds of suet, and states the method of purification.

The Purity Rubric—This was first introduced into the U. S. P. VIII to limit the quantity of innocuous impurities in chemicals, by stating in terms of percentage the amount of pure substance that must be present. It has been continued and extended to drugs and many other articles in the U. S. P. X. Thus, under *Potassii Iodidum*, Potassium Iodide, will be found the "purity rubric" as follows: "Potassium Iodide, when dried to constant weight at 100° C. contains not less than 99 per cent of KI". It might appear at first sight, that a medicinal chemical should always contain one hundred per cent of the pure product, but practical experience shows that absolute purity is not attainable, and that the presence of minute quantities of impurities (provided they are harmless) does not affect the medicinal value of a chemical. Under the pharmacopœias formerly in use, prosecutions were often instituted, convictions obtained, and penalties imposed by the authorities, because there was no purity rubric, no allowance for the absorption of moisture, or for the presence of traces of substances which were innocuous. The purity rubric remedies this defect by definitely stating the amount of permissible impurities. In the case of most vegetable drugs a limit has been fixed for the allowable percentage of foreign matter. In some instances this applies to other portions of the same plant but usually it is intended to exclude the presence or admixture of foreign substances.

The Official Description—Immediately following the official definition of the substances there will be noticed in the Pharmacopœia, in smaller type, what has been termed the *official description*; this consists usually, for drugs, of a concise statement of their physical characteristics, when entire, and also, in most instances, the structure of the same drug when sectioned or powdered. In the chemicals the official definition usually includes the symbolic formula, the purity rubric, and the official description, which are printed in smaller type, exactly as in the case of the vegetable drugs. To the descriptions of the chemical drugs are usually added the solubility statements.

Tests for Identity and Purity—In the U. S. P. X the tests which establish the identity of a chemical and those which insure the pharmacopœial degree of purity are grouped under appropriate headings. Ash limits, to restrict the amount of soil and sand adhering to roots and plants, an occasional identity test, and other means of determining purity or the presence of adulterants have also been appended to vegetable drugs. It is not to be understood that the tests under the caption "Tests for purity" are the final and exclusive indication of quality. The monographs are divided and sub-heads used only for

convenience of reference and an article to be official must meet every requirement of the text.

Assay Processes—The assaying of many chemicals, drugs, oils, and preparations is necessary to fix their value definitely as medicinal agents, and many such assays have been introduced into the U. S. P. and N. F. This work requires skill, knowledge, and experience, and each process requires careful study.

A chapter has been added to this edition in which will be found detailed explanations of all assay methods, and the advanced student is referred to this chapter for information.

The majority of assay methods are chemical, involving either *gravimetric*, *volumetric*, or *electrolytic* processes. For vegetable drugs containing definite active principles *proximate assays* or *biological assays* have been adopted whenever practicable.

Doses—An innovation was adopted by the U. S. P. VIII by the insertion of the average dose for most articles; this has been continued in the U. S. P. X. The dose of a medicine can never be a fixed and unvarying quantity; the age and condition of the patient, the severity of the disease, the idiosyncrasy and tolerance for medicines, become factors in determining the dose and the physician must give all of these facts consideration. For these reasons, an "average dose" was used in order to furnish a guide to pharmacists and physicians. The following quotation from the preface of the Pharmacopœia is appended:

"The Convention instructed the Committee 'to state the average approximate (but neither a minimum nor a maximum) dose for adults, and, where deemed advisable, also for children. The metric system is to be used, and the approximate equivalent in apothecary weights or measures inserted in parenthesis,' and the Committee was further directed to make the following distinct declaration *'that neither this Convention nor the Committee of Revision created by it intends to have these doses regarded as obligatory on the physician or as forbidding him to exceed the doses given whenever, in his judgment, this may seem advisable'.*"

Pharmacopœial Illustrations—The following examples are selected from the U. S. P. X and are given in condensed form.

CINCHONA
Cinchona
Cinch.

[Official Latin title]
[Official English title]
[Official Abbreviation]
[Synonyms]

PERUVIAN BARK

Cinchona is the dried bark of *Cinchona Succirubra* Pavon.....or of *Cinchona Ledgeriana Moens* .....(Fam. *Rubiaceæ*). Cinchona yields not less than 5 per cent of the alkaloids of Cinchona.

[Official definition and Purity Rubric]

Description and physical properties.

Unground Cinchona—In quills or curved pieces or in broken fragments; bark from ..... taste astringent and very bitter.

Structure—Cork, frequently bearing dense masses of lichen tissue on its outer surface .... small groups between the medullary rays.

Powdered Cinchona—Brown; bast-fibers, frequently whole, spindle-shaped ..... sphenoidal microcrystals very minute.

[Official description]

Assay—Heat 5 Gm. of Cinchona, in fine powder, for one hour, in a 500 cc. flask.....Use chloroform for the final extraction.

[Assay]

Preparations—Fluidextractum Cinchonæ, etc.

AVERAGE DOSE—Metric, 1Gm.—Apothecaries, 15 grains.

SODII HYDROXIDUM
Sodium Hydroxide
Sod. Hydrox.

CAUSTIC SODA

[Symbolic formula and Purity Rubric]

Sodium Hydroxide contains not less than 90 per cent of NaOH.

Caution.—Great care is necessary in handling it, as it rapidly destroys organic tissues.

Description and physical properties.

Dry, white, or nearly white, fused masses, or sticks,.....becoming covered with.....carbonate.

One Gm. of Sodium Hydroxide is soluble in 0.9 cc. of water at 25° C. .....very soluble in alcohol.

Tests for identity—An aqueous solution.....responds to the reactions for sodium.

Tests for purity—An aqueous solution. . . (1 in 50) . . . . meets the requirements of the test for *heavy metals*.

Assay—Place about 10 Gm. of Sodium Hydroxide in a glass-stoppered weighing bottle, and weigh accurately. Transfer. . . and titrate 100 cc. of the filtrate with normal hydrochloric acid.

Preserve in well-closed containers.

Preparation—Liquor Sodii Hydroxidi.

The Preparations of the Pharmacopœia

Although these will be considered in detail in the body of this work, a few general remarks will be appropriate here. The "parts by weight" plan adopted by the U. S. Pharmacopœia, 1880, was dropped in the 1890 revision, and the "solids by weight, liquids by measure" principle accepted. This is more in accord with the methods used in English speaking countries and harmonizes with the established practice of medicine, *i.e.*, giving doses of liquids by volume. A great advance was made by the adoption of the metric system for expressing the quantities, which were thus also made definite. Every pharmacist should employ the metric system exclusively in making preparations; but for the convenience of those who prefer the older system, corresponding quantities are given in the working formulas in this book, based on the old system of avoirdupois weight and apothecaries measure. The latter will be found much less convenient than the metric quantities, especially if the operator has procured a set of metric weights and measures and has learned to use them.

The U. S. P. official text is printed in this book by authority from the Board of Trustees of the United States Pharmacopœial Convention. When alternative quantities are given, the latter are enclosed in brackets in the text, and are printed in smaller type in the list of ingredients. The object of this arrangement is to indicate that the alternative quantities are not used in the Pharmacopœia.

The alternative quantities are not intended to be equivalents of the metric quantities and the two systems are not interchangeable; either the metric or the alternative formula may be used but in no case part of one and part of the other; different type distinguishes one from the other.

National Formulary

The Third Edition of the N. F. was made a standard under the Pure Food and Drugs Act, June 30, 1906, and the Fifth Edition, published in 1926, has been printed in this book, authority being granted by the Council of the American Pharmaceutical Association, as the National Formulary is the property of that organization although the profits arising from its sale are not used for the benefit of the Association, but are devoted to the work of the next succeeding revision. Its origin dates from 1882 when Charles Rice, Ph.D., organized a Committee from New York and Brooklyn to frame a book of formulas for unofficial preparations. The New York and Brooklyn Formulary was subsequently enlarged and the joint Committee presented it to the American Pharmaceutical Association in 1885 as the nucleus for the construction of the National Formulary. The book has gone through five editions and is quoted in national and state laws as of equal authority with the Pharmacopœia.

The National Formulary V has been carefully revised (1926) and its standards are in harmony with those of the U. S. P. X. Its position is secondary and follows the lead of the Pharmacopœia. Some of the preparations of the Pharmacopœia which were deleted are now found in the National Formulary, because physicians continue to use such preparations.

In the National Formulary the standards of the U. S. P. X are used; thus, where alcohol, glycerin, syrup, iodine, tincture of opium, cinchona, and other U. S. P. drugs and preparations are directed, it means that they must conform in strength and tests to the standards of the U. S. P. X.

It is important to remember that if a drug or preparation is sold under or

by a name recognized in the U. S. Pharmacopœia or National Formulary it must not differ from the standard of strength, quality, and purity determined by the tests laid down in either of these books official at the time of investigation. A drug or preparation is not deemed to be adulterated if it differs from the official standards, provided such standards are plainly stated upon the bottle, box, or container.

This position of the National Formulary made it desirable that its standards should be used in this book so that the student would become familiar with the preparations of both books and recognize the fact that they are of equal force before the law, and the N. F. texts are printed in this book by authority from the American Pharmaceutical Association.

In both the U. S. P. and N. F., the standards are intended solely to apply to substances which are used for medicinal purposes and when professedly bought, sold, or dispensed as such.

New and Non-official Remedies (N. N. R.)

The American Medical Association for a number of years, through its Council on Pharmacy and Chemistry, has issued an annual publication under the above title. In this are listed such unofficial representatives of the newer materia medica, chiefly synthetic or biological, as have been accepted under the rules of the Council. Many of these are proprietary, that is, they are chemicals, drugs, or similar preparations, used in the treatment of diseases, but protected against free competition, as to name, product, composition, or process of manufacture by secrecy, patent, copyright, or by any other means.

To be accepted by the Council, the composition of products must be known, suitable tests for identification must be available, no unwarranted therapeutic or false claims may be made, and other requirements must be complied with which insure the ethical character of the product.

The book also provides descriptions and tests, therapeutic uses, and doses, and is a valuable reference book in the pharmacist's library. Many articles accepted by the N. N. R. are included in this book in the lists of unofficial substances, with permission.

Dispensatories

A dispensatory is a commentary on a pharmacopœia. Like the textbooks on pharmacy, the various dispensatories are privately owned and are revised more frequently than are the Pharmacopœia and the National Formulary. The U. S. Pharmacopœia describes the drugs and chemical substances of the materia medica, establishes the degree of purity of many of them, and defines the strength of the preparations. The dispensatories comment on the substances, giving their physical, medical, and pharmaceutical history, with their doses and uses. The number of substances noted in the Pharmacopœia is limited. On the other hand, the dispensatories present, in addition, information about those substances which are official in our own and other pharmacopœias, and those which are of occasional or rare use. There are two dispensatories which comment especially upon the materia medica and preparations of the U. S. Pharmacopœia,—the United States Dispensatory, which was first published in 1833, and the National Dispensatory, which was first issued in 1879. King's American Dispensatory, adopted by the National Eclectic Medical Association in 1879 as its standard authority, is especially designed for the use of eclectic practitioners. The plans of these works are similar. The text

of the Pharmacopœia is first inserted and immediately following are appended the comments of authors and editors. The arrangement of the subjects is strictly alphabetical, the United States Dispensatory dividing them, however, into two classes, distinguished by type of two sizes. The principal portion of the work, that in the larger type, is devoted to a commentary on the preparations of the United States and other Pharmacopœias; the unofficial and less important subjects are to be found in the second part. In the National Dispensatory the unofficial substances are considered either in the body of the book or under sub-divisions as allied drugs. The possession of a reliable commentary upon the Pharmacopœia is a necessity which is fully realized by pharmacists.

PART II

TECHNICAL OPERATIONS IN PHARMACY

CHAPTER III

METROLOGY

Weight and Measure

METROLOGY in its modern significance comprises the study of the art of weighing and measuring, and the accumulation of facts with regard to units of weight and measure which are now or have formerly been in use. In pharmacy the definition includes the measure of the gravitating force of bodies, which always bears a direct ratio to their mass, and is commonly called *weight;* the determination of the bulk or extent of the body, its *measure;* and the relation which measure bears to weight when compared with a standard, known as *specific gravity.*

Weight cannot be annihilated and is modified only by altitude and that but slightly. Temperature and barometric pressure have no practical effect upon it. *Volume,* however, is easily influenced by temperature which must be taken into account in making preparations accurately and in the determination of specific gravity.

Weight

A knowledge of the systems of weights and measures in use must necessarily command the early attention of the student, and a short account of the origin of the present systems may be of service in fixing in the mind the essential distinctions between them. The sense of the weight of a body cannot be conveyed intelligibly to the mind unless a means of comparison is chosen. As weight is the measure of the gravitating force of a body, so this force is expressed as related to a standard of resistance, which is exactly that which would balance the body and keep it in equilibrium, when used with a mechanical device constructed for this specific purpose. Such standards are termed *weights* and the mechanical devices are called *balances* or *scales.*

The standards which have been chosen by various nations are arbitrary, and instances are common where different standards are in use at the same time in the same country. Many of the ancient standards are clearly referable to variable parts of the human body, as nail, foot, span, pace, cubit (length of the forearm), fathom or orgyia (stretch of the arms). In the history of metrology three periods may be traced: 1. The *Ancient,* during which the old classical standards originated, and which terminated with the decline of the Roman Empire. It is interesting to note that the unit of distance used at the present day by all nations in maritime measurements is the *nautical* or *meridian mile* or one-sixtieth of a degree of the earth's equatorial circumference, and that this is exactly equal to 1000 Egyptian fathoms or 4000 Egyptian cubits.

These Egyptian measurements which have persisted for more than 4000 years were based upon astronomical or meridian measurements which were imperishably recorded in the great Pyramid of Ghizeh, whose perimeter is exactly 500 of these fathoms, or one-half of a nautical mile. 2. The *Mediæval,* extending to the sixteenth century. In this period the old standards were lost, but their names were preserved, and European nations adopted various independent standards. 3. The *Modern.* Since the seventeenth century the efforts of most enlightened nations have been directed toward scientific accuracy and simplicity, and during the present century toward international uniformity.

Historical metrology is also referred to as *Documentary Metrology* which is concerned with the study of monuments and records of ancient periods, and *Inductive Metrology*, which is concerned with the accumulation of data concerning the measurement of large numbers of objects which have been referred to as standards but which have no exact measure except by statutory regulation.

A history of the development of standard weights and measures is appended.[1]

---

[1] *The Development of Modern Weights and Measures*—In Great Britain, in the year 1266, the 51st act of the reign of Henry III declares "that by the consent of the whole realm of England the measure of the King was made,—that is to say, that an English silver penny called the sterling, round and without clipping, shall weigh *thirty-two grains of wheat*, well dried and gathered out of the middle of the ear; and twenty pence (penny-weights) do make an ounce and twelve ounces a pound, and eight pounds do make a gallon of wine, and eight wine gallons do make a bushel, which is the eighth of a quarter".

The sixteen-ounce pound (avoirdupois) was derived from a more ancient source, and was undoubtedly of Roman origin, and introduced at the time of the first civilization of the British island. The word "haberdepois", according to Gray, was, however, first used in English laws in 1303.

A statute of Edward I (A. D. 1304) states "that every *pound* of money or of *medicines* is of *twenty* shillings *weight*, but the pound of all other things is *twenty-five shillings weight*. The *ounce* of *medicines* consists of *twenty pence*, and the *pound* contains *twelve* ounces (the Troy Pound), but in other things the pound contains *fifteen* ounces, in both cases the ounce weighing twenty pence".

These laws unfold the theory of the ancient weights and measures of Great Britain, and reveal the standard,—*i.e.*, a natural object, grains of wheat; a difference existed then between the troy and the avoirdupois pound, but the weights now in use are one-sixteenth heavier than those of Edward I, owing to the change made in the value of the coin by the sovereign subsequently; in addition to this, the true penny-weight standard was lost, and in the next revision of the weights and measures the present troy and avoirdupois standards were adopted. The troy weight is of still earlier origin. The great fairs of the eighth and ninth centuries were held at several French cities, including *Troyes*, and the gathering places of traders from all countries. Coins were frequently so mutilated that they were sold by weight, and the standard weight of Troyes for selling coin was adopted for precious metals and medicines in all parts of Europe. The troy ounce and the avoirdupois ounce were originally intended to have the same weight, but after the revision it was found that the avoirdupois ounce was lighter by forty-two and a half grains than the troy ounce.

The subsequent adoption of troy weight by the London College of Physicians in 1618, on the recommendation of Sir Theodore Turquet de la Mayerne, who compiled their first Pharmacopœia, has entailed upon all apothecaries who are governed by British customs, to this day, the very great inconvenience of buying and selling medicines by one system of weights (the *avoirdupois*) and compounding them by another (the *apothecaries* or *troy*).

In the next century efforts were made toward reforming the standards, and the Royal Society, in 1736, began the work, which ended in the preparation, under the direction of the House of Commons, by Mr. Bird, of the standard "yard" and standard "pound" troy in 1760. Copies of these have been made, no intentional deviation has been made since, and they are still the standards used most largely in the United States. In 1816, on account of the growing popularity of the French metrical system, and in view of the desirability of securing a standard which could easily be recovered in case of loss or destruction and which should be commensurable with a simple unit, steps were taken in England to secure these advantages. The labors of English scientists led to the adoption of the *Imperial* measures and standards, which were legalized January 1, 1826, and are now in general use in Great Britain, thus introducing another element of confusion into an already complicated subject.

In this system the *yard* is equivalent to 36 inches, and its length was determined by comparison with a pendulum beating seconds of mean time, in a vacuum, at the temperature of 62° F. at the level of the sea in the latitude of London, which length was found to be 39.1393 inches. The *pound troy* (containing 5760 grains) was determined by comparison with a given measure of distilled water under certain conditions. Thus, a cubic inch of distilled water was weighed with brass weights in air at 62° F. the barometer at 30 inches, and it weighed 252.458 grains. The standard for measures of capacity in Great Britain (either dry or liquid) is the *Imperial gallon*, and this contains 10 pounds avoirdupois (each 7000 grains) of distilled water weighed in air at 62° F. the barometer standing at 30 inches, the *bushel* containing 8 such gallons. Washington, in his first annual message to Congress, Jan. 1790, recommended the establishment of uniformity in currency, weights and measures, action was taken with reference to the currency and recommendations were made by Jefferson, then Secretary of State, for the adoption of either of the currently used English systems or a decimal system. However, nothing was accomplished until in 1819-20 when efforts were again made in the United States to secure uniformity in the standards which were in use by the several States. Finally, after a lengthy investigation, the Secretary of the Treasury, on June 14, 1836, was directed by Congress to furnish each State in the Union with a complete set of the revised standards, and thus we have the *troy pound* (5760 grains), the *avoirdupois pound* (7000 grains), and the *yard* (36 inches) all identical with the British standards; but the United States *gallon* is quite different, the old wine gallon of 231 cubic inches, containing 58372.2 grains of distilled water at its maximum density, weighed in air of the temperature of 62° F. the barometer standing at 30 inches, being retained, while the bushel contained 77.274 pounds of water under the same conditions, thus making the dry quart about 16 per cent greater in volume than the liquid quart.

In 1864 the use of the metric measures was legalized in Great Britain, but not made compulsory, and in 1866 the United States followed the same course.

By the United States law of July 28,1866, all lengths, areas, and cubic measures are derived from the international meter equivalent to 39.37 inches. Since 1893 the United States Office of Standard Weights and Measures has been authorized to derive the yard from the meter, 1 yard equals $\frac{3600}{3937}$ meter, and the customary weights are referred to the kilogram by Executive order approved April 5, 1893. All capacities are based on the equivalent 1 cubic decimeter equals 1 liter, the decimeter being equal to 3.937 inches. The gallon still remains at 231 cubic inches and the bushel contains 2150.42 cubic inches. This makes the liquid quart equal to 0.946 liters and the dry quart 1.1013 liters, while the Imperial quart is 1.1359 liters. The customary weights are derived from the international kilogram, based on the value that 1 avoirdupois pound=453.5924277 grams and that $\frac{5760}{7000}$ avoirdupois pound equals 1 troy pound. See History of Standard Weights and Measures of the United States, by L. A. Fischer, U. S. Bureau of Standards.

The British Pharmacopœia of 1898, while giving alternative equivalents in the metric system, adopted avoirdupois weight (termed Imperial weight) for expressing quantities which were to be weighed. Avoirdupois weight is also in general use in the United States for commercial purposes, including the buying and selling of drugs on the large scale. The British Pharmacopœia of 1914, however, adopted the metric system exclusively for its processes and tests.

The following systems of weights and measures are now in use in the United States and the pharmacist must have a practical knowledge of all of them:

Weights

Avoirdupois Weight

Pound		Ounces		Grains
℔ 1	=	16	=	7000
		oz. 1	=	437.5

Apothecaries Weight (also called Troy Weight)

Pound		Troy Ounces		Drachms		Scruples		Grains
1	=	12	=	96	=	288	=	5760
		℥ 1	=	8	=	24	=	480
				ʒ 1	=	3	=	60
						℈ 1	=	gr. 20

It will be observed that the troy ounce contains 42½ grains *more* than the avoirdupois ounce, while the troy pound contains 1240 grains *less* than the avoirdupois pound. Fortunately, one unit common to troy, or apothecaries, and avoirdupois weight has been saved,—namely, *the grain*. The abbreviations of the denominations of apothecaries weight are represented by the signs ℥, ounce; ʒ, drachm; ℈, scruple; and *gr.*, grain; these have long been in use, but may possibly be mistaken for one another in rapid or careless writing. The abbreviations or signs of avoirdupois weight differ from those of troy weight, and care should be used not to confound them; they are ℔., pound; oz., ounce; gr., grain. The avoirdupois "dram" is sometimes although rarely referred to. It is the sixteenth part of the avoirdupois ounce or $27\frac{11}{32}$ grains. It has no legal status in the United States.

Volumes

Apothecaries or Wine Measure, U. S.

Gallon		Pints		Fluidounces		Fluidrachms		Minims
Cong. 1	=	8	=	128	=	1024	=	61440
		O. 1	=	16	=	128	=	7680
				f ℥ 1	=	8	=	480
						f ʒ 1	=	♏ 60

Imperial Measure, Br.

(Used in Great Britain)

Gallon		Pints		Fluidounces		Fluidrachms		Minims
C. 1	=	8	=	160	=	1280	=	76800
		O. 1	=	20	=	160	=	9600
				fl. oz. 1	=	8	=	480
						fl. dr. 1	=	min. 60

Note. The Imperial gallon, pint, fluidounce, and minim are all different from the corresponding quantities in the apothecaries or United States wine measure.

When the subject of the weights and measures in ordinary use is studied, the lack of simplicity and close relation is clearly apparent. The pint of distilled water at 25° C. (77° F.) (the temperature adopted for taking specific gravities and solubilities by the U. S. P. X), weighs 7273.1 (7273.125) grains and the fluidounce 454.6 grains, or, more accurately, 454.5703 grains. We have thus three ounces in use of different values,—troy ounce, 480 grains; avoirdupois ounce, (and also the Imperial fluidounce), 437.5 grains; and fluidounce, 454.6 grains.

The U. S. gallon of water weighs 8.33 avoirdupois pounds, and the pint weighs 1.0416 avoirdupois pounds; the pound therefore equals 0.9601 pints and calculations assuming the equivalence of the pint and the pound are obviously incorrect.

The Imperial measure differs from our wine measure principally in having twenty fluidounces in the pint instead of sixteen; the fluidounce, however, is appreciably smaller than the apothecaries' fluidounce. A convenient relation exists, however, between measure and weight in the *Imperial gallon, which contains ten avoirdupois pounds of water* at 15.6° C. (60° F.).

The Imperial fluidounce contains the same number of grains as the avoirdupois ounce (437.5). This is a serious objection to the use of the English graduated measures in the United States, because they indicate Imperial fluidounces instead of U. S. fluidounces, a factor which must be taken into account when compounding formulas of British origin. *It is also improper and inaccurate to use measures graduated in the U. S. system in measuring quantities directed in English formulas where the Imperial measure is intended.* The error amounts to nearly two pints in the gallon.

Approximate Measures

In apportioning doses for a patient, the practitioner is usually compelled to order the liquid medicine to be administered in certain quantities that have been established by custom, and estimated as follows:

	Alternative	Metric
A tumblerful	f ℥ viii	240 cc.
A teacupful	f ℥ iv	120 cc.
A wineglassful	f ℥ ii	60 cc.
A tablespoonful	f ℥ iv	15 cc.
A dessertspoonful	f ℥ ii	8 cc.
A teaspoonful	f ℥ i	4 cc.

A drop, through a popular error, is considered to be 1 minim.

The equivalents given above for the teaspoonful, dessertspoonful, and tablespoonful are authorized by the U. S. P. X.

In almost all cases the modern teacups, tablespoons, dessertspoons, and teaspoons, after careful tests by many authorities, were found to average 25 per cent greater capacity than the theoretical quantities given above, and the use of accurately graduated medicine glasses, which may be had now at a trifling cost, should be insisted upon (see Fig. 5).

Fig. 5

Graduated medicine glass

The Metric System—The idea of adopting a scientific standard for the basis of metrology, which could be accurately reverified, was suggested by a number of individuals after the Renaissance. Jean Picard, the French astronomer in the 17th century proposed to take as a unit the length of a pendulum beating one second of time at sea level, at a latitude of 45°.

James Watt, the English inventor in 1783, first suggested the application of decimal notation, and the commensurability of weight, length, and volume. The French National Assembly in 1790 appointed a committee to decide the preferability of the pendulum standard or a terrestrial measure of some kind. The committee reported in 1791 in favor of the latter and commissions were appointed to measure an arc of meridian and to perfect the details of the commensurability of the units and of nomenclature.

The unit decided upon was the *meter*, which was the one-millionth part of a quadrant of longitude running through Paris. This makes the *meter*, the one forty-millionth part of the earth's polar circumference. In 1799 the commissions reported in detail upon the system and defined the *liter* as the volume of the cube of one-tenth of a *meter*, and the *gram* as the weight of 1/1000 liter of distilled water at its maximum density of 4° C. The new system became compulsory in France in 1801, and found rapid favor among scientific workers in all civilized countries.

National jealousies and the natural antipathy to changing established customs interfered greatly with its adoption during the early part of the 19th century. At present the metric system is in use in every great country of the world excepting the United States and Great Britain and in these two countries it is legalized for reference to and definition of other standards, and is in exclusive use by scientific workers. In the United States the metric system was legalized in 1866, but not made compulsory, and in the same year the international prototype meter and kilogram were adopted as fundamental standards.

The United States silver coinage is based upon the metric system, the half dollar being exactly 12½ grams and the quarter and the dime being of the proper proportionate weights.

Since 1875 there has been established and maintained an International Bureau of Weights and Measures, with headquarters at Paris, which is managed by an International Committee, upon which all civilized countries are represented, the object of the committee being to make and provide prototypes of the meter and kilogram for the subscribing nations.

The United States prototype standards, constructed of a platinum-iridium alloy, were brought from Paris in 1890 and are now in the custody of the Bureau of Standards at Washington, D. C. They have been reproduced and distributed by our own government to the various states having bureaus needing such replicas. The original United States prototype meter was taken back to Paris some years later for reverification and was found to have altered less that one fifty-thousandth of an inch after fifteen years of use.

The name Metric System is very appropriate, as *each unit is derived from the meter;* it is also known as the *Decimal System*, because in obtaining the multiples and sub-divisions the number ten (*decem*) is used solely. The prefixes, which indicate *multiplication*, are of Greek derivation,—deka, 10; hecto, 100; kilo, 1000. Myria, meaning 10,000, was a term used in the original system but is not employed in practice. The *division* of the units is expressed by Latin prefixes,—deci, $\frac{1}{10}$; centi, $\frac{1}{100}$; milli, $\frac{1}{1000}$.

The following table will indicate to the student the basis of the metric system. The full table with abbreviations follows:

Prefixes		Meaning		Units
milli-	= *one-thousandth*	$\frac{1}{1000}$	.001	**"meter"** *for length*
centi-	= *one-hundreth*	$\frac{1}{100}$	.01	
deci-	= *one-tenth*	$\frac{1}{10}$	.1	**"gram"** *for weight or mass*
Unit	= *one*	1	1	
Deka-	= *ten*	$\frac{10}{1}$	10	
Hecto-	= *one hundred*	$\frac{100}{1}$	100	**"liter"** *for capacity*
Kilo-	= *one thousand*	$\frac{1000}{1}$	1000	

Abbreviation	Meter	Abbreviation	Liter	Abbreviation	Gram
1 milli- meter, mm. =	.001	1 milli- liter, ml. or mil =	.001	1 milli- gram, mg. =	.001
1 centi- meter, cm. =	.01	1 centi- liter, cl. =	.01	1 centi- gram, cg. =	.01
1 deci- meter, dm. =	.1	1 deci- liter, dl. =	.1	1 deci- gram, dg. =	.1
Meter, M.	**1.**	**Liter, L.**	**1.**	**Gram, Gm.**	**1.**
1 Deka- meter, Dm. =	10.	1 Deka- liter, Dl. =	10.	1 Deka- gram, Dg. =	10.
1 Hecto-meter, Hm. =	100.	1 Hecto-liter, Hl. =	100.	1 Hecto-gram, Hg. =	100.
1 Kilo- meter, Km. =	1000.	1 Kilo- liter, Kl. =	1000.	1 Kilo- gram, Kg. =	1000.

Note—These terms are used without the hyphens, which are inserted here for emphasis in teaching the use of the prefixes.

In pharmaceutical practice a number of the above measures are rarely if ever used. Of the measures of length, the *millimeter* (mm.) and *centimeter* (cm.) are employed in the U. S. Pharmacopœia in the descriptions of drugs. In microscopy *micromillimeter* (mkm.) or preferably, *micron* (μ), signifies the thousandth part of a millimeter, and is often used, but the Pharmacopœia has adopted the decimal part of a millimeter instead of the micron, under powdered drugs, thus, under cimicifuga the starch grains are described as being "from 0.003 to 0.015 mm. in diameter". Measurements pertaining to the size of colloidal particles are termed micro-micromillimeter ($\mu\,\mu$), meaning the millionth part of a millimeter. In measures of capacity, the term *milliliter* was, for many years, generally replaced by the term *cubic centimeter* (cc.) in chemical and pharmaceutical practice. The more accurate term *milliliter*, or its abbreviated form *mil* or *ml.*, was adopted by the Ninth Revision of the United States Pharmacopœia and the N. F. IV, but it proved so unpopular in practice that the U. S. P. X and the N. F. V have returned to the older term *cubic centimeter* (cc.). For all practical purposes the two terms have the same value, 1 mil being equivalent to 1.000027 cubic centimeters. The difference amounts to only 1½ minims in a gallon and may be disregarded. The cc. and the liter have been chosen as the most convenient units for measure.

In weight, the *milligram*, *centigram*, *gram*, and *kilogram* are selected; the latter, the commercial unit for larger quantities of drugs, is called the *kilo*. This habit of appropriating only certain of the most convenient denominations for practical work has an analogy in the disuse of the theoretical terms of the system of United States coinage. Thus, the double eagle, eagle, and dime are ignored, while dollars and cents are preferred as units. The principal merits of the metric system are: 1. That every weight and measure bears a simple relation to the initial unit, the meter. 2. That every unit is multiplied or divided by the same number (*i.e.*, 10) to obtain the various denominations, and increase or decrease is expressed by simply moving the decimal point. 3. The commensurability of units of weight, length, and volume. 4. Its almost universal adoption makes it an international system.

Length—*Meter.* Each side of the square (Fig. 6) measures 1 decimeter; one is graduated into tenths (*centimeters*), and these into tenths (*millimeters*) (the scale beneath shows the comparison with inches): 10 decimeters = 1 METER = 39.3700 in. (remember three threes, 3 ft., 3 in., and ⅜ of an inch).

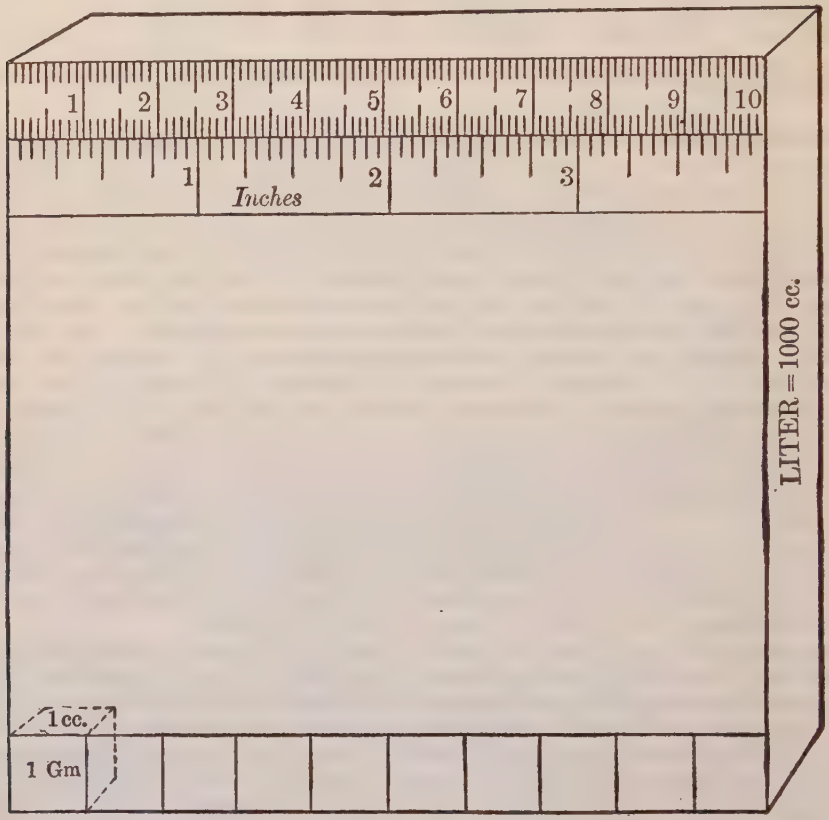
Capacity—*Liter.* A hollow cube having each side of the same size as the square would hold a LITER = 1000 mils, usually spoken of as cc. = 2.11342 pints.

Weight—*Gram.* The weight of distilled water at 4° C. (39.2° F.) contained in a cube of the $\frac{1}{1000}$ of a liter is equal to a GRAM = 15.432 grains, and measures 1 *milliliter* (see Fig. 6).

The advantages of the metric system have become more and more apparent

upon examination, and its simplicity, brevity, and adaptability to everyday needs are now universally conceded. The progress which it had made in this country up to 1890 fully warranted its exclusive adoption in the U. S. Pharmacopœia; hence definite quantities were given and metric weights and measures alone employed.

FIG. 6



Metric diagram

The use of the metric weights and measures in the text of the U. S. Pharmacopœia makes it necessary for every pharmacist to become familiar with them, and therefore an easy method of remembering their relations to each other and their equivalents in other systems is desirable. The tables of equivalents which follow are taken from the Pharmacopœia, and were prepared by the U. S. Bureau of Standards.

Equivalents of Weights and Measures

Metric, Avoirdupois and Apothecaries

NOTE—The values given for the relation of weight to measure and *vice versa*, are for water at the temperature of 4° C. (39.2° F.) *in vacuo*. For ordinary, practical purposes these values may be used without correction.

Weights						Metric Weight and Measure	Measures		
Grains	Apothecaries		Avoirdupois				Fluid		Fluidounce and fractions
	oz.	grains	lbs.	oz.	grains	Gm. or cc.*	ounces	minims	
15432.4	32	72.4	2	3	119.9	1000	33	391.1	33.815
15360.0	32	.....	2	3	47.5	995.311	33	314.9	33.656
15060.5	31	180.5	2	2	185.5	975.906	33	.....	33
15046.5	31	166.5	2	2	171.5	975	32	465.3	32.969
14880.0	31	.....	2	2	5.0	964.208	32	290.1	32.604
14660.7	30	260.7	2	1	223.2	950	32	59.5	32.124
14604.1	30	204.1	2	1	166.6	946.333	32	.....	32
14400.0	30	.....	2	..	400.0	933.104	31	265.2	31.553
14274.9	29	354.9	2	..	274.9	925	31	133.7	31.279
14147.8	29	227.8	2	..	147.8	916.760	31	.....	31
14000.0	29	80.0	2	..	.....	907.185	30	324.6	30.676
13920.0	29	.....	1	15	357.5	902.001	30	240.4	30.501
13889.1	28	449.1	1	15	326.6	900	30	207.9	30.433
13691.4	28	251.4	1	15	128.9	887.187	30	.....	30
13562.5	28	122.5	1	15	.....	878.835	29	344.4	29.718
13503.3	28	63.3	1	14	378.3	875	29	282.2	29.588
13440.0	28	.....	1	14	315.0	870.897	29	215.6	29.449
13235.0	27	275.0	1	14	110.0	857.614	29	.....	29
13125.0	27	165.0	1	14	.....	850.486	28	364.3	28.759
13117.5	27	157.5	1	13	430.0	850	28	356.4	28.742
12960.0	27	.....	1	13	272.5	839.794	28	190.8	28.397
12778.6	26	298.6	1	13	91.1	828.041	28	.....	28
12731.7	26	251.7	1	13	44.2	825	27	430.6	27.897
12687.5	26	207.5	1	13	.....	822.136	27	384.1	27.800
12480.0	26	.....	1	12	230.0	808.690	27	165.9	27.346
12345.9	25	345.9	1	12	95.9	800	27	24.9	27.052
12322.3	25	322.3	1	12	72.3	798.469	27	.....	27
12250.0	25	250.0	1	12	.....	793.787	26	404.0	26.842
12000.0	25	.....	1	11	187.5	777.587	26	141.1	26.294
11960.1	24	440.1	1	11	147.6	775	26	99.1	26.206
11865.9	24	345.9	1	11	53.4	768.896	26	.....	26
11812.5	24	292.5	1	11	.....	765.437	25	423.8	25.883
11574.3	24	54.3	1	10	199.3	750	25	173.3	25.361
11520.0	24	.....	1	10	145.0	746.484	25	116.2	25.242
11409.5	23	369.5	1	10	34.5	739.323	25	.....	25
11375.0	23	335.0	1	10	.....	737.088	24	443.7	24.924
11188.5	23	148.5	1	9	251.0	725	24	247.5	24.516
11040.0	23	.....	1	9	102.5	715.380	24	91.4	24.190
10953.1	22	393.1	1	9	15.6	709.750	24	.....	24
10937.5	22	377.5	1	9	.....	708.738	23	463.6	23.966

* NOTE—By the "cc." in this table is meant the one-thousandth part of the liter or a milliliter (ml).

Equivalents of Weights and Measures—*Continued*

Weights						Metric Weight and Measure	Measures		
Grains	Apothecaries		Avoirdupois				Fluid		Fluidounces and fractions
	oz.	grains	lbs.	oz.	grains	Gm. or cc.*	ounces	minims	
10802.6	22	242.6	1	8	302.6	700	23	321.7	23.670
10560.0	22	.....	1	8	60.0	684.277	23	66.5	23.139
10500.0	21	420.0	1	8	.....	680.389	23	3.4	23.007
10496.7	21	416.7	1	7	434.2	680.177	23	.....	23
10416.8	21	336.8	1	7	354.3	675	22	396.0	22.825
10080.0	21	.....	1	7	17.5	653.173	22	41.7	22.087
10062.5	20	462.5	1	7	.....	652.039	22	23.3	22.049
10040.4	20	440.4	1	6	415.4	650.604	22	.....	22
10031.0	20	431.0	1	6	406.0	650	21	470.2	21.980
9645.2	20	45.2	1	6	20.2	625	21	64.4	21.134
9625.0	20	25.0	1	6	.....	623.690	21	43.2	21.090
9600.0	20	.....	1	5	412.5	622.070	21	16.8	21.035
9584.0	19	464.0	1	5	396.5	621.031	21	.....	21
9259.4	19	139.4	1	5	71.9	600	20	138.6	20.289
9187.5	19	67.5	1	5	.....	595.340	20	63.0	20.131
9127.6	19	7.6	1	4	377.6	591.458	20	.....	20
9120.0	19	.....	1	4	370.0	590.966	19	472.0	19.983
8873.6	18	233.6	1	4	123.6	575	19	212.9	19.444
8750.0	18	110.0	1	4	.....	566.991	19	82.8	19.173
8671.2	18	31.2	1	3	358.7	561.885	19	.....	19
8640.0	18	.....	1	3	327.5	559.863	18	447.2	18.932
8487.8	17	327.8	1	3	175.3	550	18	287.1	18.598
8312.5	17	152.5	1	3	.....	538.641	18	102.7	18.214
8214.8	17	54.8	1	2	339.8	532.312	18	.....	18
8160.0	17	.....	1	2	285.0	528.759	17	422.3	17.880
8102.0	16	422.0	1	2	227.0	525	17	361.3	17.753
7875.0	16	195.0	1	2	.....	510.291	17	122.5	17.255
7758.5	16	78.5	1	1	321.0	502.739	17	.....	17
7716.2	16	36.2	1	1	278.7	500	16	435.6	16.907
7680.0	16	.....	1	1	242.5	497.656	16	397.5	16.828
7437.5	15	237.5	1	1	.....	481.942	16	142.4	16.297
7330.4	15	130.4	1	..	330.4	475	16	29.8	16.062
7302.1	15	102.1	1	..	302.1	473.167	16	.....	16
7200.0	15	.....	1	..	200.0	466.552	15	372.6	15.776
7000.0	14	280.0	1	..	.....	453.592	15	162.3	15.338
6944.6	14	224.6	..	15	382.1	450	15	104.0	15.217
6845.7	14	125.7	..	15	283.2	443.594	15	.....	15
6720.0	14	.....	..	15	157.5	435.449	14	347.8	14.725
6562.5	13	322.5	..	15	.....	425.243	14	182.2	14.379
6558.8	13	318.8	..	14	433.8	425	14	178.2	14.371
6389.3	13	149.3	..	14	264.3	414.021	14	.....	14
6240.0	13	.....	..	14	115.0	404.345	13	322.9	13.673

* NOTE—By the "cc." in this table is meant the one-thousandth part of the liter or a milliliter (ml).

Equivalents of Weights and Measures—*Continued*

Weights						Metric Weight and Measure	Measures		
Grains	Apothecaries		Avoirdupois			Gm. or cc.*	Fluid		Fluidounces and fractions
	oz.	grains	lbs.	oz.	grains		ounces	minims	
6172.9	12	412.9	..	14	47.9	400	13	252.4	13.526
6125.0	12	365.0	..	14	.....	396.893	13	202.0	13.421
5932.9	12	172.9	..	13	245.4	384.448	13	.....	13
5787.1	12	27.1	..	13	99.6	375	12	326.6	12.681
5760.0	12	.....	..	13	72.5	373.242	12	298.1	12.621
5687.5	11	407.5	..	13	.....	368.544	12	221.9	12.462
5476.6	11	196.6	..	12	226.6	354.875	12	.....	12
5401.3	11	121.3	..	12	151.3	350	11	400.8	11.835
5280.0	11	.....	..	12	30.0	342.138	11	273.3	11.569
5250.0	10	450.0	..	12	.....	340.194	11	241.7	11.504
5020.2	10	220.2	..	11	207.7	325.302	11	.....	11
5015.5	10	215.5	..	11	203.0	325	10	475.1	10.990
4812.5	10	12.5	..	11	.....	311.845	10	261.6	10.545
4800.0	10	.....	..	10	425.0	311.035	10	248.4	10.518
4629.7	9	309.7	..	10	254.7	300	10	69.3	10.144
4563.8	9	243.8	..	10	188.8	295.729	10	.....	10
4375.0	9	55.0	..	10	.....	283.495	9	281.4	9.586
4320.0	9	.....	..	9	382.5	279.931	9	223.6	9.466
4244.0	8	403.9	..	9	306.4	275	9	143.5	9.299
4107.4	8	267.4	..	9	169.9	266.156	9	.....	9
3937.5	8	97.5	..	9	.....	255.146	8	301.3	8.628
3858.1	8	18.1	..	8	358.1	250	8	217.8	8.454
3840.0	8	.....	..	8	340.0	248.828	8	198.7	8.414
3651.0	7	291.0	..	8	151.0	236.583	8	.....	8
3500.0	7	140.0	..	8	.....	226.796	7	321.1	7.669
3472.3	7	112.3	..	7	409.8	225	7	292.0	7.608
3360.0	7	.....	..	7	297.5	217.724	7	173.9	7.362
3194.7	6	314.7	..	7	132.2	207.010	7	.....	7
3086.5	6	206.5	..	7	24.0	200	6	366.2	6.763
3062.5	6	182.5	..	7	.....	198.447	6	341.0	6.710
2880.0	6	.....	..	6	255.0	186.621	6	149.0	6.311
2738.3	5	338.3	..	6	113.3	177.437	6	.....	6
2700.7	5	300.7	..	6	75.7	175	5	440.4	5.918
2625.0	5	225.0	..	6	.....	170.097	5	360.9	5.752
2400.0	5	.....	..	5	212.5	155.517	5	124.2	5.259
2314.9	4	394.9	..	5	127.4	150	5	34.7	5.072
2281.9	4	361.9	..	5	94.4	147.865	5	.....	5
2187.5	4	267.5	..	5	.....	141.748	4	380.7	4.793
1929.0	4	9.0	..	4	179.0	125	4	108.9	4.227
1920.0	4	.....	..	4	170.0	124.414	4	99.4	4.207
1825.5	3	385.5	..	4	75.5	118.292	4	.....	4
1750.0	3	310.0	..	4	.....	113.398	3	400.6	3.835

* NOTE—By the "cc." in this table is meant the one-thousandth part of the liter or a milliliter (ml).

Equivalents of Weights and Measures—*Continued*

Weights						Metric Weight and Measure	Measures		
Grains	Apothecaries		Avoirdupois				Fluid		Fluidounces and fractions
	oz.	grains	lbs.	oz.	grains	Gm. or cc.*	ounces	minims	
1543.2	3	103.2	..	3	230.7	100	3	183.1	3.381
1440.0	3	.....	..	3	127.5	93.310	3	74.5	3.155
1388.9	2	428.9	..	3	76.4	90	3	20.8	3.043
1369.1	2	409.1	..	3	56.6	88.719	3	.....	3
1312.5	2	352.5	..	3	.....	85.049	2	420.4	2.876
1234.6	2	274.6	..	2	359.6	80	2	338.5	2.705
1157.4	2	197.4	..	2	282.4	75	2	257.3	2.536
1080.3	2	120.3	..	2	205.3	70	2	176.2	2.367
960.0	2	.....	..	2	85.0	62.207	2	49.7	2.104
925.9	1	445.9	..	2	50.9	60	2	13.9	2.029
912.8	1	432.8	..	2	37.8	59.146	2	.....	2
875.0	1	395.0	..	2	.....	56.699	1	440.3	1.917
771.6	1	291.6	..	1	334.1	50	1	331.5	1.691
617.3	1	137.3	..	1	179.8	40	1	169.2	1.353
480.0	1	.....	..	1	42.5	31.1035	1	24.9	1.052
463.0	..	.....	..	1	25.5	30	1	6.9	1.014
456.380	..	.....	..	1	18.88	29.5729	1	.....	1
437.5	..	.....	..	1	.....	28.350	..	460.15	0.959
385.8	..	.....	..	..	.....	25	..	405.78	0.845
308.6	..	.....	..	..	.....	20	..	324.62	0.676
154.3	..	.....	..	..	.....	10	..	162.31	0.338
15.4324	..	.....	..	..	.....	1	..	16.23	0.0338
1	..	.....	..	..	.....	0.06480	..	1.0517	0.0022
0.9508	..	.....	..	..	.....	0.06161	..	1	0.0021

*Note—By the "cc." in this table is meant the one-thousandth part of the liter or a milliliter (ml).

Equivalents of Weights and Measures—*Continued*

From 480 Grains down

Grains	Metric Weight and Measure Gm. or cc.*	Minims (of Water at 4° C.)	Grains	Metric Weight and Measure Gm. or cc.*	Minims (of Water at 4° C.)
480 [1 ℥	31.103	504.8	**240** [4 ℥	15.552	252.4
478.4	**31**	503.2	231.5	**15**	243.5
475.4	30.805	**500**	228.2	14.786	**240.0**
463.0	**30**	486.9	**218.75** [½ av. oz.	14.175	230.1
456.4	29.573	**480** [1 f℥	216.1	**14**	227.2
450	29.160	473.3	**210**	13.608	220.9
447.5	**29**	470.7	200.6	**13**	211.0
437.5 [1 av. oz.	28.350	460.2	199.7	12.938	**210.0**
432.1	**28**	454.5	185.2	**12**	194.8
427.9	27.725	**450**			
420 [7 ℥	27.216	441.7	**180** [3 ℥	11.664	189.3
416.7	**27**	438.2	171.1	11.090	**180.0**
401.2	**26**	422.0	169.8	**11**	178.5
399.3	25.876	**420**	154.3	**10**	162.3
390	25.272	410.2	**150**	9.720	157.8
385.8	**25**	405.8	142.6	9.242	**150.0**
380.3	24.644	**400**	138.9	**9**	146.1
370.8	24.028	**390**	123.5	**8**	129.8
370.4	**24**	389.5			
360 [6 ℥	23.328	378.6	**120** [2 ℥	7.776	126.2
354.9	**23**	373.3	114.1	7.393	**120.0**
342.3	22.180	**360**	**109.375** [¼ av. oz.	7.087	115.0
339.5	**22**	357.1	108.0	**7**	113.6
330	21.384	347.1	**100**	6.480	105.2
324.1	**21**	340.9	95.1	6.161	**100.0**
313.8	20.331	**330**	92.6	**6**	97.4
308.6	**20**	324.6	**80**	5.184	84.1
			77.2	**5**	81.2
			76.1	4.929	**80.0**
			61.7	**4**	64.9
300 [5 ℥	19.440	315.5	**60** [1 ℥	3.888	63.1
293.2	**19**	308.4	57.0	3.697	**60.0**
285.2	18.483	**300**	**54.6875** [⅛ av. oz.	3.544	57.5
277.8	**18**	292.2	47.5	3.081	**50.0**
270	17.496	284.0	**50**	3.240	52.6
262.4	**17**	275.9	46.3	**3**	48.7
256.7	16.635	**270**	42.8	2.772	**45.0**
246.9	**16**	259.7	**40**	2.592	42.1
			38.0	2.464	**40.0**
			33.3	2.156	**35.0**
			30.9	**2**	32.5

* NOTE—By the "cc." in this table is meant the one-thousandth part of the liter or a milliliter (ml).

Equivalents of Weights and Measures—*Continued*

From 30 Grains down			Weights from 5 Grains down		
Grains	Metric Weight and Measure Gm. or cc.*	Minims (of Water at 4° C.)	Grams	Grains in decimal fractions	Grains in common fractions
30 [½ ʒ	1.944	31.55	0.324	5	5
28.52	1.848	30	0.292	4.5	4½
23.77	1.540	25	0.259	4	4
20	1.296	21.04	0.227	3.5	3½
19.02	1.232	20	0.194	3	3
15.4324	1	16.23	0.162	2.5	2½
			0.130	2	2
15	0.972	15.78	0.097	1.5	1½
14.26	0.924	15	0.065	1	1
14	0.907	14.72			
13.31	0.863	14	0.0607	0.9375	15/16
13	0.842	13.67	0.0583	0.90	9/10
12.36	0.801	13	0.0567	0.8750	7/8
12	0.778	12.63	0.0526	0.8125	13/16
11.41	0.739	12	0.0518	0.80	4/5
11	0.713	11.57	0.0486	0.75	3/4
10.46	0.678	11	0.0445	0.6875	11/16
			0.0405	0.6250	5/8
10	0.648	10.52	0.0364	0.5625	9/16
9.51	0.616	10	0.0324	0.5	1/2
9	0.583	9.46			
8.56	0.554	9	0.0283	0.4375	7/16
8	0.518	8.41	0.0259	0.40	2/5
7.72	0.5	8.12	0.0243	0.3750	3/8
7.61	0.493	8	0.0202	0.3125	5/16
7	0.454	7.37	0.0162	0.25	1/4
6.66	0.431	7	0.0121	0.1875	3/16
6	0.389	6.31	0.0081	0.1250	1/8
5.70	0.370	6	0.0040	0.0625	1/16
			0.0032	0.05	1/20
5	0.324	5.26	0.0026	0.04	1/25
4.75	0.308	5	0.0022	0.033	1/30
4	0.259	4.20	0.0018	0.0278	1/36
3.80	0.246	4	0.0016	0.025	1/40
3	0.194	3.15	0.0013	0.02	1/50
2.85	0.185	3	0.0011	0.0167	1/60
2	0.130	2.11	0.0010	0.0156	1/64
1.90	0.123	2	0.0006	0.01	1/100
1	0.06480	1.0518	0.0005	0.0078	1/128
0.9508	0.06161	1	0.0004	0.0062	1/160
			0.0003	0.0048	1/210
			0.0002	0.0031	1/320
			0.0001	0.0016	1/640

*Note—By the "cc." in this table is meant the one-thousandth part of the liter or a milliliter (ml).

Equivalents of Linear Measures

Metric to English

Centimeters	Inches	Centimeters	Inches	Millimeters	Inches	
					in decimal fractions	in 32ds.
150	59.06	55	21.65	25.4	1	$\frac{32}{32}$
145	57.09	53.3	21	25	0.98	..
140	55.12	50.8	20	24.0	0.94	..
139.7	55	50	19.69	23.8	0.94	$\frac{30}{32}$
135	53.15	48.3	19	23.0	0.91	$\frac{29}{32}$
130	51.18	45.7	18	22.2	0.88	$\frac{28}{32}$
127.0	50	45	17.72	22.0	0.87	..
125	49.21	43.2	17	21.0	0.83	..
120	47.24	40.6	16	20.6	0.81	$\frac{26}{32}$
115	45.28	40	15.75	20	0.79	..
114.3	45	38.1	15	19.1	0.75	$\frac{24}{32}$
110	43.31	35.6	14	19.0	0.75	..
105	41.34	35	13.78	18.0	0.71	..
101.6	40	33.0	13	17.5	0.69	$\frac{22}{32}$
100	39.37	30.5	12	17.0	0.67	..
99.1	39	30	11.81	16.0	0.63	..
96.5	38	27.9	11	15.9	0.62	$\frac{20}{32}$
95	37.40	25.4	10	15	0.59	..
94.0	37	25	9.84	14.3	0.56	$\frac{18}{32}$
91.4	36	22.9	9	14.0	0.55	..
90	35.43	20.3	8	13.0	0.51	..
88.9	35	20	7.87	12.7	0.50	$\frac{16}{32}$
86.4	34	17.8	7	12.0	0.47	..
85	33.46	15.2	6	11.1	0.44	$\frac{14}{32}$
83.8	33	15	5.91	11.0	0.43	..
81.3	32	12.7	5	10	0.39	..
80	31.50	10.2	4	9.5	0.38	$\frac{12}{32}$
78.7	31	10	3.94	9	0.35	..
76.2	30	9	3.54	8.7	0.34	$\frac{11}{32}$
75	29.53	8	3.15	8	0.31	..
73.7	29	7.6	3	7.9	0.31	$\frac{10}{32}$
71.1	28	7	2.76	7.1	0.28	$\frac{9}{32}$
70	27.56	6	2.36	7	0.28	..
68.6	27	5.1	2	6.4	0.25	$\frac{8}{32}$
66.0	26	5	1.97	6	0.24	..
65	25.59	4	1.57	5.6	0.22	$\frac{7}{32}$
63.5	25	3	1.18	5	0.20	..
61.0	24	2.54	1	4.8	0.19	$\frac{6}{32}$
60	23.62	2	0.79	4	0.16	..
58.4	23	1	0.39	3.2	0.12	$\frac{4}{32}$
55.9	22			3	0.12	..
				2.4	0.09	$\frac{3}{32}$
				2	0.08	..
				1.6	0.06	$\frac{2}{32}$
				1	0.04	..
				0.8	0.03	$\frac{1}{32}$
				0.1	0.0039	..

Equivalents of Linear Measures

English to Metric

Feet	Meters	Centimeters	Inches	Millimeters	Inches fractions	Inches decimal fractions	Millimeters
25	7.620	762.0	34	863.6	16/16	1.000	25.40
24	7.315	731.5	33	838.2	15/16	0.9375	23.81
23	7.010	701.0	32	812.8	7/8	0.8750	22.22
22	6.706	670.6	31	787.4	13/16	0.8125	20.64
21	6.401	640.1	30	762.0	6/8	0.7500	19.05
20	6.096	609.6	29	736.6	11/16	0.6875	17.46
19	5.791	579.1	28	711.2	5/8	0.6250	15.88
18	5.486	548.6	27	685.8	9/16	0.5625	14.29
17	5.182	518.2	26	660.4	1/2	0.5000	12.70
16	4.877	487.7	25	635.0	7/16	0.4375	11.11
15	4.572	457.2	24	609.6	3/8	0.3750	9.52
14	4.267	426.7	23	584.2	5/16	0.3125	7.94
13	3.962	396.2	22	558.8	1/4	0.2500	6.35
12	3.658	365.8	21	533.4	3/16	0.1875	4.76
11	3.353	335.3	20	508.0	1/8	0.1250	3.18
10	3.048	304.8	19	482.6	1/16	0.0625	1.59
9	2.743	274.3	18	457.2	1/32	0.03125	0.79
8	2.438	243.8	17	431.8	1/64	0.01562	0.40
7	2.134	213.4	16	406.4	1/100	0.01000	0.25
6	1.829	182.9	15	381.0	1/200	0.00500	0.127
5	1.524	152.4	14	355.6	1/320	0.00312	0.08
4	1.219	121.9	13	330.2	2/3	0.667	16.93
3	0.9144	91.44	12	304.8	1/3	0.333	8.47
2	0.6096	60.96	11	279.4	4/5	0.800	20.32
1	0.3048	30.48	10	254.0	3/5	0.600	15.24
0.9	0.2743	27.43	9	228.6	2/5	0.400	10.16
0.8	0.2438	24.38	8	203.2	1/10	0.100	2.54
0.7	0.2134	21.34	7	177.8			
0.6	0.1829	18.29	6	152.4			
0.5	0.1524	15.24	5	127.0			
0.4	0.1219	12.19	4	101.6			
0.3	0.0914	9.144	3	76.2			
0.2	0.0610	6.096	2	50.8			
0.1	0.0305	3.048	1	25.4			

Orthography, Pronunciation, and Reading

Orthography—There are two methods of orthography of the metric units in use in the United States; in one of these, the original French, the units are spelled mètre, litre, gramme; in the other, proposed by the American Metric Bureau, the units are spelled meter, liter, gram. In the U. S. Pharmacopœias for three decades, ever since the original adoption of the metric system, the French gramme was used and meter and liter adopted, but the U. S. P. X has adopted the spelling gram.

Pronunciation—Meter is pronounced *mee'ter*, liter, *lee'ter*, either gram or gramme is pronounced *gram*, not, in two syllables, as sometimes heard, *gram'me;* centimeter should be pronounced sen'tee-mee-ter, not son'tee-mee-ter. The latter faulty pronunciation is quite common, and is due to confounding the French pronunciation with the English. Either son-tee-ma'tr (French) or sen'tee-mee-ter (English) would be correct, but to use half of the French and half of the English is obviously improper, and, as the metric system is now Anglicized, the simple English pronunciation is more appropriate.

Reading—Some difficulty is usually experienced by those unfamiliar with the metric system in reading the quantities. In the linear measures in pharmacy, centimeters and millimeters are almost exclusively used; thus, 0.05 M. would not be read five hundredths of a meter, but 5 centimeters (5 cm.); if the millimeter column contains a unit, as in 0.055 M. it is read fifty-five millimeters (55 mm.), in preference to fifty-five thousandths of a meter.

Fractions of a millimeter must be read decimally, as, 0.0555 mm., fifty-five and five-tenths millimeters. In measures of capacity, cubic centimeters, cc. are exclusively used for quantities of less than a liter, the terms half liter, quarter liter, deciliter, centiliter, milliliter are replaced by 500 cc. 250 cc. 100 cc. 10 cc. 1 cc.; with water the cc. is considered equivalent to a gram. In weight, when the quantity is relatively large, and in commercial transactions, the (kilogram) is abbreviated to kilo, pronounced kee-lo; when less than a (kilogram), and not less than a gram, the quantity is read with the gram for the unit; 2000 Gm. would be read either as two thousand grams or as two kilos, and 543 Gm. would be read five hundred and forty-three grams, while 2543 Gm. is sometimes read two kilos and five hundred and forty-three grams, although twenty-five hundred and forty-three grams is usually preferred. For quantities below the gram, decigrams are not used, but centigrams and milligrams are regarded as the most convenient units; they are read in the same way as centimeters and millimeters.

WEIGHING AND MEASURING

Among the first operations that the student is called upon to perform are the very important ones of *weighing* and *measuring*. The former process requires the use of the *balance*, or, as more frequently but less preferably termed, *scales*. As the successful performance of many of the operations in pharmacy depends upon a thorough knowledge of the principles of the balance and a correct understanding of its care and use, it has been selected as one of the first subjects for consideration.

There is a relativity of accuracy in weighing (or measuring) which must not be overlooked, and which may be illustrated by giving consideration to the following graded list: coal, ice, salt, sugar, epsom salt, morphine, strychnine, aconitine, and radium. One of the most important things for the pharmacist to

learn is the degree of tolerance or error permissible in weighing or measuring any particular ingredient.

The empiric methods of the kitchen embodied in such quantities as a handful or pinch, have no place in pharmacy. Accurate work can be accomplished only by means of suitable apparatus.

It is obviously unnecessary to discuss such weighing devices as platform scales, steelyards, crane scales, spring balances, computing scales or any of the specialized or unusual types not commonly used in retail or in manufacturing pharmacy.

The *balance* may be defined as an instrument for determining the relative weights of substances, and should be *correctly constructed, skilfully used,* and *carefully protected from injury,* if accurate results are to be obtained.

Construction of the Balance—For systematic consideration pharmaceutical balances, which all belong to the general class known as counter balances, may be classified as follows: 1. *Single beam, equal arms.* 2. *Single beam, unequal arms.* 3. *Double beam, unequal arms.* 4. *Compound lever balances.* 5. *Torsion balances.*

1. The Single Beam, Equal Arm Balance—This instrument which still maintains its supremacy, notwithstanding many attempts to supplant it, is the *single beam, equal arm balance,* which may be described as consisting of a metallic lever or beam, divided into two equal arms at the center by a knife edge, upon which it is supported. At exactly equal distances from this point of support, and situated in the same plane, are placed the end knife edges; these suspend the pans which carry the substances to be weighed. The principles used in the construction of this balance have been in continuous use from the earliest periods of antiquity. A properly constructed balance should possess the following requirements:

1. *When the beam is in a horizontal position, the center of gravity should be slightly below the point of support, or central knife edge, and perpendicular to it.*

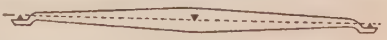
The relative sensitiveness of the balance depends upon the fulfilment of this principle, which may be roughly illustrated by forcing a pin through the center of a circular piece of pasteboard; if the edge of the pasteboard is touched slightly, it does not oscillate at all, but revolves around the center to a degree corresponding to the impulse given it. In this position it illustrates neutral equilibrium. If the pin is removed and inserted at a very short distance above the center, and the edge of the pasteboard touched as before, it will oscillate slowly, corresponding to a very sensitive beam, the point of support being slightly above the center of gravity; if the pin is again removed and inserted far above the center, and the same impulse imparted to the edge, it will oscillate quickly, illustrating stable equilibrium characteristic of a beam which comes to rest quickly and is not particularly sensitive. Unstable equilibrium may be illustrated by balancing the disk so that the point of support is below the center. The slightest touch then causes it to reverse its position completely and finally come to rest with the center of gravity below the point of support.

2. *The end knife edges must be at exactly equal distances from the central knife edge; they must all be in the same plane, and the edges absolutely parallel to each other.*

It is very apparent that the conditions of a good prescription balance cannot be satisfied if there is inequality in the length of the arms of the beam. In Fig. 7 the distance from the central knife edge to the one on the left must be exactly the same as the distance from the central knife edge to the one on the right, otherwise unequal weights would be required to establish equilibrium.

If the central knife edge is placed either above or below a line drawn so that it connects the end knife edges, the loading of the pans will either cause the beam to cease oscillating, or will diminish the sensitiveness in proportion to the load. If the knife edges are not parallel, the weight of a body would not be constant upon every part of the pan, but would be greater if placed near the edge on one side, and correspondingly less at a point directly opposite.

Fig. 7



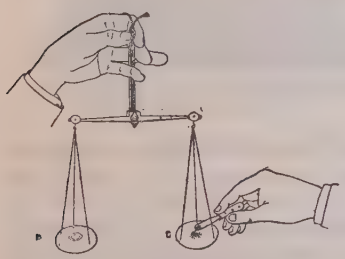
Position of knife edges

3. *The beam should be inflexible, but as light in weight as possible, and the knife edges in fine balances should bear upon agate planes.*

Rigidity of the beam is necessary, because any serious deflection caused by a loading of the pans would lower the end knife edges, and thus accuracy in weighing would be impossible. The beam should not be heavier than necessary, because the sensitiveness of the balance would be thereby lessened, and to diminish friction which constantly increases with the age and use of a balance, the bearings of the knife edges should be agate planes, which are polished flat pieces of the very hard mineral called agate.

The Tests of a Balance—Having stated the essential points in the construction of the balance, the tests, which are always applied by manufacturers before approving a balance, will now be described. These tests may be applied by any intelligent and careful person to satisfy himself with regard to the construction and character of a balance, the origin, history, or condition of which are in doubt. The prescription balance, being one of the most delicate and important of the instruments in use by the pharmacist, is selected for illustration. 1. A suitable counter or table having been secured, the balance is placed in a level position. This is accomplished by means of levels and adjusting screws which are now a part of the equipment of every first class balance. The beam is then elevated so that it is free to oscillate, and when the oscillations have ceased, the smallest weight to which the balance is sensitive is placed upon the right hand pan,—it should at once respond to the weight; this tests its sensitiveness with unloaded pans. 2. Both pans are now loaded with the full weight that the balance is designed to carry, and then the smallest weight is placed upon the right hand pan,—the oscillation, although slower than in the first test, ought to be as decided; this shows its sensitiveness when loaded. 3. The pans should now be loaded to half the capacity of the balance, and perfect equilibrium attained. The weights on the right hand pan must now be exchanged for those on the left hand pan, and *vice versa;* if equilibrium is still maintained, the arms of the beam are equal. 4. The pans should be moderately loaded and balanced, and one of the larger weights shifted in different positions upon each of the pans in turn, and any variation in equilibrium carefully noted. This variation, as previously mentioned, indicates a lack of parallelism in the knife edges.

Fig. 8



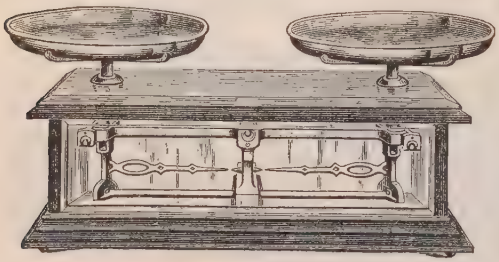
Manner of holding scales

Hand Scales—The commonest form in which this principle is utilized in pharmacy is seen in the cheap hand scales now almost entirely out of use. In those usually seen the beam is of brass, with a steel central knife edge, having a perforation in each end of the beam for the insertion of two wire hooks, to which are attached silken cords for supporting the

pans. The manner of holding these scales is shown in Fig. 8. They are now rarely employed and do not comply with the legal requirements for prescription balances.

Prescription Balances—The advantage of substituting a rigid metallic column for the usually unsteady human arm as a support to the beam is easily apparent, for, in addition to the increased stability which is gained both hands are left free to perform the weighing; more time can usually be devoted to secure equilibrium and the oscillations can be more accurately observed.

FIG. 9



Counter scales in "glass box"

Prescription balances are now available in many forms (See Figs. 13 and 14). The "take down" type commonly used in teaching institutions is not suitable for continuous and daily use in a pharmacy. Illustrations are given of a number of different types of prescription balances, some of which belong to the simpler form of single beam, equal arm balance, and others to the type known as box scales, in which the mechanical parts are enclosed and protected from injury. Most careful pharmacists have two balances for use in the prescription department. These are described by some legal authorities, pertaining to weights and measures, as Class A and Class B balances.

The Class A balance is the balance of greatest sensitiveness and should be used in weighing quantities of ten grains or less. The Class B balance, which need not be so expensive nor so sensitive, should be used in weighing quantities above ten grains.

FIG. 10

Scale with graduated parallel beam and sliding weight

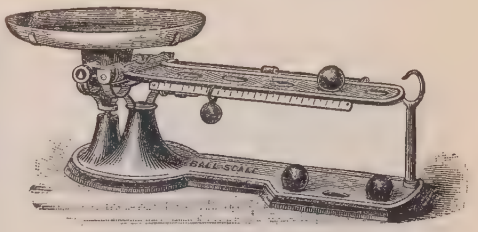
The tolerances established by the United States Bureau of Standards for these two classes of balances provides for a variation of one-fifth of a grain when the load on the balance is one-half ounce in a Class A balance, and a variation of one-half grain for the same load in a Class B balance. Smaller or larger loads are permitted to have the same proportionate error or variation.

The finest prescription balances are now provided with solid nickel or solid silver pans and gold-plated beams. As the pans are subjected to more wear and tear than any other part of the balance, it is economical to use *solid* rather than *plated* pans, for constant friction wears off the plating, and the additional cost for replating soon absorbs the difference in price. Equipped in this way, and with agate bearings, a prescription balance is durable and really cheap, because it will remain for a long time fully equal to the most exacting demands. The most expensive, most sensitive, and most accurate type of single beam equal arm balance is the *analytical balance.* This is fully discussed in the Chapter on "The Pharmacist as an Analyst", Part IX.

Counter Scales—For counter and dispensing purposes, the single beam, equal arm principle was formerly exclusively used. This type of balance occupied so much valuable counter space that it has been entirely replaced by one of the other types of scales, usually the compound lever type with the working parts enclosed (See Fig. 9). A very convenient form of dispensing scale for smaller quantities, made by Troemner, is shown in Fig. 10. The beam is provided with a horizontal, graduated bar, upon which a poise slides backward and forward; the beam is graduated so that apothecaries' or metric weight may be used, and a projecting shelf attached to the base forms a convenient receptacle for the weights.

2. Forms of Single Beam, Unequal Arm Balances—This type of balance is preferred for laboratory work when larger amounts are to be weighed. The principle upon which these very practical weighing machines are founded is based on the following law of physics, "*The power is to the weight or resistance in the inverse ratio of the length of the arms of the lever*". The inequality in the length of the arms of this beam permits of the convenient use of one movable weight upon the graduated longer arm of the beam, thus dispensing with the use of small weights, which are liable to be lost.

FIG. 11

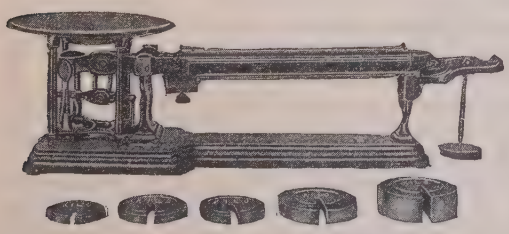


Ball scale

Troemner furnishes a convenient scale of this type for pharmacists' use. It is termed the "ball scale" (see Fig. 11). The beam is flat and perforated with five holes, which are about four inches apart; an iron ball is placed in one of these holes when a substance is to be weighed; the distance from the fulcrum of course determines the weight. It will weigh from ¼ oz. av. up to 16 pounds, and is furnished with an extra "sliding poise", to use in taring or balancing bottles when liquids are to be weighed. The purchaser of this scale need not buy a set of avoirdupois weights.

3. Double Beam, Unequal Arm Balances—This scale (see Fig. 12) is of great advantage in laboratory or manufacturing work because it is particularly adapted for weighing liquids, the weight on the one beam being used to tare the bottle or jar, while the other weight is left free so that it can be adjusted at once to the weight of the liquid desired. These are now to be had with the scale graduated either in the avoirdupois or in the metric system.

FIG. 12



Manufacturing laboratory scale

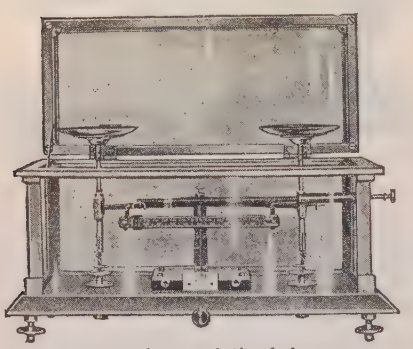
4. Compound Lever Balances—The principle of the compound lever was first applied in the construction of balances by Robervahl, of Paris, about A. D. 1660. It has been skilfully adopted for both prescription balances and the general counter and platform scales. The principal objection to this type of balance, when compared with single beam balances, consists in the multiplicity of points of contact and suspension, thus necessarily increasing friction and the liability to disarrangement; but

their general convenience and improvements in construction have brought them into favor. The principle of the Robervahl compound lever balance, with the arrangement of the levers, is shown in the box scale in Fig. 9.

One of the practical advantages possessed by this form of balance is the small amount of polished metal to keep in order, and, as the working parts are enclosed in a tight box of glass, wood, or marble, dust and corrosive vapors are largely excluded; as they are made to occupy as little space as possible, the pans are conveniently low and unobstructed.

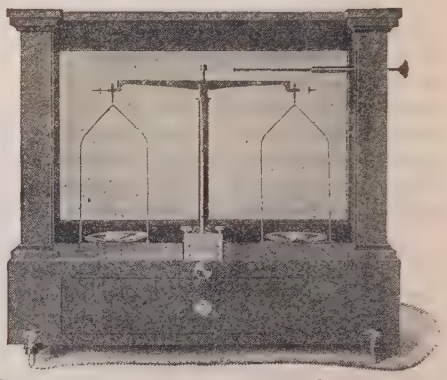
Box prescription scales, on the compound lever principle, have come into extensive use, and they are the most convenient scales for weighing moderately small quantities. The Troemner scale (Fig. 13), a Class A balance, is enclosed in bevel plate glass, the bearings are agate and the scale is provided with a side beam graduated from $\frac{1}{10}$ grain to 15 grains. Their strongest recommendation is the ease with which they may be cleaned and kept in order;

FIG. 13



Troemner's prescription balance

FIG. 14



Troemner's prescription balance

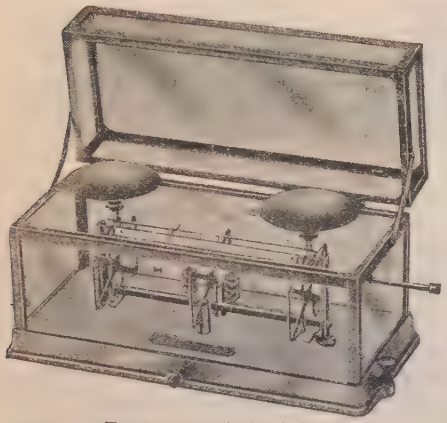
the only polished metal liable to be affected by corrosive vapors is found in the pans, and these are of solid nickel; a hinged glass cover effectually excludes dust and vapors when the balance is not in use. If a pharmacist has a delicate, single beam balance for weighing alkaloids and powerful poisons (see Fig. 14), and a box prescription scale for weighing ordinary quantities, he is well equipped for compounding prescriptions.

Torsion Balances—A simple illustration of the principle of torsion is afforded by tying a stout piece of cord to a firm support and inserting a lead pencil in the middle of the cord between the strands, at right angles to it. If the free end of the cord is tightly stretched, and the effort is made to turn the lead pencil over, it will be at once noticed that resistance is offered, and if the pencil is released, it at once flies back to its original position.

Torsion is the term applied to this method of twisting. The principle of supporting the beam of a balance upon a tightly stretched wire, with the view of doing away with knife edges and diminishing friction, occupied the attention of inventors for years. In 1882 Prof. Roeder and Dr. Springer contrived an ingenious torsion balance which gave promise of valuable results. Two illustrations of this original balance are shown on page 54 of the first edition of the "PRACTICE OF PHARMACY". Recent improvements have greatly increased its efficiency; the most important difficulty in applying the principle—that of torsional resistance—was overcome by the device of placing a weight just above the center of gravity, torsional resistance having the ten-

dency to keep the beam in a horizontal position, while the elevation of a weight above the center of gravity, by its tendency to produce unstable equilibrium (see page 42), exercises an opposite effect—that of inclining the beam to be top heavy, and therefore to tip on either side. If now the weight is made adjustable, by mounting it upon a perpendicular screw, so that it can be raised or lowered, it is possible to arrange these opposite forces so that one exactly neutralizes the other. In this manner sensitiveness is obtained.

Fig. 15



Torsion prescription balance

Fig. 16

Frame

Fig. 17

Frame with wire

In the torsion prescription balance (see Fig. 15) two beams are used, supported upon three frames, each of the latter having a flattened metallic band stretched tightly over its edge. Fig. 16 shows one of these frames, and Fig. 17 shows a frame with the wire stretched upon it. The form of the prescription balance is that of the box scale, enclosed in a glass case; a rider beam graduated upon the upper edge from $\frac{1}{8}$ of a grain to 10 grains and on its lower edge from 0.01 Gm. to 0.65 Gm., furnishes a very convenient means of weighing small quantities without having to use small weights. A base upon which the torsion balance may be placed, containing a drawer, is very convenient for holding weights, powder papers, etc.

The torsion principle has also been applied to analytical balances and scales designed to carry heavier loads, as well as counter scales.

Care of Balances—The necessity for protecting the delicate mechanism of a balance is frequently overlooked, notwithstanding the possibility of having a fine apparatus irretrievably ruined by lack of care in using or cleaning it or in protecting it while at rest. The position chosen for the balance or scales should be upon a level and firm counter, desk, or table, where it will be subjected to little risk of injury from dampness, dust, or corrosive vapors, and where the knife edges will not be liable to become dulled by jarring or other vibration.

In the finer class of balances, protection is afforded by enclosing them in glass cases having sash doors in the front and sometimes in the back. They are protected against injury from vibration by the use of a lever for elevating or locking the beam, so that the knife edges are not in contact with any surface whatever. To prevent injury from jarring while the balance is in use, by a weight falling on the pan, or other accident, the finest balances are provided with pan supports, which break the fall and serve the additional purpose of quickly arresting the beam, thus saving time while weighing.

In using a fine prescription balance neither the weights nor the substance that is to be weighed should be placed on the scale pans while the beam is free to oscillate. The desired weight should be placed upon one scale pan (usually the one on the right hand side) and an amount of the substance to be weighed, approximately the desired weight, placed upon the opposite pan. The beam

should then be released by means of the lever and if the substance is in excess, the beam should be locked and a small portion removed and the beam again released and the oscillations observed. This procedure should be repeated until the correct amount is obtained. In case of a deficiency of the substance to be weighed the reverse procedure is followed until the correct amount is obtained. With practice this can be very deftly and very quickly done and the sensitiveness of the balance retained for years.

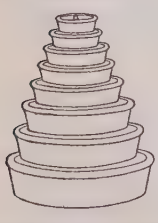
Such balances are often protected against injury from corrosive vapors by having some quicklime (unslaked lime), and some sulphuric acid in separate, open but properly protected, containers within the balance case. This protects from acid and alkaline vapors and also produces dehydration of the air in the case to a certain extent. The quicklime and acid must be frequently renewed to be effective.

Substances which act on metals, like iodine, corrosive sublimate, etc., and those which are adhesive, like the extracts, should not be weighed directly upon the scale pans, but upon counterpoised watch crystals, or, if these are not at hand, upon highly glazed paper, care being taken to balance the papers before weighing the substance. In cleaning the scales, great care should be exercised; polishing powders should be used sparingly; a portion is very apt to find its way into crevices and elude detection until an attempt is made to adjust the scales, when the increased weight of one of the sides of the beam leads to its discovery. Frequent cleaning with soft leather is generally sufficient to keep a balance in good order; but if through neglect it becomes necessary to use more active measures, some simple polishing powder for the silver and brass work, with soapsuds for nickel plate, and simple brushing for the lacquered brass, is all that is necessary.

Metallic Weights used in Pharmacy

The weights used by the pharmacist are a very important part of his outfit, and care in their selection and examination is necessary. False economy is particularly to be avoided, as the use of cheap, inaccurate weights must lead ultimately to serious consequences. Prescription weights have been found in use in drug stores by official inspectors so worn that the characters on their faces had disappeared, and, on the contrary, weights have been found with bits of hardened extract and dirt almost entirely obscuring their characters. An unused set of standard weights should be kept on hand, so that at least once a year the weights in daily use can be tested and adjusted or rejected if necessary.

FIG. 18

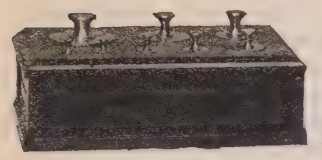


Common avoirdupois weights

Common avoirdupois weights are usually made of iron, and are of the flat, circular form (see Fig. 18), japanned to prevent rusting; these form a pyramidal pile, and range from half an ounce to four pounds; they may be adjusted if found to be incorrect by adding to or diminishing the amount of lead which is hammered into a depression in the base of each. These weights are sometimes made of brass in this form, and sometimes of zinc; the latter, however, are brittle and unserviceable. When used for general retail sales, the cylindrical weights, known technically as "block weights", are preferable (see Fig. 19). If the block is made of two kinds of wood glued together, so as to avoid shrinkage, they are very desirable, particularly if each cylindrical hole in the block has been made large enough to hold easily each weight. The advantages of block weights are, that the gaps left by missing weights are readily noticed, and that the greater surface of the weight is protected from

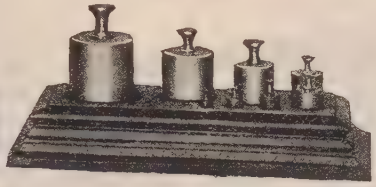
the action of corrosive vapors when not in use. When the weights are nickel plated, a more imposing appearance is produced by arranging them on an ebonized block in recesses (see Fig. 20). The disadvantage of this form is that the surfaces are not protected from oxidation, and they need cleaning more frequently.

Fig. 19



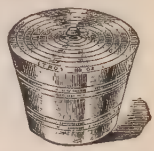
Block weights

Fig. 20



Cylindrical weights

Fig. 21

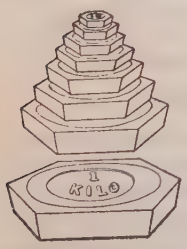


Cup troy weights

Troy weights may be had either as "block weights" or "cup weights"; the latter are to be preferred, particularly if the block avoirdupois weights are in use, for they are then easily distinguished from each other. The cup troy weights range from ¼ ounce to 32 ounces, and have many conveniences (see Fig. 21). When the outside weight is separated, it will be found to have the exact weight of all the rest; if one of the weights is missing, its absence is at once noticed in the incomplete nest, and their compact form is a great recommendation. Weights cannot well be made to occupy less space than these, while all the inside weights are protected from abrasion and corrosion.

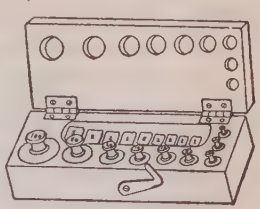
Metric weights may be procured of iron (japanned) for weighing larger quantities, when they are preferably hexagonal and flat in shape, to distinguish them from the ordinary round avoirdupois weights (see Fig. 22). The most useful form for the pharmacist's purposes are undoubtedly the brass weights. They are also supplied in the form of block weights, plainly marked to distinguish them from the avoirdupois weights of similar style. These usually range from 1000 grams to 10 grams. A small set made by Becker, and contained in a solid block, ranging from 0.01 gram to 100 grams, as shown in Fig. 23, is very reliable and convenient.

Fig. 22



Metric weights (iron)

Fig. 23



Metric weights (block)

For prescription purposes, a very inexpensive yet accurate set is made by Troemner, by which 50 grams may be weighed by using all the brass weights, while ample provision is made for weighing the fractional parts of a gram.

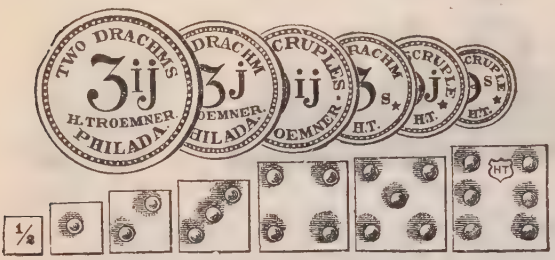
For analytical purposes, metric weights are almost exclusively used; usually the highest weight is 100 grams, the lowest 0.001 gram or 1 milligram. The weights, from one gram upward, are of brass, finely lacquered; the smaller weights are made of squares of platinum foil, with one corner turned up, to permit of their being easily handled with the forceps. Fractions of a milligram are weighed by means of the rider upon the graduated beam of the balance.

In analytical work and in using the Class A balance in prescription work, the weights should never be handled with the fingers but always with the forceps which accompany a fine and accurate set of weights. In the more expensive sets of weights the forceps are tipped with bone or ivory to prevent

the wearing away of the weights during handling. With proper care the accuracy of a fine set of weights may be maintained for years.

Prescription weights.—Too much care can hardly be exercised in the selection of weights to be used in compounding prescriptions. The cost of accurate weights is trifling, yet weights have been found by inspectors in this line of investigation which are disgracefully inaccurate. The round, flat, brass "drachm" weights, which have the denomination stamped distinctly on their faces in raised characters, are most generally used (see Fig. 24). These range from 10 grains to 120 grains in weight. Brass weights of similar shape ranged according to units of the decimal system are also available, and are frequently used. The old fashioned square brass "drachm" weights have passed out of use. The brass foil grain weights are very unsatisfactory, and should not be employed, because of their liability to corrosion. Undoubtedly the best grain weights are the aluminum wire weights. These are more easily and quickly distinguished from one another

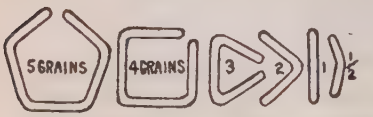
Fig. 24



Troy prescription weights

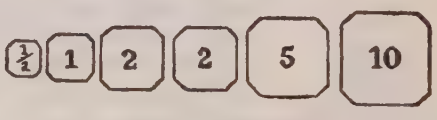
than any other form, and there is less likelihood of dangerous mistakes than from the flat weights, where the denomination is stamped upon the face, often faintly, and is liable to be obliterated by constant use or by corrosive contact. The number of sides in the wire weights at once gives the denomination (see Fig. 25). The shapes of these wire weights are so distinctive, and they are so easily handled, that they should be invariably used. The aluminum grain weights, cut out of aluminum plates, are to be preferred to the flat, brass grain weights, because they are less liable to corrosive action. They are usually more accurately adjusted; the corners of the weights are clipped, and each weight is usually pressed into a curved form, so that it may be easily picked up (see Fig. 26).

Fig. 25



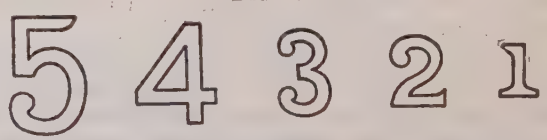
Aluminum wire weights

Fig. 26



Aluminum grain weights

Fig. 27



Aluminum grain weights

In still another form of aluminum grain weights the outlines of the arabic numerals themselves are stamped from sheet aluminum (see Fig. 27).

Measuring Liquids—Tinned iron measures nearly cylindrical in shape, but slightly wider at the bottom, are generally used for measuring liquids when the quantity is over a pint. A set of these measures usually consists of five (gallon, half-gallon, quart, pint, and half-pint). Those made of tinned iron, or of the

enameled sheet iron called agate ware, are greatly inferior to those made of *tinned copper*. Tinned iron measures soon become rusty, and although a protection is afforded if enameled, particles of the enamel chip off, and the exposed iron soon contaminates the liquids measured in them. The first cost of copper measures is greater than tinned iron, but they are far more durable. Care must be taken to protect them from blows which will cause dents, as these may be serious enough to detract from the accuracy of the measures. Fig. 28 shows copper measures of the usual form. Cylindrical metric measures having a diameter just half their height, of tinned copper or brass, in sets of ten, including dekaliter, half-dekaliter, double liter, liter, half-liter, double deciliter, deciliter, half-deciliter, double centiliter, and centiliter are obtainable (see Fig. 29). Copper measures of unusual design are made by H. Sherman, of Philadelphia (see Fig. 30). These have the merit of being less liable to error in measuring and less likely to spill than those of ordinary shape, because of the contracted surface at the top, also alcoholic liquids evaporate less from these than from other types of measures.

Fig. 28

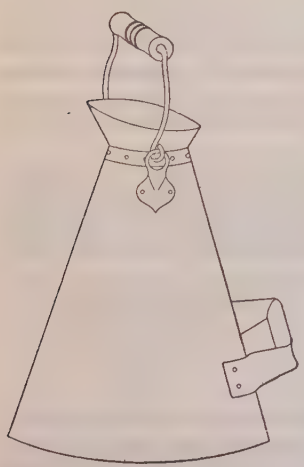
Copper measures

Fig. 29

Metric measures

Fig. 31 illustrates a form of copper measure much used in measuring oils. The flexible outlet tube permits the delivery of the liquid without danger of spilling.

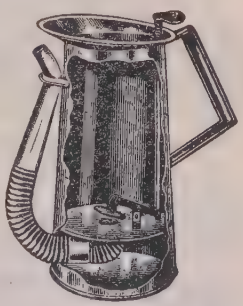
Fig. 30



Special copper measure

Glass measures are preferred for relatively small quantities of liquids, for, although always subject to loss from breakage, they can be more accurately adjusted to indicate the measure. On account of the transparency of glass, the level of the liquid at any height may be seen through the measure, while it is possible to measure accurately with opaque vessels only when they are completely filled.

Fig. 31



Copper measure with outlet

Glass graduated measures are almost exclusively used for quantities of one pint or less, and are of two forms—*conical* and *cylindrical*. The conical graduate is preferred in practical work because of the greater ease with which it can be cleaned, but cylindrical measures are more accurate because of their uniform and smaller average diameter. Thus, if a conical graduated measure has at the 3 fl. oz. mark a diameter of 3 inches (see Figs. 32 and 33), and the cylindrical graduate (see Fig. 34) a diameter at the same mark of

1 inch, it follows that a trifling error in reading the quantity in the cylindrical graduate, either slightly above or below the line, would be increased if similarly made in the conical graduate by exactly the number of times that the surface of the liquid in the conical graduate exceeds that in the cylindrical graduate at the given point. Graduates for prescription use are now always

FIG. 32

Conical metric graduate

FIG. 33

Conical apothecaries graduate

FIG. 34

Cylindrical graduate

graduated by hand, the former moulded graduates not meeting the specifications of the Bureau of Standards.

Bureau of Standards—*Specifications for Glass Graduates.* 1. Graduates shall be made to contain or to deliver the indicated volume at 20° C. (68° F). They shall be legibly, conspicuously, and permanently marked to indicate whether they are graduated to contain or to deliver.

2. Graduates shall be either cylindrical or conical in shape. In the case of all cylindrical graduates the ratio of length of the graduated scale to the internal diameter shall not be less than five to one. In the case of conical graduates the ratio of length of the graduated scale to the internal diameter at the highest graduation shall not be less than two to one, and at one-fourth of the total capacity this ratio shall not be less than one to one.

3. Graduates shall be made of good quality glass, thoroughly annealed, clear, transparent, of uniform but not excessive thickness, and free from bubbles and streaks.

4. Graduates shall be provided with a base at right angles to the axis and of such a diameter that the graduate will stand when placed on a surface making an angle of 25 per cent, or approximately 15°, with the horizontal.

5. All graduates shall be provided with pouring lips.

6. The graduation marks shall be perpendicular to the axis, and parallel to the base and to each other.

7. The graduation marks shall be varied in length in such a manner that they may be conveniently read, but in no case shall any graduation mark extend less than one-fourth of the distance around the graduate. The main graduation marks shall extend at least one-half of the distance around the graduate, provided, however, that on duplex, or double-scale, graduates a clear space shall be left between the ends of the main graduation marks on the two scales, and this space, measured parallel to the graduation marks, shall conform to the following values:

Circumference of graduate at the graduation marks	Distance between ends of graduation marks
	Inch
Up to 5 inches	1/3
From 5 to 10 inches, inclusive	1/4
More than 10 inches	3/8

8. Graduation marks shall be clear and distinct and uniform in character. They shall be etched or engraved, and shall not exceed 0.015 inch (0.38 mm.) in width. Blown or pressed graduation marks shall not be allowed.

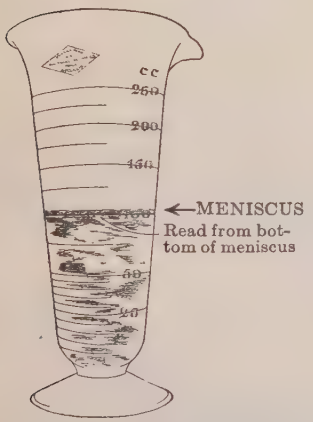
9. The clear interval between the graduation marks shall not be less than 0.04 inch (1 mm.).

10. The value of the main graduation marks shall be plainly designated, each number being placed either directly upon or immediately above the graduation mark to which it refers, but the position of the numbers shall be consistent throughout the graduated scale. If placed upon the graduation marks, the numbers shall be placed from the ends a sufficient distance to allow the ends to be used in making a setting. Intermediate graduation marks shall not be numbered.

11. On all single-scale graduates, where the main graduation marks do not completely encircle the graduate, the middle points of the main graduation marks shall be directly opposite the lip. On duplex, or double-scale, graduates the center of the clear spaces between the ends of the main graduation marks, provided for in specification 7, shall be approximately 90° from the lip.

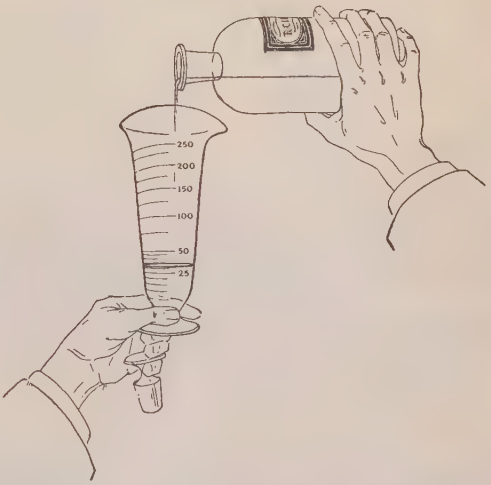
Moulded graduates are sometimes seen for use in preparing solutions for photographic purposes but are not accurate. At this time all graduates made by reliable firms bear a guarantee of accuracy and the name of the manufacturer. Graduation in both the apothecaries and the metric system on opposite sides of a graduate, at one time frequently seen, is no longer permitted by some laws governing weights and measures. When an aqueous or alcoholic liquid is poured into a graduate, which has the form of a cylinder, capillary

Fig. 35



Reading meniscus

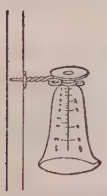
Fig. 35a



Measuring in a graduate

attraction causes its surface to become concave, *i.e.*, that portion in contact with the vessel is drawn upward. This phenomenon is known as the formation of a *meniscus* (See Fig. 35), and in determining the volume of a liquid *the reading must be made at the bottom of this meniscus.* This regulation has been established by the U. S. Bureau of Standards and all glass measuring vessels are graduated upon this basis.

Fig. 36



Graduate hook

When pouring into a graduate from a stock bottle the graduate should be taken in the left hand, as illustrated in Fig. 35a. The shelf bottle is then grasped with the right hand with the label in such a position that after pouring, any excess of liquid will not soil the label should it run down the side of the bottle.

The stopper is now removed with the free fingers of the left hand, while still holding the graduate; the graduate is raised and held so that the graduation point to be read is on a level with the eye, and the liquid then measured.

Fig. 37

Minim pipette

The next move replaces the stopper, and the bottle may then be returned to the counter or shelf. Finally the liquid is poured into the bottle or mortar, for dispensing or compounding. Notice that the graduations are etched upon the glass measure in such a position that the entire operation, including measuring and pouring from the graduate, may be conducted without taking the graduate from the left hand, only tilting it.

Glass measuring vessels, larger than 1 pint or 500 cc., are usually in the form of a jar (see Fig. 414).

Fig. 36 shows a simple method of supporting a graduate after cleaning it. A brass hook is screwed into an upright, preferably over the sink; the prongs are so adjusted that they easily catch the graduate base. An excellent form of graduate rack is illustrated in Part XI, under "the sink".

The extension of the graduating mark into a circle which passes entirely around the graduate is an improvement which obviates the necessity of placing the graduate upon a level place, as the corresponding mark upon the opposite side may be seen through the glass, and the graduate easily leveled even when held in the hand. For measuring smaller quantities of liquids, graduated glass tubes of much less diameter should be used. Minim pipettes are more accurate and convenient than conical minim graduates, and the operation is more cleanly. The graduations on the minim measure are necessarily in the narrowest and lowest portion of a comparatively tall measure. Now, if it is desired to measure 10 minims of a volatile oil the surface which the oil must traverse when this measure is inverted is so great that probably 20 per cent of the oil will be left adhering to the measure. In those instances of liquid preparations where the smaller liquid is miscible with the larger quantity of diluting liquid, the minim graduate may be rinsed and this loss recovered, but inconveniences are largely overcome and greater accuracy secured by the use of a minim pipette (see Fig. 37).

In administering small quantities of liquids, the very convenient *drop* is almost always used. The impression that a drop is equivalent to a minim, and that sixty drops of any fluid are equivalent to a fluidrachm, is widespread. This impression doubtless arose from the fact that sixty ordinary drops of *water* are about equal to a fluidrachm; but many circumstances cause variations in the relative size of drops. Thick viscous liquids, like the mucilages and the syrups, necessarily produce large drops, because the drop adheres to the surface of the glass so long as its weight does not overcome its power of adhesion, while bromine and chloroform, heavy, mobile liquids, having very little adhesion to the dropping surface, produce very small drops, only one-fifth the size of the drop of syrup of acacia. The shape and surface of the vessel from which the liquid is dropped also have an influence in determining the size of the drop. The greater the extent of surface to which the drop adheres, the larger, proportionally, will be the drop.

A "normal" or "standard" drop measure was recommended by the Brussels Conference of 1902 for International adoption. The external diameter of the outlet tube of this *normal dropper* shall be exactly 3 millimeters and so adjusted that at a temperature of 15° C., it shall yield 20 drops of distilled water, weighing 1 Gm.

In the opinion of the Committee of Revision of the Pharmacopœia such a dropper did not seem to be practicable or necessary and was not adopted.

It is believed that the measurement of small volumes of liquids through the use of graduated pipettes (see Fig. 339), is more reliable, when accuracy is required, than through the use of even a standard dropper. This is evidently the opinion of the majority of pharmacists and chemists since a standard dropper has never gained popularity in the United States.

If drops are specified on a prescription, the usual custom is to employ an "eye dropper" shaped much like the minim pipette in Fig. 37.

CHAPTER IV

SPECIFIC GRAVITY

Specific gravity is the ratio of the weight of a given substance to the weight of an equal bulk of a standard substance.

The substance taken as a standard is *water* for solids or liquids, and *air* for hydrogen or gases.

The weights of bodies being obviously in proportion to their masses, the specific gravity of a substance is equivalent to its relative density, and the term *density* has replaced the term *specific gravity* in many scientific works. Density is sometimes briefly defined as "mass per unit volume." The terms density, usually abbreviated "D", and specific gravity, usually abbreviated "Sp. Gr." may be considered as synonymous.

If great accuracy is required, corrections must be made for differences in temperature and for the buoyancy of the air. The latter variation, being slight, is usually disregarded, but temperature is so important that a statement of the fact is usually included in the definition, as follows: *Specific gravity is the weight (or mass) of one body compared with the weight (or mass) of an equal bulk or volume of another body selected as the standard, both bodies having the same temperature, or the temperature of each being definitely known.*

Absolute specific gravity, for solids or liquids, is taken or calculated at the temperature of 4° C. (39.2° F.), which is the temperature of the maximum density of water. *Apparent specific gravity,* as it is called, is the kind of specific gravity that is ordinarily taken in scientific work, and may be taken at any other temperature, but the temperature should always be stated. Sometimes for purposes of convenience specific gravities are taken in which the instrument is not standardized at the same temperature as that of the substance at the time the specific gravity is being taken. Such facts are recorded in a definite manner as illustrated by the following:

Specific gravity at 4°/4° means absolute specific gravity.
Specific gravity at 25°/25° means specific gravity at 25° C.
Specific gravity at 25°/4° means that the specific gravity has been taken at 25° C. but that the pycnometer or hydrometer has been standardized at 4° C. Other similar combinations may be interpreted in the light of the above explanations.

The official temperature for taking specific gravities in pharmacy is 25° C., the official temperature recognized by the U. S. Pharmacopœia for most chemical and physical operations. There is one important exception to this in the case of alcoholic liquids, in which the temperature is 15.56° C., (60° F.), as this temperature was legally adopted many years ago by the United States Government for determining alcoholic strengths for excise purposes, and has never been changed.

Specific gravities are always expressed decimally. Thus, if a certain volume of water is weighed and then the same volume of chloroform, the latter is found to be nearly half again as heavy as the former and it is expressed as a decimal unit and fraction thus: 1.475, meaning that it is one and four hundred and seventy-five thousandths times as heavy as water. Taking a lighter substance for an example, it is found that oil of turpentine is not nearly as heavy as water and the specific gravity of a specimen of this substance is expressed as 0.860, which means that it is only eight hundred and sixty thousandths as heavy as water.

The heaviest metal known has a specific gravity of 22.48; it is the rare metal osmium. To give a comparative idea of some commoner metals, ordinarily recognized as being heavy, it is found that gold has a specific gravity of 19.32 and lead has a specific gravity of 11.34.

The lightest metal known has a specific gravity of 0.534; it is the rare element lithium. Somewhere between these two extremes will be found the specific gravities of the thousands of substances, both liquid and solid, which are of importance in pharmacy.

The specific gravities of liquids concern the pharmacist much more than the specific gravities of solids.

The principle of taking specific gravities of either liquids or solids is precisely the same. The object sought is the weight of a bulk or volume of water equal to that of a convenient quantity of the body of which the specific gravity is to be taken.

This may be expressed by a simple algebraic formula made up of factors as follows:

W = Weight of object
W^1 = Weight of equal bulk of water.
Sp. Gr. = Specific gravity.

The formula exemplifying the underlying principles discussed above is:

$$\text{Sp. Gr.} = \frac{W}{W^1}$$

From this may be deduced the following:

$$W = \text{Sp. Gr.} \times W^1$$

$$W^1 = \frac{W}{\text{Sp. Gr.}}$$

From these three equations all specific gravity calculations may be simply and easily made.

The principal difficulty with specific gravity calculations and the reason why some students find them hard to comprehend is found in the fact that, except when metric system units are used, there are complicated preliminary calculations usually necessary, because of the lack of commensurability of the units previously mentioned under the theory of weights and measures.

If the principles of specific gravity are once thoroughly learned in connection with calculations in the metric system, little difficulty will be experienced later in making any application of them desired if the other systems of weights and measures are accurately known, and their relations to each other perfectly understood.

Take for example a substance in which 100 cc. weighs exactly 150 Gm.; the preceding equation can be applied:

$$\text{Sp. Gr.} = \frac{W}{W^1} \text{ or Sp. Gr.} = \frac{150}{100} \text{ or } 1.50$$

The specific gravity is found to be 1.50, but if a substance is taken of which one fluidounce weighs one and one-half ounces avoirdupois, no simple method of calculation is possible, for each factor must be reduced to the only common unit, the grain, and the equation is much more complicated, as shown by the following:

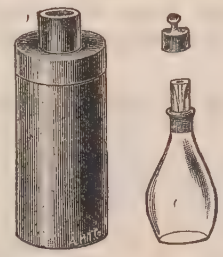
$$\text{Sp. Gr.} = \frac{W}{W^1} \text{ or Sp. Gr.} = \frac{437.5 \times 1.5}{454.6} \text{ or } 1.44+$$

The temperature directed in the U. S. P. is 25° C. (77° F.). When not specified, it is understood to mean 25° C. (77° F.); but in many investigations, particularly those conducted in Europe, the temperature selected is that of the maximum density of water, 4° C. (39.2° F.). For practical purposes the temperature adopted by the Pharmacopœia is most useful in the latitude of the United States.

Specific Gravity of Liquids

The *specific gravity bottle* (*pycnometer* or *pyknometer*) is the most accurate instrument for taking the specific gravity of liquids. Figs. 38 and 39 show several types commonly used. Some of these are provided with counterpoise weights which exactly balance the empty bottle. In most cases, however, the actual weight of the bottle (called the "*tare*") must be previously ascertained, and this weight subtracted each time a specific gravity is taken. For very accurate work, and especially in the determination of alcoholic strength, the pycnometer is equipped with a thermometer, so that the weighing may be quickly accomplished when the exact temperature is reached at which the specific gravity is to be taken. Any ordinary flask or bottle may be used for taking the specific gravity of a liquid if it can be accurately weighed and if it has been standardized by ascertaining the weight of water contained at the standard temperature, when filled to a mark previously made on the neck of the container.

Fig. 38



Specific gravity bottle with tare

Fig. 39

Specific gravity bottle with thermometer

It is usually found advisable to employ pycnometers which at the standard temperature hold some simple unit volume of water as 100 Gm., 50 Gm., 25 Gm., 10 Gm., or 5 Gm., or 1000 grains or 100 grains if the metric system is not used.

This simplifies calculating very much as will be seen by an example. A pycnometer or bottle, weighing 20.613 Gm. when empty, holds exactly 25 Gm. of water at 25° C. When filled with simple syrup, the official strength of which is under question, it weighs 51.863 Gm. Subtracting the tare of the bottle, 20.613 Gm., we find the weight of the syrup to be 31.250 Gm., and dividing this by 25, the weight of water which the bottle holds, the specific gravity is found to be 1.25 and the syrup is therefore below standard, for its specific gravity should not be below 1.313. (See also page 76 and Part XVI.)

Hydrometers

A *hydrometer* is a floating instrument which is used to indicate the specific gravity of a liquid by sinking to a depth corresponding to the density of the liquid. Its principle of action was probably first made known by Archimedes, and depends upon the fact that when a solid body is placed in a liquid in which it is capable of floating, it sinks to a certain point, and this floating point is reached when the body has displaced a volume of liquid exactly equal to its own weight. Hydrometers may be divided into two classes for convenience of study: 1. Those in which the weight is constant, but the depth of immersion subject to change. 2. Those in which the depth of immersion is constant, but the weight subject to change. To the first class belong nearly all the hydrometers especially useful to pharmacists, and of these, two kinds are generally used, one for liquids heavier, the other for those lighter, than water. The best hydrometers now in use are constructed so as to indicate directly the specific gravity when used at the proper temperature. The earliest hydrometers were devised for use in manufacturing operations conducted by unskilled and uneducated workmen who could not be depended upon to remember decimal fractions or observe distinctions based on small decimal differences,

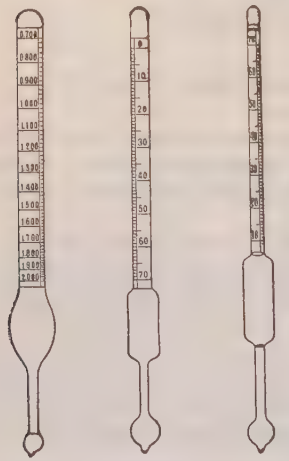
but who could be taught to use hydrometers in which an arbitrary scale consisting of whole numbers was employed.

Many such arbitrary scale hydrometers have been in use. The most important one is Baumé's. Several of lesser importance are Twaddell's and Gay-Lussac's and Brix's. To the second class belong the hydrometers which are intended to sink, by the addition of weights, to a given mark on the stem, and thus displace a constant volume, like Fahrenheit's, Nicholson's, Guyton de Morveau's, etc. These are seldom seen except in physical laboratories or in lecture counter experiments, to illustrate a principle.

1. Hydrometers in which the weight is constant, but the depth of immersion subject to change.

Specific Gravity Hydrometers—This form of hydrometer (see Fig. 40) is coming into more frequent use. It is capable of registering specific gravity accurately to the third decimal place. A series of instruments is needed to cover the entire practical working range which is from 0.700 to 2.000.

FIG. 40 FIG. 41 FIG. 42



Specific gravity hydrometer | Baumé's hydrometer for heavy liquids | Baumé's hydrometer for light liquids

Baumé's Hydrometers—This form was the first one of its class to come into general use, having been originally described by Baumé in his "*Éléments de Pharmacie.*" Two instruments were used by Baumé, one for liquids heavier than water, the other for liquids lighter than water. This type of hydrometer, as now made, consists of a glass tube loaded at the bottom with mercury or small shot, having a bulb blown in it just above the loaded end.

A cylindrical tube, loaded so as to cause it to assume an upright position in a liquid, may be used as a hydrometer. The only advantage gained in expanding the lower portion into bulbs is one of convenience, that of increasing the volume of the hydrometer, and thus permitting the use of shorter instruments. The graduations upon the stem of Baumé's hydrometer are called degrees. They are entirely arbitrary, and were made in the following manner:

For the hydrometer to be used for *liquids heavier than water* (See Fig. 41), sufficient mercury was added to the lower bulb to cause it to sink in water to a convenient point near the top of the stem; this was marked 0. The instrument was then placed in a solution containing 15 per cent by weight of common salt, and the point at which it rested was marked 15. The space between these two points was divided into fifteen equal parts, and the scale below was extended by marking off similar spaces. *For liquids lighter than water* (see Fig. 42), the instrument was placed in a 10 per cent by weight solution of common salt, and loaded so that it floated at a point just above the bulb; this was marked 0. The hydrometer was then transferred to water, the point at which it rested was marked 10, the space between was divided into ten equal parts, and the scale above was extended by marking off similar spaces.

Formulas are available for converting Baumé's degrees into specific gravity by a simple calculation. The following is the formula of the U. S. Bureau of Standards for calculating degrees Baumé from specific gravity.

For liquids heavier than water:

$$°B. = 145 - \frac{145}{\text{Sp. Gr.} \times \frac{60°}{60°}\text{F.}}$$

For liquids lighter than water:

$$°B. = \frac{140}{\text{Sp. Gr.} \times \frac{60°}{60°}\text{F.}} - 130$$

A close approximation, in which temperature is disregarded, may be obtained from the following formulas for calculating specific gravities from degrees Baumé, taken from *Moerk's Analytical Chemistry*.

For liquids heavier than water:

$$\text{Sp. gr.} = 145 \div 145 - °B.$$

For liquids lighter than water:

$$\text{Sp. gr.} = 140 \div 130 + °B.$$

The Bureau of Standards has coöperated with the American Petroleum Institute to standardize a slightly different scale for liquids lighter than water. This scale is based upon the following formula:

$$\text{Degrees A. P. I.} = \frac{141.5}{\text{Sp. Gr.} \times \frac{60°}{60°}\text{F.}} - 131.5$$

Specific gravities at $\frac{60°}{60°}$ F. $\left(\frac{15°.56}{15°.56}\text{ C.}\right)$ corresponding to degrees Baumé for liquids heavier than water.

[Calculated from the formula, specific gravity $\frac{60°}{60°}$ F. $= \frac{145}{145 - \text{Deg. Baumé}}$]

Deg. Baumé	Specific Gravity	Deg. Baumé	Specific Gravity	Deg. Baumé	Specific Gravity	Deg. Baumé	Specific Gravity
0.5	1.0035	19.0	1.1508	37.5	1.3488	56.0	1.6292
1.0	1.0069	19.5	1.1554	38.0	1.3551	56.5	1.6384
1.5	1.0105	20.0	1.1600	38.5	1.3615	57.0	1.6477
2.0	1.0140	20.5	1.1647	39.0	1.3679	57.5	1.6572
2.5	1.0175	21.0	1.1694	39.5	1.3744	58.0	1.6667
3.0	1.0211	21.5	1.1741	40.0	1.3810	58.5	1.6763
3.5	1.0247	22.0	1.1789	40.5	1.3876	59.0	1.6860
4.0	1.0284	22.5	1.1837	41.0	1.3942	59.5	1.6959
4.5	1.0320	23.0	1.1885	41.5	1.4010	60.0	1.7059
5.0	1.0357	23.5	1.1934	42.0	1.4078	60.5	1.7160
5.5	1.0394	24.0	1.1983	42.5	1.4146	61.0	1.7262
6.0	1.0432	24.5	1.2033	43.0	1.4216	61.5	1.7365
6.5	1.0469	25.0	1.2083	43.5	1.4286	62.0	1.7470
7.0	1.0507	25.5	1.2134	44.0	1.4356	62.5	1.7576
7.5	1.0545	26.0	1.2185	44.5	1.4428	63.0	1.7683
8.0	1.0584	26.5	1.2236	45.0	1.4500	63.5	1.7792
8.5	1.0623	27.0	1.2288	45.5	1.4573	64.0	1.7901
9.0	1.0662	27.5	1.2340	46.0	1.4646	64.5	1.8012
9.5	1.0701	28.0	1.2393	46.5	1.4721	65.0	1.8125
10.0	1.0741	28.5	1.2447	47.0	1.4796	65.5	1.8239
10.5	1.0781	29.0	1.2500	47.5	1.4872	66.0	1.8354
11.0	1.0821	29.5	1.2554	48.0	1.4948	66.5	1.8471
11.5	1.0861	30.0	1.2609	48.5	1.5026	67.0	1.8590
12.0	1.0902	30.5	1.2664	49.0	1.5104	67.5	1.8710
12.5	1.0943	31.0	1.2719	49.5	1.5183	68.0	1.8831
13.0	1.0985	31.5	1.2775	50.0	1.5263	68.5	1.8954
13.5	1.1027	32.0	1.2832	50.5	1.5344	69.0	1.9079
14.0	1.1069	32.5	1.2889	51.0	1.5426	69.5	1.9205
14.5	1.1111	33.0	1.2946	51.5	1.5508	70.0	1.9333
15.0	1.1154	33.5	1.3004	52.0	1.5591	70.5	1.9468
15.5	1.1197	34.0	1.3063	52.5	1.5676	71.0	1.9595
16.0	1.1240	34.5	1.3122	53.0	1.5761	71.5	1.9728
16.5	1.1284	35.0	1.3182	53.5	1.5847	72.0	1.9863
17.0	1.1328	35.5	1.3242	54.0	1.5934	72.5	2.0000
17.5	1.1373	36.0	1.3303	54.5	1.6022	73.0	2.0139
18.0	1.1417	36.5	1.3364	55.0	1.6111		
18.5	1.1462	37.0	1.3426	55.5	1.6201		

Specific gravities at $\frac{60°}{60°}$ F. $\left(\frac{15°.56}{15°.56}\text{ C.}\right)$ corresponding to degrees Baumé for liquids heavier than water.

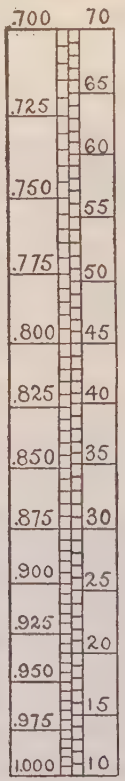
[Calculated from the formula, specific gravity $\frac{60°}{60°}$ F. $= \frac{140}{130 + \text{Deg. Baumé}}$]

Deg. Baumé	Specific Gravity	Deg. Baumé	Specific Gravity	Deg. Baumé	Specific Gravity	Deg. Baumé	Specific Gravity
10.0	1.0000	33.0	0.8589	56.0	0.7527	79.0	0.6699
10.5	0.9964	33.5	0.8563	56.5	0.7507	79.5	0.6683
11.0	0.9929	34.0	0.8537	57.0	0.7487	80.0	0.6667
11.5	0.9894	34.5	0.8511	57.5	0.7467	80.5	0.6651
12.0	0.9859	35.0	0.8485	58.0	0.7447	81.0	0.6635
12.5	0.9825	35.5	0.8459	58.5	0.7427	81.5	0.6619
13.0	0.9790	36.0	0.8434	59.0	0.7407	82.0	0.6604
13.5	0.9756	36.5	0.8408	59.5	0.7388	82.5	0.6588
14.0	0.9722	37.0	0.8383	60.0	0.7368	83.0	0.6573
14.5	0.9689	37.5	0.8358	60.5	0.7349	83.5	0.6557
15.0	0.9655	38.0	0.8333	61.0	0.7330	84.0	0.6540
15.5	0.9622	38.5	0.8309	61.5	0.7311	84.5	0.6527
16.0	0.9589	39.0	0.8284	62.0	0.7292	85.0	0.6512
16.5	0.9556	39.5	0.8260	62.5	0.7273	85.5	0.6497
17.0	0.9524	40.0	0.8235	63.0	0.7254	86.0	0.6482
17.5	0.9492	40.5	0.8211	63.5	0.7235	86.5	0.6467
18.0	0.9459	41.0	0.8187	64.0	0.7216	87.0	0.6452
18.5	0.9428	41.5	0.8163	64.5	0.7198	87.5	0.6437
19.0	0.9396	42.0	0.8140	65.0	0.7179	88.0	0.6422
19.5	0.9365	42.5	0.8116	65.5	0.7161	88.5	0.6407
20.0	0.9333	43.0	0.8092	66.0	0.7143	89.0	0.6393
20.5	0.9302	43.5	0.8069	66.5	0.7125	89.5	0.6378
21.0	0.9272	44.0	0.8046	67.0	0.7107	90.0	0.6364
21.5	0.9241	44.5	0.8023	67.5	0.7089	90.5	0.6349
22.0	0.9211	45.0	0.8000	68.0	0.7071	91.0	0.6335
22.5	0.9180	45.5	0.7977	68.5	0.7053	91.5	0.6321
23.0	0.9150	46.0	0.7955	69.0	0.7035	92.0	0.6306
23.5	0.9121	46.5	0.7932	69.5	0.7018	92.5	0.6292
24.0	0.9091	47.0	0.7910	70.0	0.7000	93.0	0.6278
24.5	0.9061	47.5	0.7887	70.5	0.6983	93.5	0.6264
25.0	0.9032	48.0	0.7865	71.0	0.6965	94.0	0.6250
25.5	0.9003	48.5	0.7843	71.5	0.6948	94.5	0.6236
26.0	0.8974	49.0	0.7821	72.0	0.6931	95.0	0.6222
26.5	0.8946	49.5	0.7799	72.5	0.6914	95.5	0.6208
27.0	0.8917	50.0	0.7778	73.0	0.6897	96.0	0.6195
27.5	0.8889	50.5	0.7756	73.5	0.6880	96.5	0.6181
28.0	0.8861	51.0	0.7735	74.0	0.6863	97.0	0.6167
28.5	0.8833	51.5	0.7714	74.5	0.6846	97.5	0.6154
29.0	0.8805	52.0	0.7692	75.0	0.6829	98.0	0.6140
29.5	0.8778	52.5	0.7671	75.5	0.6813	98.5	0.6127
30.0	0.8750	53.0	0.7650	76.0	0.6796	99.0	0.6114
30.5	0.8723	53.5	0.7630	76.5	0.6780	99.5	0.6100
31.0	0.8696	54.0	0.7609	77.0	0.6763	100.0	0.6087
31.5	0.8669	54.5	0.7588	77.5	0.6747		
32.0	0.8642	55.0	0.7568	78.0	0.6731		
32.5	0.8616	55.5	0.7547	78.5	0.6715		

It must be borne in mind, however, that the hydrometer cannot be as accurate an instrument for taking specific gravity as the pycnometer or specific gravity bottle. The adhesion of air bubbles when in use and the consequent buoyant and error-producing effect, the liability to variation in the diameter of the stem, the inaccuracies in the scale, and the difficulties of adjusting it to give correct readings are the principal disadvantages of hydrometers.

FIG. 43

FIG. 44



Scales of specific gravity hydrometer

In the illustrations shown in Figs. 43 and 44, the arbitrary scale of Baumé, made up of equal spaces, is shown immediately in contact with a specific gravity scale. The spaces of the latter gradually increase in size from below upward, and the highest space is nearly four times the size of the lowest. Before any hydrometer is accepted for use, it should be tested by floating it in water at the temperature indicated on the hydrometer, and, the specific gravity of several liquids having been ascertained carefully by the specific gravity bottle, the hydrometer should be floated in the same liquids, and any deviation carefully noted. A hydrometer which registers uniformly one or two points too low or too high need not be rejected, because the error can be added or subtracted each time and the constant error marked on the box for a memorandum; but if an error of any magnitude must be added to one part of the scale, and another subtracted from another part, it is economy to reject the instrument at once. Hydrometers are usually floated in tall, cylindrical, glass jars (see Fig. 45), and it is frequently necessary to cool the liquid by placing the jar in ice water after inserting a thermometer, and, after the temperature has been lowered to the desired degree, observing the point to which the hydrometer sinks in the liquid. The U. S. Bureau of Standards has established a definite reading point for hydrometers. This is described as follows in circular No. 16. *The Testing of Hydrometers.* "In reading the hydrometer scale the eye is placed slightly below the plane of the surface of the test liquid; it is raised slowly until the surface, seen as an ellipse, becomes a straight line. The point where this line cuts the hydrometer scale should be taken as the reading of the hydrometer". It is usually best to cool the liquid below the standard temperature adopted for the hydrometer, and then, after wiping the jar, the correct higher temperature may be gradually obtained by holding the jar in the hands until the temperature rises to the desired point. A hydrometer having an elongated bulb with cylindrical sides, as shown in Fig. 46, is more likely to give a false indication if permitted to touch the sides of the jar than one having an oval or globular

FIG. 46

Hydrometer with elongated bulb

FIG. 45

Hydrometer jar

bulb (see Fig. 40); the latter can touch the jar at only one point, and hence can move freely up and down, while the former may have one side touching the side of the jar for its entire length. To obviate this, Doctor Squibb suggested the use of a jar with four perpendicular indentations in it, and a hydrometer having an oval bulb (see Fig. 47). The points of contact between the urinometer bulb and the indentations in the jar are best shown in the transverse sectional view immediately below the cut of the urinometer.

Fig. 47

Urinometer and jar (Squibb)

The *urinometer* (see Fig. 47) is one of the most useful special applications of the hydrometer; as its name indicates, it is used to take the specific gravity of urine (see Chapter on Urinalysis); a special scale, which is easily understood, is sometimes used. The very delicate stem, which hardly permits of the use of specific gravity figures, is divided into sixty spaces, numbered 10 to 60; by adding 1000 to each of these numbers, and pointing off three decimal places from the right, the true specific gravity is shown. In Doctor Squibb's urinometer the specific gravity is indicated without abbreviation, the number uppermost on the scale being 1.000, the lowest 1.060, the intervening figures being 1.010, 1.020, 1.030, 1.040, and 1.050.

The *saccharometer* is intended to take the specific gravity of syrups. The scale is sometimes graduated so as to indicate the percentage of sugar in solution, rarely the actual specific gravity; sometimes Baumé's scale (*pèse-sirop*) is used as is also the hydrometer of Brix. The *eleometer*, a very delicate instrument, is used to take the specific gravity of fixed oil. The *lactometer* is employed in detecting the adulteration of milk with water; it has a limited application and is mainly used in connection with the fat content of milk, previously estimated, for the calculation of the total milk solids.

Special hydrometers are often made for taking the specific gravity of liquids, like petroleum benzin, ether, petroleum, vinegar, wine, beer, solutions of silver nitrate, sea water, etc.; probably the most useful to the pharmacist of all those having special applications is the one made for testing alcohol.

Alcoholometers may be purchased which combine the thermometer with the hydrometer, as shown in Fig. 48, the scale frequently having the percentage, by volume, of absolute alcohol or degrees proof marked opposite the corresponding specific gravity. This instrument is capable of very accurate use in a limited field of work and in the hands of an experienced person. It cannot be used in determining the alcoholic strength of any liquid containing more than traces of substances other than alcohol and water. For instance, the alcoholic strength of distilled extract of witchhazel, or of hydro-alcoholic distillates of any kind may be accurately determined, but not the alcoholic strength of wines or flavoring extracts by its direct application or use.

Fig. 48

Alcoholometer

Tralles' hydrometer is an alcoholometer having a centesimal scale. It has been used by the United States government in gauging spirits, and at one time was in general use by distillers. Each division of the scale corresponds to a given percentage of pure alcohol, by volume, in the liquor.

Cartier's hydrometer, largely used in France, is merely a modification of Baumé's *pèse-esprit*, or hydrometer for liquids lighter than water; the zero of the scale is the same as Baumé's (10°), but the degrees are not of the same value, 32° of Baumé's scale being equal to 30° Cartier. Dorvault gives the following approximate rule for conversion: Cartier's degrees may be converted into Baumé's by subtracting 10, multiplying the remainder by 0.08, and adding the product to Cartier's degree.

Baumé's degrees may be converted into Cartier's by subtracting 10, multiplying the remainder by 0.08, and subtracting the product from Baumé's degree.

Gay-Lussac's centesimal alcoholometer has a scale divided into 100 unequal degrees. The zero corresponds to pure water at 15° C. (59° F.) and the 100 mark to absolute alcohol. The advantage of this method is that every intermediate degree expresses the percentage of pure alcohol by measure contained in the spirit. Thus, when the instrument stands at the 50 mark in an alcoholic liquid, it indicates that 100 measures of the liquid contain 50 of pure alcohol.

Brix's hydrometer is used in the sugar industry and registers the amount of dissolved sugar in weak saccharine liquids, such as fruit juices, etc.

Sikes' hydrometer is used in Great Britain in the collection of the excise revenue. It is a brass instrument having a spherical bulb, with a weight at the bottom to make it float upright; the stem is divided into 20 parts, and every other division numbered, from 0 to 10. A series of nine weights are furnished with the instrument, numbered from 10 to 90; these are to be added to the weight at the bottom to cause the hydrometer to sink, so that a reading may be had on the graduated scale; this reading, added to the number on the weight employed, gives a figure which indicates the strength of the spirit by referring to a table which accompanies the instrument.

Jones' hydrometer is similar to Sikes', but by many is regarded as an improvement on it.

Dica's hydrometer belongs to the same class.

Twaddell's hydrometer is frequently employed in the industries and technical works often quote the degrees of this scale. It is used for liquids heavier than water, and is graduated so that the number of the degree, multiplied by 5 and added to 1000, and subsequently divided by 1000, gives the specific gravity. Thus, 20° Twaddell indicates the specific gravity of 1.100; 50° Twaddell, 1.250.

Beck's hydrometer is rarely used or referred to. In this scale 0 corresponds to the specific gravity 1.00, and 30 to that of 0.850; the scale is extended equally above and below 0. For tables, see some of the older reference works. *Bayley's Chemist's Pocket Book*, p. 178.

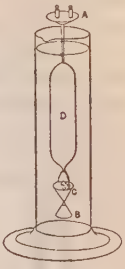
Zanetti's hydrometers have a scale which requires the addition of a cipher to the number of the degree to show the specific gravity.

2. Hydrometers in which the depth of the immersion is constant, but the weight subject to change.

Fahrenheit's hydrometer was one of the first instruments of this class to come into general use. Robert Boyle described, however, in 1675, his "New Essay Instrument", and Fahrenheit's hydrometer was very similar to it in principle. It had but a single mark on the stem, which was surmounted by a small scale pan and weights were placed on the pan to cause the hydrometer to sink to the mark. As this mark indicated the point at which the instrument would float in water at a given temperature when certain weights were placed on the pan, it follows that when it was immersed in a liquid of different specific gravity the weights would have to be changed to float the instrument to the fixed mark; the ratio which this weight bore to the weight used for water gave the specific gravity.

Nicholson's hydrometer is similar in principle to Fahrenheit's, but is modified so that it can be used for taking the specific gravity of heavy or light solids. Fig. 49 is an illustration of one of the most convenient forms of the instrument; it is usually made of brass; there is a single mark on the stem and a scale pan on the summit. To the lower extremity of the hydrometer two conical cups are attached; their apexes are joined so as to resemble an hour glass; the lowest cone has several apertures at the top, to permit of the escape of air when the instrument is immersed. The weight of the hydrometer is usually so adjusted that a 1000 grain weight is needed on the scale pan to float it to the mark on the stem. The specific gravity of solid substances is obtained by weighing them first in air, on the upper platform, and then submerged, in the upper cup, and making the necessary calculations from the factors obtained. The lower cup is used for taking the specific gravity of bodies lighter than water, and is very convenient, the weight of the hydrometer keeping the light body submerged when the lower cup is placed over it. The specific gravity is obtained in the same manner as in the case of bodies heavier than water. One of the advantages of Nicholson's hydrometer is that it can be used in place of a balance for weighing small quantities, as shown above.

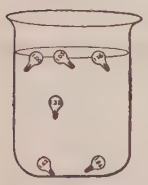
FIG. 49



Nicholson's hydrometer

Lovi's beads, or *specific gravity beads*, are sometimes used for taking the specific gravity of liquids; they are especially useful in large scale manufacturing operations which are conducted by unskilled workmen, and in such cases as where a boiling liquid is to be evaporated until it has a given specific gravity, or in mixing liquids of different densities. They are balloon shaped, hollow globes of glass, of different sizes and weights, having specific gravity figures scratched upon their sides. These figures indicate the specific gravity of a liquid in which the beads swim indifferently; that is, they neither rise nor sink, if the specific gravities of the bead and liquid are the same and the temperature is constant and at the same degree as that at which the beads were standardized. The illustration, Fig. 50, shows their method of use, those heavier than the liquid sinking, those lighter floating, while the one supported indifferently (1.25) indicates the specific gravity of the liquid. Lovi's beads may be defined as hydrometers which indicate but one specific gravity.

FIG. 50

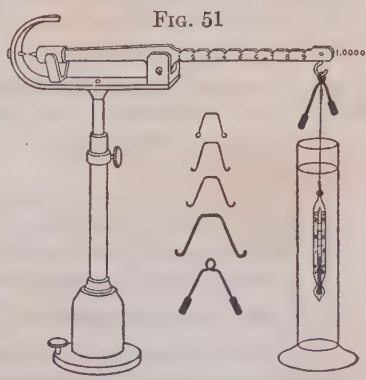


Lovi's beads

Methods of taking the Specific Gravity of Small Quantities of Liquids

Westphal Specific Gravity Balance—This balance is a very convenient device for taking the specific gravities of liquids (see Fig. 51). Sliding weights on the beam give the specific gravity as a direct reading after the temperature has been adjusted, the equilibrium attained, and the sum of the weights determined.

FIG. 51



Westphal specific gravity balance

Gannal's Method—Gannal suggested a very convenient modification of this method of taking the specific gravity of a liquid. A piece of glass, "*densi-*

mètre hydrostatique", having the shape of an olive, has a volume of 10 cc. This is suspended from the hook at the end of the beam of a balance by a horsehair (see Fig. 51), and weights are added to the opposite scale pan until the balance is restored; it is then immersed in the liquid, and the metric weight required to restore the equilibrium gives the specific gravity without a calculation.

Specific Gravity Pipette—Grauer recommends the use of a small pipette having a fine orifice at the lower end, and at the upper end a short piece of rubber tube closed by a pinchcock; a mark is scratched on the pipette to show a point to which a convenient weight of water rises (1 Gm.); enough of the liquid to be tested is drawn by the mouth through the tube to rise to the mark, and it is then closed; the weight of the liquid indicates its specific gravity.

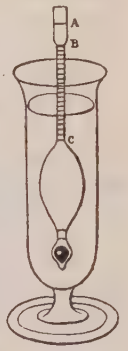
Fig. 52

Nicol's specific gravity tube

A very accurate tube form, known as *Nicol's Specific Gravity Bottle*, is shown in Fig. 52.

Rousseau's Densimeter—This ingenious instrument is constructed upon the plan of a hydrometer (see Fig. 53). The stem from B to C is divided into 20 equal parts; the cup-shaped tube upon the summit of the stem holds exactly 1 cc. When the densimeter is floated in water at the proper temperature, it sinks to the point C at the bottom of the stem; when the cup is filled with water to the cc. mark, it causes the instrument to sink to the point B; this space, B C, being divided into 20 equal parts, it follows that each division corresponds to $\frac{1}{20}$ of a Gm., or 0.05 Gm. If one cc. of oil of rose is placed in the cup, it will sink the densimeter to 17.2 divisions of the scale; then $17.2 \times 0.05 = 0.860$, the specific gravity of the oil of rose.

Fig. 53



Rousseau's densimeter

Specific Gravity of Solids

As has been stated, the taking of the specific gravity of a solid is of comparatively rare occurrence in pharmacy. The same principle obtains that has been so thoroughly discussed and illustrated in connection with the specific gravity of liquids and may be taken in a number of different ways.

The rule for solids is as follows:

Rule.—Divide the weight of the body by the weight of water displaced (loss of weight in water); the quotient will be the specific gravity.

The taking of the specific gravity of solids will be considered under the following heads:

1. Solids insoluble in, and heavier than water.
2. Solids soluble in, and heavier than water.
3. Solids insoluble in, and lighter than water.
4. Solids soluble in, and lighter than water.

1. To take the specific gravity of a solid insoluble in, and heavier than water.

a. With the Balance—It is customary to recommend a special balance for taking the specific gravity of solids, known technically as the hydrostatic balance; but a good prescription or analytical balance will answer perfectly for practical purposes. The substance, preferably in one piece, is first weighed accurately and the weight noted; a horse hair or piece of fine, waterproofed silk thread is then tied around it with a slip knot, and a tight loop at the other end is made, which is attached to the hook at the end of the scale beam; a

small wooden bench made for the purpose, or extemporized by taking out the bottom and one of the sides of a small wooden or stiff pasteboard box, is now arranged over the scale pan so that it does not touch it or interfere with its free movement; upon this a small beaker or wide mouthed jar is placed, and two-thirds filled with distilled water (see Fig. 54). The suspending thread must be adjusted to such length that it will permit of the complete immersion of the substance in the water. Upon weighing the immersed substance, after freeing it from attached air bubbles, it will be at once noticed that it has lost weight, and all that remains to be done is to apply the rule—divide the weight of the body by its loss of weight in water.

Fig. 54

Taking the specific gravity of a solid

For example, 805.5 grains of copper lose by immersion in water 90 grains; then 805.5 divided by 90 gives 8.95, the specific gravity of the copper. See also Nicholson's hydrometer, Fig. 49.

b. With the Specific Gravity Bottle—The specific gravity bottle or pycnometer (see Figs. 38 and 39) has already been described. It is particularly adapted to taking specific gravities of solid substances which are in small fragments or even in a much finer state of subdivision. To use the instrument for a solid substance, the previously weighed body is dropped into the bottle, which is then filled with water at the temperature of 25° C. (77° F.), the exterior of the bottle is carefully dried, and after the counterpoise (the exact weight of the empty bottle), has been placed upon the opposite scale pan, it is weighed. To obtain the *loss of weight* in water of the substance, it is only necessary to deduct the weight of the contents of the bottle (*i.e.*, that of the water and the immersed body) from the weight of the body in air, plus that of the water which the bottle holds when full,—*i.e.*, 100 Gm.; the rule is then to be applied—divide the weight of the body by its loss of weight in water.

Fig. 55

Graduated specific gravity tube

Example—A piece of aluminum wire weighs 10 Gm.; when dropped into a 100 Gm. bottle, and the bottle filled with water at the proper temperature, the weight of both is 106.2 Gm. As the bottle when filled with water alone held 100 Gm., and as the weight of the aluminum in air is 10 Gm., both together weigh 110 Gm.; hence 110 Gm., less 106.2 Gm., gives 3.8 Gm., the loss of weight of the aluminum in water. *Apply the rule*, $\frac{10.}{3.8} = 2.63$, sp. gr.

The specific gravity of any insoluble powder, like calomel, litharge, etc., may be taken in exactly the same way, but care must be observed to agitate the powder with a small quantity of water in the bottle, before adding the rest, to eliminate the possibility of adherent bubbles of air, which would be the cause of error.

c. With the Graduated Tube—A graduated tube is provided in which each space indicates a Gm. (cc.) of water (or better if graduated in smaller subdivisions); the zero mark should be somewhat above the bottom of the tube, as shown in Fig. 55. Now, if water is poured into the tube exactly up to the zero mark, and a weighed solid body dropped into it, the water will rise in the tube and indicate the weight of a bulk of water equal to that of the substance; this is equivalent to the loss in water. *Then apply the rule*—divide the weight of the body by its loss of weight in water. Any cylindrical graduated measure may be used if the volume of the water is accurately noted before and after

the immersion of the previously weighed substance. It is evident that this method cannot be as accurate as either of those above mentioned, as small differences are more clearly indicated by a good balance than by tube reading.

d. By immersing the Solid in a transparent Liquid of the Same Density—This method may be applied where the body is small, is not very heavy specifically, and is insoluble in the liquid. This method is used in the U. S. P. X to take the specific gravity of beeswax (see Part V). Small globules or blocks of the wax are immersed in a mixture of alcohol and water which is then adjusted by the addition of one or the other as needed until the globules or masses of wax float indifferently in the liquid and neither sink nor rise. The specific gravity of the solid will of course be the same as that of the liquid, which may be ascertained after the removal of the wax by straining or filtration, using a specific gravity bottle. (See page 57.)

2. To take the specific gravity of a solid soluble in, and heavier than water.

A liquid must be selected in which the solid is insoluble, like olive oil, petroleum benzin, or oil of turpentine. The specific gravity of the oil or other liquid having been ascertained, it is used just as if it were water, the object being to find out the apparent loss of weight of the substance when immersed in the oil; this having been obtained, a simple proportion must be made as follows: as the specific gravity of the oil is to the specific gravity of water, so is the loss of weight in the oil to the loss of weight in water. *Then apply the rule*—divide the weight of the body by its loss of weight in water.

Example—The loss in weight of 20 Gm. of citric acid, by immersion in oil, is 11.5 Gm. then, as

Sp. gr. of oil		Sp. gr. of water		Loss of weight in oil		Loss of weight in water
0.920	:	1.000	::	11.5	: × or 12.5, then	$\frac{20.0}{12.5} = 1.6$, sp. gr. of citric acid.

It is obvious that either the balance, specific gravity bottle, or graduated tube can be used in this case; but it is possible in some cases to coat the soluble substance with varnish and treat it then as an insoluble substance, and thus avoid the use of an oily liquid. A pill of blue mass may be coated with shellac varnish, and then treated as an insoluble substance as in 1, *b*. The practical difficulty, however, is to secure a thin coating which shall be impervious to water.

3. To take the specific gravity of a solid insoluble in, and lighter than water.

The solution of this problem requires the aid of a heavy insoluble body, which is to be attached to the light body, so as to secure the immersion of both. It is plain that if the loss of weight in water of the heavy substance is deducted from the loss of weight in water of both the heavy and the light body, the result must give the loss of weight in water of the light body alone. *Then apply the rule*—divide the weight of the body by its loss of weight in water.

Example—A piece of paraffin weighs 17.4 Gm., a piece of brass loses by immersion in water 0.6 Gm.; when the brass is attached to the paraffin, both together lose by immersion in water 20.6 Gm.; by deducting 0.6 Gm. (the loss in water of the brass) from 20.6 Gm. (the loss in water of both) the loss in water of the paraffin alone is found, *i. e.*, 20 Gm.; then $\frac{17.4}{20.0} = 0.870$, sp. gr. of paraffin. See also Nicholson's hydrometer, Fig. 49.

4. To take the specific gravity of a solid soluble in, and lighter than water.

The use of the specific gravity bottle is recommended in cases of this kind, and the process is the same as in 2. The selection of a suitable liquid lighter

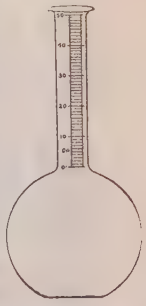
than the body, and in which it is insoluble is, however, usually attended with difficulty. The proportion would be, as the specific gravity of the light liquid is to the specific gravity of water, so is the loss of weight in the light liquid to the loss of weight in water. *Then the rule must be applied*—divide the weight of the body by the loss of weight in water.

Specific Volume

Specific volume in pharmacy may be defined *as the volume of one body compared with the volume of an equal weight of another body selected as the standard, both bodies having the same temperature.* It is directly the opposite of specific gravity. The temperature chosen is usually 25° C. (77° F.). 1. *To obtain the specific volume of a liquid*—**Rule:** Divide the volume of the given weight of the liquid by the volume of an equal weight of water, or divide the specific gravity of water (1.000) by the specific gravity of the liquid. *Ex.*—1403 Gm. of nitric acid measure 1000 cc. and 1403 Gm. of water measure 1403 cc.; then $\frac{1000}{1403} =$ 0.7127, sp. vol. of nitric acid. 2. *To obtain the volume of a given weight of a liquid*—**Rule:** Multiply the vol. of an equal weight of water by the sp. vol. of the liquid. *Ex.*—How many fl. oz. are there in 100 oz. av. of nitric acid? 100 oz. av. of water measure 96.21 fl. oz.; then $96.21 \times 0.7127 = 68.56 +$ fl. oz. of nitric acid.

Very early in the tyro's experience the fact is recognized that pound bottles designed for different liquids vary in size, a pint bottle, for instance (which may be regarded as a rough standard), holding about a pound avoirdupois of water; the same bottle, however, would only be four-fifths full if a pound of glycerin were poured into it, and two-thirds full if chloroform were used, while a pound of petroleum benzin would fill the pint bottle, and there would be almost enough to spare to fill another pint bottle. A bottle which would hold a pound of ether would hold two pounds of chloroform, and a pint bottle holding one pound of water holds fourteen pounds of mercury. These facts are, of course, capable of the explanation that the specific volumes of liquids lighter than water are greater than that of water, while those of liquids heavier than water are less. An instructive and useful bottle may be made by selecting a flask with a long and not very narrow neck (see Fig. 56), the bulb of which would hold about 100 cc. of water at 4°C.; if the neck would hold about 50 cc. of the same liquid at the same temperature, and a mark was made at the 100 cc. point and the tube graduated from 100 cc. to 150 cc., it would follow that in order to find the specific volume of any lighter liquid within the capacity of the bottle, all that would be necessary would be to pour into the flask 100 Gm. of such liquid at the proper temperature and read off the point to which the liquid rises. A bottle to be used for heavy liquids would have the 100 cc. mark at the top of the neck and the cc. graduations below decrease in value. A bottle of limited range may be constructed having the 100 cc. mark half way between the top of the bulb and the top of the neck. That specific volume is the antithesis of specific gravity is shown by the fact that in order to obtain the specific volume of a liquid the measure of a given weight of the liquid is divided by the measure of an equal weight of water, and (as has been shown heretofore) specific gravity is obtained by dividing the weight of a given measure of the liquid by the weight of an equal measure of water; therefore it follows that when the specific volume of a liquid is multiplied by its specific gravity the product must be 1, or the specific gravity of water.

FIG. 56



Specific volume bottle

Weight and Volume Relations, U. S. P. X

Specific gravity true 25° C. / 25° C.	Specific volume.	Weight of 1 U. S. gallon in pounds avoirdupois in air.	Weight of 100 fluid-ounces in ounces avoirdupois.	Weight of 1 fluidounce in grains.	Volume in U. S. gallons of 100 lbs. avoirdupois.	Volume in fluidounces of 100 ozs. avoirdupois.	Volume in fluidounces of 1000 grains.
0.70	1.4286	5.816	72.70	318.0	17.195	137.56	3.144
0.71	1.4085	5.899	73.74	322.6	16.953	135.62	3.100
0.72	1.3889	5.982	74.78	327.1	16.717	133.73	3.057
0.73	1.3699	6.065	75.82	331.7	16.487	131.90	3.015
0.74	1.3514	6.149	76.86	336.2	16.264	130.11	2.974
0.75	1.3333	6.232	77.90	340.8	16.047	128.38	2.934
0.76	1.3158	6.315	78.94	345.3	15.836	126.69	2.896
0.77	1.2987	6.398	79.98	349.9	15.630	125.04	2.858
0.78	1.2821	6.481	81.02	354.5	15.429	123.43	2.821
0.79	1.2658	6.565	82.06	359.0	15.233	121.87	2.786
0.80	1.2500	6.648	83.10	363.6	15.043	120.34	2.751
0.81	1.2346	6.731	84.14	368.1	14.857	118.85	2.717
0.82	1.2195	6.814	85.18	372.7	14.675	117.40	2.684
0.83	1.2048	6.897	86.22	377.2	14.496	115.99	2.651
0.84	1.1905	6.981	87.26	381.8	14.325	114.60	2.620
0.85	1.1765	7.064	88.30	386.3	14.157	113.25	2.589
0.86	1.1628	7.147	89.34	390.9	13.992	111.93	2.559
0.87	1.1494	7.230	90.38	395.4	13.831	110.65	2.529
0.88	1.1364	7.314	91.42	400.0	13.673	109.39	2.500
0.89	1.1236	7.397	92.46	404.5	13.520	108.16	2.472
0.90	1.1111	7.480	93.50	409.1	13.369	106.95	2.445
0.91	1.0989	7.563	94.54	413.6	13.222	105.78	2.418
0.92	1.0870	7.646	95.58	418.2	13.078	104.62	2.391
0.93	1.0753	7.730	96.62	422.7	12.937	103.50	2.366
0.94	1.0638	7.813	97.66	427.3	12.799	102.40	2.341
0.95	1.0526	7.896	98.70	431.8	12.666	101.32	2.316
0.96	1.0417	7.979	99.74	436.4	12.532	100.26	2.292
0.97	1.0309	8.063	100.78	440.9	12.403	99.23	2.268
0.98	1.0204	8.146	101.82	445.5	12.276	98.21	2.245
0.99	1.0101	8.229	102.86	450.0	12.152	97.22	2.222
1.00	1.0000	8.312	103.90	454.6	12.031	96.24	2.200
1.02	0.9804	8.479	105.98	463.7	11.794	94.36	2.157
1.04	0.9615	8.645	108.06	472.8	11.567	92.54	2.115
1.06	0.9434	8.812	110.14	481.9	11.349	90.79	2.075
1.08	0.9259	8.978	112.22	491.0	11.138	89.11	2.037
1.10	0.9091	9.144	114.31	500.1	10.936	87.49	2.000
1.12	0.8929	9.311	116.39	509.2	10.740	85.92	1.964
1.14	0.8772	9.477	118.47	518.3	10.552	84.41	1.929
1.16	0.8621	9.644	120.55	527.4	10.370	82.96	1.896
1.18	0.8475	9.810	122.63	536.5	10.194	81.55	1.864
1.20	0.8333	9.977	124.71	545.6	10.024	80.19	1.833
1.22	0.8197	10.143	126.79	554.7	9.859	78.87	1.803
1.24	0.8065	10.309	128.87	563.8	9.700	77.60	1.774
1.26	0.7937	10.476	130.95	572.9	9.546	76.37	1.746
1.28	0.7813	10.642	133.03	582.0	9.396	75.17	1.718

Weight and Volume Relations, U. S. P. X—*Continued.*

Specific gravity true 25° C. / 25° C.	Specific volume.	Weight of 1 U. S. gallon in pounds avoirdupois in air.	Weight of 100 fluid-ounces in ounces avoirdupois.	Weight of 1 fluidounce in grains.	Volume in U. S. gallons of 100 lbs. avoirdupois.	Volume in fluidounces of 100 ozs. avoirdupois.	Volume in fluidounces of 1000 grains.
1.30	0.7692	10.809	135.11	591.1	9.252	74.01	1.692
1.32	0.7576	10.975	137.19	600.2	9.111	72.89	1.666
1.34	0.7463	11.142	139.27	609.3	8.975	71.80	1.641
1.36	0.7353	11.308	141.35	618.4	8.843	70.75	1.617
1.38	0.7246	11.475	143.43	627.5	8.715	69.72	1.594
1.40	0.7143	11.641	145.51	636.6	8.590	68.72	1.571
1.42	0.7042	11.807	147.59	645.7	8.469	67.75	1.549
1.44	0.6944	11.974	149.67	654.8	8.352	66.81	1.527
1.46	0.6849	12.140	151.75	663.9	8.237	65.90	1.506
1.48	0.6757	12.307	153.83	673.0	8.126	65.01	1.486
1.50	0.6667	12.473	155.92	682.1	8.017	64.13	1.466
1.52	0.6579	12.640	158.00	691.2	7.912	63.29	1.447
1.54	0.6494	12.806	160.08	700.3	7.809	62.47	1.428
1.56	0.6410	12.973	162.16	709.4	7.709	61.67	1.410
1.58	0.6329	13.139	164.24	718.5	7.611	60.89	1.392
1.60	0.6250	13.305	166.32	727.6	7.516	60.13	1.374
1.62	0.6173	13.472	168.40	736.7	7.423	59.38	1.357
1.64	0.6098	13.638	170.48	745.8	7.332	58.66	1.341
1.66	0.6024	13.805	172.56	754.9	7.244	57.95	1.325
1.68	0.5952	13.971	174.64	764.1	7.158	57.26	1.309
1.70	0.5882	14.138	176.72	773.2	7.073	56.59	1.293
1.72	0.5814	14.304	178.80	762.3	6.991	55.93	1.278
1.74	0.5747	14.470	180.88	791.4	6.911	55.29	1.264
1.76	0.5682	14.637	182.96	800.5	6.832	54.66	1.249
1.78	0.5618	14.803	185.04	809.6	6.755	54.04	1.235
1.80	0.5556	14.970	187.12	818.7	6.680	53.44	1.222
1.82	0.5495	15.136	189.20	827.8	6.607	52.85	1.208
1.84	0.5435	15.302	191.28	836.9	6.535	52.28	1.195
1.86	0.5376	15.469	193.36	846.0	6.465	51.72	1.182
1.88	0.5319	15.636	195.44	855.1	6.396	51.17	1.170
1.90	0.5263	15.802	197.53	864.2	6.328	50.63	1.157
1.92	0.5208	15.968	199.61	873.3	6.262	50.10	1.145
1.94	0.5155	16.135	201.69	882.4	6.198	49.58	1.133
1.96	0.5102	16.301	203.77	891.5	6.135	49.08	1.122
1.98	0.5051	16.468	205.85	900.6	6.073	48.58	1.110
2.00	0.5000	16.634	207.93	909.7	6.012	48.09	1.100

CHAPTER V

THE ARITHMETIC OF PHARMACY

In no wise does the arithmetic of pharmacy differ from any other arithmetic in so far as its first principles are concerned. The rules of addition, subtraction, division, and multiplication apply here exactly as they apply in any other practical application of arithmetic. The decimal point observes the same laws of conduct; the numerator in the fraction sits astride the denominator; the quotient cannot be had until the division is completed—all of these things are in the arithmetic of pharmacy precisely as they are in the arithmetic of commerce, of chemistry, of engineering, or of any other business, trade, or profession.

Let the foregoing be clearly understood. The student who undertakes a study of the arithmetic of pharmacy does so in order to become familiar with the solving of those distinct problems which occur in the practice of professional duties. No student in pharmacy who was able to manipulate the fundamental problems of the elementary school arithmetic, need have any fear of finding unusually intricate problems in the work of the pharmacy school, or in daily practice.

He need have no *fear* but he must have a wholesome *respect*. That respect must be for *accuracy*.

It is readily appreciated that the pharmacist must have, besides all of his other qualifications, a sense of the accurate. An incorrect calculation on paper, if put into practice, might cause great disaster and interminable worry. It is obvious when dealing with such substances as aconitine and strychnine, where the dose is a small fraction of a grain, and an error may mean the difference between life and death, that all calculations must be handled with absolute accuracy.

The arithmetical principles governing the solution of a problem in compound interest may be exactly the same as those governing the solution of a problem in prescription compounding, but the issues involved are vastly different. One deals with money which may be restored when lost; the other deals with human life which when lost is gone forever.

It is hardly necessary to point out that in presenting this chapter it is pre-supposed that those who study it are familiar with the fundamentals of arithmetic. Yet it is known from experience that many entrants into the courses in pharmacy, although graduates from high schools, commence their professional training sadly deficient in a knowledge of the simplest processes of arithmetic.

The advice to students who appreciate their weakness in this respect is to acquire an elementary text book on the subject and carefully study its contents. The two main weaknesses in the arithmetic of the novitiate in pharmacy are in handling fractions and in the placing of the decimal point.

"What is one-half of one-fortieth?"

This question tendered to hundreds of aspirants to college matriculation has always brought more than fifty per cent of incorrect responses. The arithmetic of pharmacy demands much better ground work than is reflected by such a result.

Weights and Measures

The chapter on Metrology (page 26), deals so comprehensively with the theory of weights and measures that it would be superfluous to introduce here anything beyond a few questions and answers to afford practice in handling the units of the several systems, and the conversion of one system into the other.

The Metric System

Remember Its Special Advantages

(a) Commensurability of the units.

Thus: 10 cc. of water weighs 10 Gm.
25 cc. of water weighs 25 Gm.
1000 cc. (1 liter) of water weighs 1000 Gm. (1 kilo).

(b) It is the system of decimal progression, like the system of coinage. Ten of the low unit make one of the next higher unit.

$$\$3.95 = \begin{cases} 3 \text{ dollars} \\ 9 \text{ dimes} \\ 5 \text{ cents} \end{cases}$$

$$3.95 \text{ Gm.} = \begin{cases} 3 \text{ grams} \\ 9 \text{ decigrams} \\ 5 \text{ centigrams} \end{cases}$$

Addition—1. Add: 3 Kgm., 33 Gm., 3 cgm., 433 mgm.

Note: The gram is the unit of weight, therefore the answer should be in terms of grams and fractions thereof.

Solution:

3 Kgm.	=	3 × 1000	=	3000.	Gm.
33 Gm.	=			33.	Gm.
3 cgm.	=	3 ÷ 100	=	.03	Gm.
433 mgm.	=	433 ÷ 1000	=	.433	Gm.
				3033.463	Gm.

Subtraction—2. Subtract: 285 cc. from 5 liters.

Note: In volume measure the cubic centimeter, or cc., is the unit generally used, hence the answer should be given in cc.

5 liters = 5000 cc. and
5000 cc. − 285 cc. = 4715 cc.

Multiplication:

Note: The product is always of the same denomination as the multiplicand, thus:

20 Gm. × 4 = 80 Gm. . . . not 80 cc. or 80 anything else.

Therefore if the multiplicand should be composed of several units it should be resolved to one unit before multiplying.

Thus: (9 Dgm. 9 cm. 9 cgm.) × 25 is equivalent to
99.09 Gm. × 25 = 2477.25. Gm.

3. What will be the total weight of the ingredients in a prescription for 25 powders, each powder containing 4 dgm. of chalk, 10 cgm. of bismuth subnitrate, and 1 mgm. of cocaine.

4 dgm. + 10 cgm. + 1 mgm. × 25 = 0.4 + 0.10 + .001 Gm. × 25 = 0.501 × 25 = 12.525 Gm.

Division.

Note: The quotient is always of the same denomination as the dividend, thus: 20 Gm. ÷ 4 = 5 Gm. not 5 cc. or 5 anything else.

4. Divide 3 liters by 25
3 liters = 3000 cc. ÷ 25 = 120 cc.

Problems

5. Add together 25 mgm., 25 cgm., 25 Gm., 25 Dgm., 25 dgm.
6. What is the total weight of the following shipment of belladonna leaves:

(1) 2 Kgm. 30 Gm.
(2) 225 Gm. 45 cgm.
(3) 855.6 Gm.
(4) 3 Hgm. 3 Dgm.
(5) 454 Gm.

7. How much is left in a 5 liter flask after the removal of three portions totalling 895 cc.?
8. Subtract the total in No. 5 from a Kilogram.
9. Multiply 48.5 cc. by 3.246.
10. A certain preparation is to contain 0.0325 Gm. of quinine in each cc. How much must be weighed out for 5 liters of the preparation?
11. How many 65 mgm. pills of aloe can be made from a 50 Gm. package of the drug?

The English Systems

Weight

There are two systems of weight measurement in use in the U. S. in the handling of medicines. This is unfortunate and causes much confusion. They are the Avoirdupois and Apothecaries systems.

a. *Avoirdupois*: This is the system of weight by which the pharmacist buys his material. It is also the system which he uses in bulk selling "over the counter"—such goods as Epsom salt, whiting, tar camphor, etc.

The Avoirdupois system is *not* the system used at the prescription counter in dispensing medicines, or in compounding formulas for medicine.

b. *Apothecaries* (Troy): This is the system of weight which is used at the prescription counter, and frequently in compounding medicines. (The United States Pharmacopœia and National Formulary use the metric system exclusively.)

These two systems differ thus:

1 pound Avoirdupois = 7000 grains
1 pound Apothecaries = 5760 grains

The *grain* Avoirdupois is exactly the same as the *grain* Apothecaries. The difference in weight between the two pounds is therefore very great (7000 − 5760 = 1240 grs.), the Avoirdupois pound being the heavier.

1 ounce Avoirdupois = 437.5 grains
1 ounce Apothecaries = 480 grains

The Apothecaries ounce is 480 − 437.5 or 42.5 grains heavier than the Avoirdupois ounce. This is because

1 pound Avoirdupois = 16 ounces
1 pound Apothecaries = 12 ounces

13. A druggist buys a 5 ounce tin of quinine sulphate. How many 5 grain capsules can be made from the contents?

The druggist purchases by the Avoirdupois system *always*.

Therefore: 5 ounces converted to grains is

437.5 × 5 or
2187.5 grains

Assuming no loss during filling, there may be made of 5 grain capsules from this lot:

2187.5 ÷ 5 or 437 capsules

Addition: 14. Add the following volumes:

4 gallons, 5 gallons, 3 pints, 2 fluid ounces, 2 pints, 4 fluid drachms, and 55 minims.

Note: Write out in proper sequence the names of the units in the system thus:

Gallons pints fl. ounces fl. drachms minims.

Now arrange the numbers in the question under each other in their proper place, starting with the first number and continuing to the end.

gallons	pints	fl. oz.	fl. dr.	min.
4				
5	3	2		
	2		4	55
Now add:	9 gal.	5 pt.	2 fl. oz.	4 fl. dr. 55 min.

Had the sum, let us say of pints, exceeded the equivalent of the next higher unit, it would have been necessary to reduce to that unit, entering the remainder, of course, under the pint unit.

Thus:

gallons	pints
2	6
	4
	5
	3 gals. 7 pints

Subtraction: 15. Subtract 1 pint, 4 fl. oz., 6 fl. dr. and 33 minims from 2 gallons.

Note: Start out as under addition.

Thus:

gallons	pints	fl. oz.	fl. dr.	min.
2	0	0	0	0
	1	4	6	33
	1 gal.	6 pt.	11 fl. oz.	1 fl. dr. 27 min.

But a far more apparent method is to partition one gallon into its component parts, thus:

	2 gallons =				
	1 gallon	7 pints	15 fl. oz.	7 fl. dr.	60 minims
now subtract		1	4	6	33
	1 gal.	6 pt.	11 fl. oz.	1 fl. dr.	27 min.

Had the minuend been 5 gallons instead of 2, the arrangement would have been:

4 gallons 7 pts. 15 fl. oz. 7 fl. dr. 60 minims

(When these are added they constitute 5 gallons. Try it.)

Volume

Volumes of liquids are recorded only in terms of the Apothecaries fluid measure system.[1] There is no Avoirdupois fluid measure.

Table A.

60 minims (min.)	=	1 fluid drachm
8 fluid drachms (fl. dr.)	=	1 fluid ounce
16 fluid ounces (fl. oz.)	=	1 pint
8 pints (O.)	=	1 gallon (Cong.)

O. is the abbreviation for the Latin word *Octarius*; Cong., for the Latin word *Congius*.

Table B.

gallon		pints		fl. oz.		fl. dr.		min.
1	=	8	=	128	=	1024	=	61,440
		1	=	16	=	128	=	7,680
				1	=	8	=	480
						1	=	60

The gill, which is ¼ pint, is obsolete, but is occasionally met with in old family recipes.

Division: 16. Divide 10 gallons, 3 pints and 4 fl. oz. by 8.

Note: In dividing proceed from left to right, beginning with the high unit. Should there be a remainder, change this to the next unit and add to the number of that unit before dividing it.

Thus:

	gal.	pt.	fl. oz.
8)	10	3	8
	1 gal.	2 pt.	7 fl. oz.

Multiplication: 17. Multiply 4 pints, 7 fl. oz. and 3 fl. dr. by 4.

Note: Begin with the smallest unit, working from right to left. When it becomes necessary, change the product to the next higher unit, writing only the remainder, if there is any, under the unit multiplied as follows:

gal.	pt.	fl. oz.	fl. dr.
0	4	7	3
			4
2 gal.	1 pt.	13 fl. oz.	4 fl. dr.

[1] The Imperial System is the fluid measure of the British Empire. Because of the proximity of Canada it becomes necessary for those who practice on the border states to learn this system. It is thoroughly discussed in the chapter on Metrology, page 29.

Problems

18. The inventory card shows that the following stocks of syrup are in the store-room.

Three one gallon bottles, 2 pints, 8 fl. oz. and 5½ gallons, 22 pints, 19 fl. oz. How much will this be altogether?

19. How many 15 min. capsules can be filled from 5 fl. oz. and 3 fl. dr. of cod liver oil?

20. How much cod liver oil is necessary to make 2500 capsules each containing 15 min.? (Give the answer in higher units).

21. A barrel supposed to have contained 50 gallons of oil of turpentine leaks slowly. It is found upon measuring that it contains only 33 gallons, 5 pints, and 2 fl. dr. How much was lost?

Relationship of Weights and Measures

Commit to memory the following equivalents, which are given with practical accuracy.

LINEAR MEASURE

1 meter = 39.37 inches
1 inch = 25 millimeters
(0.025 meter)

FLUID MEASURE

1 cc. = 16.23 minims
1 fl. oz. = 29.57 cc.

(Other equivalents may be calculated from these. Thus a pint is equal to 29.57 × 16 or approximately 473 cc.).

WEIGHT

Avoirdupois and Metric

1 ounce = 28.35 Gm.
1 pound = 454 Gm.
1 Kilogram = 2.2 pounds

Apothecaries and Metric

1 grain = 65 mgm. or 0.065 Gm.
1 gram = 15.4 grains

Problems

22. Convert 2 fl. oz., 5 fl. dr. and 33 minims into cubic centimeters.

23. Convert (a) 6.5 grains into milligrams
(b) $\frac{3}{10}$ grain into milligrams
(c) 3½ apothecary ounces into grams
(d) 3½ avoirdupois ounces into grams

24. Convert (a) 550 Gm. into avoirdupois ounces
(b) 550 Gm. into apothecaries ounces

25. Convert the following doses into metric weights:

(a) atropine sulphate, $\frac{1}{100}$ grain to $\frac{1}{60}$th grain
(b) aconitine, $\frac{1}{320}$ grain to $\frac{1}{200}$ grain
(c) codeine, $\frac{1}{6}$ grain to $\frac{1}{2}$ grain
(d) salol, 3 grains to $7\frac{1}{2}$ grains
(e) Epsom salt, 30 grains to 2 drachms

26. Change the following prescription into metric units:

℞ Arsen. Triox. gr. $\frac{1}{2}$
Hydrarg. Chlor. Corr. gr. $\frac{1}{3}$
Phenolphthal. gr. X
Mass. Ferr. Carb. ℥iss

Specific Gravity

Remember—Specific gravity is the term used to express the relative weight of a body as compared to the weight of an equal volume of water, or with some other chosen standard.

When we say that the specific gravity of mercury is 13.25, we mean that a given volume of mercury, let us say a pint, is 13.25 times as heavy as a pint of water.

Variations in temperature cause a variation in volume so that temperature must always be taken into consideration.

Liquids

In practice the specific gravity of *liquids* can be arrived at by using the following formula:

Rule:
$$\text{Sp. Gr. (of a liquid)} = \frac{\text{weight of the liquid}}{\text{weight of an equal volume of water}}$$

Solids

This is described under the chapter on Specific Gravity, page 55. While the principle remains the same, a slight change is made from the above formula, because of a deviation in the method of practically obtaining the specific gravity of a solid.

Rule:
$$\text{Sp. Gr. (of a solid)} = \frac{\text{weight of the solid in air}}{\text{loss of its weight in water}}$$

27. A certain bottle holds 320 Gm. of water, and 280 Gm. of an oil. What is the specific gravity of the oil?

$$\text{Sp. Gr.} = \frac{\text{weight of substance}}{\text{weight of an equal volume of water}}$$

$$= \frac{280}{320} = 0.875 = \text{The specific gravity of the oil}$$

Note: Specific gravity is an abstract figure, that is, it is never given in terms of grams or ounces or in any other unit.

Simply the plain figure, thus: Glycerin, Sp. Gr. 1.25
Chloroform, Sp. Gr. 1.48

Note also that, with the exception of mercury and a few other fluid substances, the specific gravity of liquids generally lies within the range between 0.5 to 2.0, and that the specific gravity of terrestrial solids rarely exceeds 20.

(Notwithstanding these facts students *do* manage to find answers to specific gravity problems that run into figures more appropriate to astronomical distances or microscopic measurements.)

28. 100 cc. of a certain liquid weighs 92 Gm. What is its specific gravity?

$$\text{Sp. Gr.} = \frac{\text{weight of substance}}{\text{weight of an equal volume of water}} = \frac{92}{?}$$

The equal volume of water must, of course, be 100 cc. and the weight of 100 cc. of water is 100 Gm.

Therefore: $$\text{Sp. Gr.} = \frac{92}{100} = 0.920$$

29. A piece of iron weighs 6.6 Gm. in air. Suspended in water it weighs 5.2 Gm. What is the Sp. Gr. of the metal?

$$\text{Sp. Gr. (of a solid)} = \frac{\text{weight of the solid in air}}{\text{loss of its weight in water}} = \frac{6.6}{?}$$

Loss of weight in water is: 6.6 Gm. − 5.2 Gm. or 1.4 Gm.

Therefore: $$\text{Sp. Gr.} = \frac{6.6}{1.4} = 4.714$$

Note: (Always work a specific gravity answer to at least the third decimal place.)

Substances which are soluble in water, copper sulphate crystals for instance, are weighed in a liquid in which they are insoluble, such as oil of turpentine, and the specific gravity of this liquid is applied as a correction factor.

The calculation is done, exactly as if water has been used and the apparent answer thus obtained, is multiplied by the specific gravity of the special liquid used, to obtain the true answer.

30. A crystal of copper sulphate weighs 5.760 Gm. in air. Suspended in oil of turpentine, having a Sp. Gr. of 0.860 it weighs 3.080. What is the specific gravity of the crystal?

Weight of the crystal in air	= 5.760
Weight of the crystal in oil of turpentine	= 3.080
Loss in weight	= 2.680

Assuming that this loss occurred with water:

$$\text{Sp. Gr.} = \frac{\text{weight of the solid in air}}{\text{loss of weight in water}} = \frac{5.760}{2.680} = 2.150$$

Applying the correction factor for oil of turpentine:

$$2.150 \times 0.860 = 1.849$$

Problems

31. An iron bottle holds 75 lbs. of mercury but only 5.533 lbs. of water. What is the Sp. Gr. of the mercury?

32. A pycnometer (Sp. Gr. bottle) holds 50 Gm. of water; of chloroform it holds 74.25 Gm. What is the Sp. Gr. of the chloroform?

33. A certain bottle weighs 31.44 Gm.; filled with water it weighs 80.92 Gm.; filled with glycerin it weighs 93.40 Gm. What is the Sp. Gr. of the glycerin?

34. What is the Sp. Gr. of an oil, an avoirdupois ounce of which measures exactly one fluid ounce?

35. A piece of metal weighs 5.44 Gm. in air; suspended in water it weighs 4.304 Gm. What is the Sp. Gr. of the metal?

36. A crystal of alum weighs 5.736 Gm. in air and 2.850 Gm. when suspended in oil of turpentine, having a specific gravity of 0.855. What is the Sp. Gr. of the alum crystal?

37. The weight of 10 cc. of a certain liquid is 195 grains. What is its specific gravity?

Specific Volume

Specific volume expresses exactly the reverse of specific gravity. It is the volume of a body compared to the volume of an equal weight of water. It is useful because, by its determination, the space which will be occupied by a certain weight of a liquid, can be readily calculated.

Remember the following formula:

$$\text{Sp. Vol.} = \frac{\text{volume of a body}}{\text{volume of an equal weight of water}}$$

Note: Because of the relation between specific gravity and specific volume, the one may be easily converted into the other.

$$\text{Thus: Sp. Gr.} = \frac{1}{\text{sp. vol.}}$$

$$\text{Sp. Vol.} = \frac{1}{\text{sp. gr.}}$$

Problems

38. A certain weight of oil measures 75 cc. The same weight of water measures 55 cc. What is the specific volume of the oil?

39. Chloroform has a specific gravity of 1.48. What is its specific volume?

40. Glycerin has a Sp. Gr. of 1.25. What is its specific volume?

41. Sulphuric acid has a Sp. Vol. of 0.554. What is its specific gravity?

42. Glycerin has a Sp. Vol. of 0.802. What is its specific gravity?

Practical Applications of Specific Gravity

(a). *Reducing volume to weight.*

METRIC

1 cc. of water weighs 1 Gm.
1 cc. of any liquid with the Sp. Gr. 1 weighs 1 Gm.
1 cc. of a liquid with the Sp. Gr. 2 weighs 1×2 or 2 Gm.
1 cc. of a liquid with the Sp. Gr. 1.5 weighs 1×1.5 or 1.5 Gm.
Thus: *The number of cc.* $\times$ *Sp. Gr.* = *Weight in grams.*

43. What is the weight in Gm. of 1 liter of chloroform having a Sp. Gr. of 1.48?

No. of cc. $\times$ Sp. Gr. = weight in grams
1000×1.48 = 1480 Gm.

APOTHECARIES' FLUID MEASURE

There is no commensurability of the units between this system and avoirdupois or troy weight.

1 fl. oz. of water does NOT weigh 1 ounce.
1 minim of water does NOT weigh 1 grain.

But it is known that:
1 fl. oz. of water weighs 454.6 grains, and that
1 minim of water weighs $\frac{454.6}{480}$ or 0.95 grain.
1 fl. oz. of water weighs 454.6 gr.
1 fl. oz. of any liquid having a Sp. Gr. of 1 weighs 454.6 gr.
1 fl. oz. of a liquid having a Sp. Gr. of 2 weighs 454.6 × 2 or 909.2 gr.

Therefore the weight in grains of a fluid ounce of any liquid is:

$$454.6 \times \text{Sp. Gr.}$$

Further, any volume in fluid ounces may be changed to grains (and thence to higher units) according to this formula.

454.6 × Sp. Gr. × number of fl. oz. = wt. in grains.

44. Calculate the weight in grains of 1 pint, 1 fl. oz. and 4 dr. of sulphuric acid, Sp. Gr. 1.8.

454.6 × Sp. Gr. × number of fl. oz. = wt. in grains.
1 pt. 1 fl. oz. 4 fl. dr. = 17.5 fl. oz.
454.6 × 1.8 × 17.5 = 14319.9 grains.

(The answer may be resolved into higher units if desired. Since the avoirdupois grain and the apothecaries are identical, either system may be calculated from the above answer.)

Since 1 minim weighs 0.95 grain, the weight in grains of a number of minims may be had according to the following formula:

0.95 gr. × Sp. Gr. × number of minims = weight in grains.

Problems

45. What is the weight in Gm. of 725 cc. of alcohol (Sp. Gr. 0.816)?
46. What is the weight in Gm. of 1 liter of ether (Sp. Gr. 0.718)?
47. What is the weight in grains of 12.5 fl. oz. of mercury (Sp. Gr. 13.5)?
48. Calculate the weight in avoirdupois pounds of 50 gallons of alcohol (Sp. Gr. 0.816)?
49. What is the weight in grains of 1 pint of gasoline (Sp. Gr. 0.684)?
50. Calculate the weight in Gm. of 5 pints of ammonia water (Sp. Gr. 0.955).
51. What is the weight in grains of 240 minims of chloroform (Sp. Gr. 1.48)?
52. What is the weight in Gm. of 900 minims of ether (Sp. Gr. 0.718)?

Proportion

Example:
100 Gm. of quinine cost $1.80. What will be the cost of 25 Gm.?
The line of reasoning followed to solve a problem of this kind is as follows:

100 Gm. costs $1.80
Therefore 1 Gm. costs 1.8¢
And 25 Gm. costs 1.8¢ × 25 or 45¢ or $0.45.

But there is another way which, though seemingly more complex, may be used very simply to solve much more abstruse problems than the above.

If the three quantities in the problem, namely 100 Gm., $1.80 and 25 Gm. be considered in connection with the answer $0.45, it will be readily seen that

100 bears the same relation to 25 as 1.80 does to 0.45. In other words the quantities and prices are in proportion. Knowing the answer, of course, it was easy to make this comparison. But the comparison may be made without knowing the answer, providing we substitute for the answer the letter x, thus:

100 is to 25 as 1.80 is to x

That constitutes a proportional statement which may be written in the conventional way:

1	2		3	4
100	: 25	: :	$1.80	: x
	is to	as		is to

There are three known terms in the statement and x the unknown. Terms are numbered, first, second, etc., from left to right. The two end terms (1 and 4) are the *extremes*, and the two middle terms (2 and 3) are the *means*. Arithmetically the product of the means must equal the product of the extremes. Therefore, if one of the *extremes* be unknown it may be had by dividing the product of the *means* by the known extreme.

100 : 25 : : $1.80 : x

means

extremes

$$x = \frac{25 \times 1.80}{100} = \$0.45$$

Certain rules must be remembered in working with proportion. They are:

(1) Let "x" always be the fourth term.

(2) Let the third term be that number in the question which expresses the same kind of value as is expected in the answer.

(3) Decide whether the answer sought will be greater or less than the third term. If greater, the larger of the two remaining terms belongs in the second place—if smaller, the lesser of the remaining terms belongs in second place.

(4) The remaining term goes in the first place.

Again:

If 100 Gm. of quinine cost $1.80 what will be the cost of 25 Gm.?

First proceed with the proportional skeleton statement:

1	2	3	4
	: :	:	x

Next ask the question: In what terms will the answer be expressed? Money, of course!

The money term . . . $1.80 then goes in the third place, as 180 cents or $1.80, since *the answer will always be in the same unit as the third term.*

1	2	3	4
:	: :	180¢	: x

Next: Is the answer to be greater or less than $1.80?

Manifestly it will be smaller, since 25 Gm. will certainly cost less than 100 Gm.

The lesser of the two remaining terms, then, goes in the second place, and the lone remaining term in the first place.

$$\begin{array}{cccccccc} 1 & & 2 & & 3 & & 4 \\ 100 & : & 25 & :: & 180¢ & : & x \end{array}$$

$$x = \frac{\text{Product of means}}{\text{Known extreme}} = \frac{180 \times 25}{100} = 45¢$$

These rules will always work correctly if properly applied.

Problems

53. If homatropine costs $3.00 a Gm., how much would 65 mgm. cost?
54. How much would 3 grains of the homatropine cost?
55. If strong silver protein costs $0.90 an ounce, how much can be bought for $5.00?
56. Mercury costs $2.80 per Kilogram. Its Sp. Gr. is 13.5: (a) How much would 100 cc. cost? (b) What would be the cost of a pound (avoir.)? (c) How much would 4 fl. oz. cost?
57. Alcohol costs $4.20 per gallon. Its Sp. Gr. is 0.816. What is the cost per pound?
58. Five pound avoirdupois of nitric acid costs at the rate of 38¢ a pound. Its Sp. Gr. is 1.412. What is the cost per liter?

Percentage Problems

Percentage, abbreviated per cent, and symbolized %, indicates parts in 100 parts.

10 per cent means 10 parts in 100 parts.

Opium, containing 10% of morphine, contains 10 parts of the alkaloid and 90 parts of other constituents, or 10 parts of the alkaloid in 100 parts of the drug

The strength of a solution, the amount of an active principle in a drug, or of an ingredient in a mixture—all may be conveniently stated in percentages, and the per cent symbol is constantly met with in the practice of pharmacy. There is not in all the arithmetic of pharmacy, so diversified a series of problems as those involving the use of the percentage idea. Nor is there in any field as prolific a source of argument as in this.

Percentage truly refers to parts per one hundred parts. It is obvious that the statement involves parts of the same kind and value. It is in connection with percentage solutions that it is often difficult to convince the student the true interpretation of the per cent values.

A 10 per cent silver nitrate solution properly means 10 parts of the silver salt in 100 parts of the finished solution. But since the salt can only be estimated in terms of weight, and the finished solution may be estimated in terms of volume or in terms of weight, it becomes necessary to qualify this statement further, thus:

Ten parts of silver nitrate, by weight, in 100 parts, by weight, of the finished solution.

When the doctor requests:

Two fluidounces of a 5% solution of cocaine hydrochloride, the correct interpretation of his order would be thus:

Two fluidounces of a solution of cocaine hydrochloride containing 5 per cent, by weight, of the alkaloidal salt.

But the quantity is given in volume (2 fl. oz.) and consequently it must be changed into units of weight before proceeding further with the calculation.

Rules for converting from volume into weight and vice versa, have been already studied; and these rules involve the use of the specific gravity factor.

Commonly in the drug store it is customary to overlook the negligible error which occurs when the specific gravity factor is overlooked, that is, then the assumption is made that the specific gravity of the finished solution is 1. But in the interest of "accuracy all the time"—a permissible inaccuracy is detrimental, particularly so since the error increases as the percentage strength increases.

If *exactly* calculated quantities are required, it is possible to obtain them by a method, which while considered by some as impractical, is nevertheless, the only accurate method available. It is as follows:

In calculating the percentage solution use as great a volume of solvent (water usually) as the quantity of solution called for. Base the calculation of the amount of ingredient upon the weight of this volume of solvent.

When this is done the finished liquid will actually measure more than the desired volume, but the definite quantity may be measured out and the excess saved or rejected according to its value, stability, etc.

59. Write a formula for 2 fluidounces of a 15 per cent solution of mild silver-protein.

Two fluidounces of water weigh $454.6 \times 2 = 909.2$ grains.

A 15% solution is:

15% ingredient
85% solvent = 909.2 grains
100% solution

The question now is:

If 85% = 909.2 grains what will 15% be?

This may be solved by proportion:

85 : 15 : : 909.2 : x (= 160.4 grains).

Thus by measuring out 2 fluidounces of water and dissolving in it 160.4 grains of mild silver-protein, there is produced a little over 2 fluidounces of an *exactly* 15 per cent solution.

The use of this exact method is suggested for all calculations involving 5 per cent and over.

Under 5 per cent the error is so negligible that the "drug store method" may be safely used.

60. Example: 2 fl. oz. of a 2.5 per cent solution of silver nitrate.

$$2 \text{ fl. oz.} = 454.6 \times 2 = 909.2 \text{ grains.}$$

$$2.5 \text{ per cent} = \frac{2.5}{100} = 0.025$$

Now if 909.2 is multiplied by this figure, the weight of the silver nitrate will be obtained. $909.2 \times 0.025 = 22.73$.

Therefore, 22.73 grains of silver nitrate dissolved in water to measure 2 fluid ounces is the answer.

Problems in Percentage

61. How much morphine is present in 280 Gm. of 11.5% opium?

62. How much resin is present in 24 avoirdupois pounds of podophyllum, which assays 2.8% resin?

63. If a certain opium has a morphine content of 11.5%, how much of the opium would contain just 9 Gm. of morphine?

64. What is the per cent of soluble matter in a certain drug, 600 Gm. of which yield 45 Gm. of soluble-extractive matter?

65. Diluted hydrocyanic acid contains 2% of absolute HCN, the rest being water. How much absolute HCN is present in 650 Gm. of diluted acid?

66. How many Gm. of 5% caustic potash solution may be made from 280 Gm. of potash?

67. What is the per cent strength of a liquid made by dissolving 16 Gm. of potassium chlorate in 1 fluidounce of water?

68. Boric acid requires 18 parts of water for solution. What is the per cent strength of a saturated solution?

69. What is the percentage of sugar in a syrup made by dissolving 5 pounds of sugar in 8 pounds of water? (Always remember that a solution is the sum of the solute (ingredient) and the solvent.)

70. Write formulas for the following solutions using the exact method:

(a) 500 cc. of a 15% aqueous solution of sodium bromide.
(b) 4 fl. oz. of a 12.5% aqueous solution of sodium bromide.
(c) 250 cc. of a 25% aqueous solution of sodium bromide.
(d) 6 fl. oz. of a 10% aqueous solution of sodium bromide.

71. Write formulas for the following solutions using any method.

(a) 4 fl. oz. of a 1% aqueous solution of silver nitrate.
(b) 1 Liter of a 2.5% aqueous solution of silver nitrate.
(c) 2 fl. oz. of a 4% solution of salicylic acid in alcohol (Sp. Gr. 0.81).

Explanation of " c ": $454.6 \times 2 = 909.2 \times 0.81 = 736.4$.
$736.4 \times 0.04 = 29.45$ grains dissolved in 2 fl. oz. of alcohol.

72. Write a formula for a quart of a 1-1000 aqueous solution of silver nitrate.

Explanation: 1 quart $= 454.6 \times 32 = 14547.2$ grains.

$$1/1000 = \frac{1}{1000} \times \frac{14547.2}{1} = 14.5 \text{ grains.}$$

14.5 grains dissolved in a quart of water.

73. Write a formula for a liter of a 1—2500 solution of silver nitrate in water.

74. U. S. P. solution of formaldehyde contains 37% of absolute formaldehyde. Write a formula for a pint of an aqueous solution containing 2.5% of absolute formaldehyde.

75. Write a formula for 4 fl. oz. of a concentrated solution of potassium permanganate of such a strength that 1 fl. dr. diluted with water to make a pint, constitutes a 1—1000 solution.

76. Write a formula for 250 cc. of a solution of silver nitrate of such a strength that 5 cc. diluted to a liter, constitutes a 1—2500 solution.

Explanation: The only clue to a solution of the problem lies in the last part of the sentence.

" 5 cc. diluted to a liter = a 1—2500 solution."

Therefore what is contained in a liter of a 1—2500 solution must be contained in the 5 cc. of the stronger solution.

$$1 \text{ liter of water} = 1000 \text{ cc.} = 1000 \text{ Gm.}$$

$$1-2500 = \frac{1}{2500} \times 1000 = 0.4 \text{ Gm.}$$

$$5 \text{ cc.} = 0.4 \text{ Gm.}$$

$$\text{Therefore: } 250 \text{ cc.} = 0.4 \times 50 = 20 \text{ Gm.}$$

Answer: 20 Gm. of silver nitrate and water sufficient to make 250 cc.

77. What is the % strength of a salt solution, obtained by diluting 200 Gm. of a 10% solution to 300 Gm.?

Explanation: The answer will be in terms of percentage.

Hence: : : : 10% : x

After dilution the strength will be less, therefore the lesser remaining term goes in the second place and the larger in the first. (The converse is true in a problem involving concentration.)

$$300 : 200 :: 10\% : x$$

$$x = \frac{10 \times 200}{300} = 6.66\%$$

78. To what weight should 5 kilograms of alcohol (95%) be diluted to make an alcohol of 50%?

79. How many pounds of 67 % nitric acid are required to make 40 pounds of 10% nitric acid?

80. To how many fluidounces must a liter of alcohol (Sp. Gr. 0.835; strength 85 per cent by weight) be diluted in order to make 62% alcohol having a Sp. Gr. of 0.89?

Note: Convert liter into Gm. Find weight of diluted product by proportion. This will be in Gm. Convert this to cc. (with Sp. Gr.); then to fl. oz.

Alligation*

Alligation Medial

81. Example: A druggist mixes together 5 pounds of 11% powdered opium, 4 pounds of 12.5% powdered opium, and 10 pounds of 9% powdered opium. What is the percentage strength of the mixture?

Explanation:	5 lb. of 11% opium	=	55 lb. of 1% opium
	4 lb. of 12.5% opium	=	50 lb. of 1% opium
	10 lb. of 9% opium	=	90 lb. of 1% opium
Totalling	19 lb. which is equivalent to		195 lb. of 1% opium

Nineteen lb. contains as much as 195 lb. of 1% opium, and the strength of the mixture must be as many times 1 per cent as 19 lb. is contained in 195

$$\text{or } \frac{195}{19} = 10.26\%.$$

82. What is the per cent of resin content in the following mixture?

25 lb. of 3 % podophyllum
5 Kilos 2.5% podophyllum
12 lb. 4.2% podophyllum
(Resolve into pounds)

* (The word alligation comes from the Latin *alligare*—to bind, referring to the binding together of value in these problems.)

83. What is the strength of the mixture produced by combining the following lots of alcohol?

2 liters of 95% alcohol
2 gallons of 50% alcohol
7 pints of 60% alcohol

(Resolve all quantities into liters)

Medial alligation may also be applied to Sp. Gr. The amounts, however, must always be in volume because Sp. Gr. expresses the weight of a given *volume*.

84. What would be the Sp. Gr. of a mixture of 150 Gm. of ether, Sp. Gr. 0.710 and 250 Gm. of chloroform Sp. Gr. 1.480?

Note: (Reduce Gm. to cc. then proceed by alligation medial).

85. What would be the Sp. Gr. of a mixture of 1 pint of glycerin (Sp. Gr. 1.248) and 1 lb. of water?

86. What would be the Sp. Gr. of a mixture of 1 gallon of alcohol of Sp. Gr. 0.816 and 1 gallon of alcohol of Sp. Gr. 0.920?

Alligation Alternate

87. Problem: In what proportion must opium containing 10.0% of morphine be mixed with 15% opium to produce opium of 12% morphine strength?

The weaker opium is 2% too weak. The stronger opium is 3% too strong. Therefore the excess in strength of 3 parts of the stronger will just balance the deficiency of 2 parts of the weaker drug.

For $3 \times 2 = 2 \times 3$.

Proceed with the solution of the problem thus:

Desired per cent, 12% $\begin{cases} 10\% = 3 \text{ parts.} \\ 15\% = 2 \text{ parts.} \end{cases}$

The figure obtained by subtracting 10% from 12% is placed against the 15%, and that obtained by subtracting the 12% from 15% placed against the 12%.

88. In what proportion must 30% alcohol, 45% alcohol, 60% alcohol, and 95% alcohol be mixed to make alcohol of 50% strength?

Desired percentage 50% $\begin{cases} \left.\begin{matrix} 30\% \\ 60\% \end{matrix}\right] = 10 \text{ parts of } 30\% \text{ alcohol.} \\ \left.\begin{matrix} 45\% \\ 95\% \end{matrix}\right] = 20 \text{ parts of } 60\% \text{ alcohol.} \\ \left.\begin{matrix} 45\% \\ 95\% \end{matrix}\right] = 45 \text{ parts of } 45\% \text{ alcohol.} \\ \left.\begin{matrix} 45\% \\ 95\% \end{matrix}\right] = 5 \text{ parts of } 95\% \text{ alcohol.} \end{cases}$

Rule: *Always link together a quantity which is less, with one which is greater than the desired percentage, otherwise the answer will be wrong.*

89. Prove the correctness of the above answer by medial alligation. Thus:

What will be the per cent strength of the following mixture?

10 parts of 30% alcohol
20 parts of 60% alcohol
45 parts of 45% alcohol
5 parts of 95% alcohol

Note: More than one correct answer may be had to certain problems in alternate alligation, depending on how the units are linked together.

90. How must the following batches of powdered opium be mixed in order to secure a 12% product, five lots containing respectively 7.5%, 9%, 10%, 14%, and 15% of morphine?

91. In what proportion should 95% alcohol, 50% alcohol, and water be mixed to make an alcohol of 35% strength?

Note: (The water may be considered as 0% alcohol.)

92. In what proportion should powdered opium, containing 12% of morphine, and powdered opium of 15% strength, and lactose, be mixed to make a 12.5% opium?

93. In what proportion must mineral oil (Sp. Gr. 0.812) be mixed with mineral oil (Sp. Gr. 0.845) to make a product having a Sp. Gr. of 0.825?

The problems heretofore solved referred only to indeterminate quantities (parts). The value of alligation alternate may be extended to problems where definite quantities are included, such as:

94. Example: How much opium containing 12% of morphine and how much of 14% strength, and how much lactose must be added to 250 Gm. of opium of 9% strength to have a product containing 10% of morphine?

Solution:

$$10\% \begin{cases} 12 \\ 0 \end{cases} = 10 \text{ parts} = ?$$
$$\begin{cases} 12 \\ 0 \end{cases} = 2 \text{ parts} = ?$$
$$\begin{cases} 9 \\ 14 \end{cases} = 4 \text{ parts} = 250 \text{ Gm.}$$
$$\begin{cases} 9 \\ 14 \end{cases} = 1 \text{ part} = ?$$

Then proceed by proportion:

$$4 : 10 :: 250 : x = 625 \text{ Gm.}$$
$$4 : 2 :: 250 : x = 125 \text{ Gm.}$$
$$4 : 1 :: 250 : x = 65.6 \text{ Gm.}$$

95. Example: How much opium of 12% morphine strength, and how much opium of 16% strength, must be used to make 25 lbs. of a product having a morphine content of 12.5%?

$$12.5 \begin{cases} 16 = 0.5 \text{ or } 5 \text{ parts} \\ 12 = 3.5 \text{ or } 35 \text{ parts} \end{cases}$$

Totalling..... .40 parts or 25 lbs.

By proportion:

$$40 : 5 :: 25 : x = 3\tfrac{1}{8} \text{ lbs.}$$
$$40 : 35 :: 25 : x = 21\tfrac{7}{8} \text{ lbs.}$$

96. How many Gm. of 28% ammonia water should be added to a Kilogram of 10% ammonia water to produce a 15% ammonia water?

97. The following lots of solution of ammonium chloride are mixed together: 200 Gm. of a 5% solution, 500 Gm. of a 1.5% solution and, 250 Gm. of a 4% solution. How much of the salt (100%), must be dissolved in the above mixture to increase its strength to 6%?

98. Three lots of powdered kola of the following alkaloidal content are mixed together: 1.28%, 1.45%, and 2%. How much of each need be used to produce 10 lb. of the finished mixture?

99. How many Gm. of nitric acid of 68% strength must be added to a Kilogram of dilute acid (10%) to make a 40% product?

Formulas and Prescriptions

100. Calculate a formula for a gallon of the following liquid:

Glycerin	3 fl. dr.
Phenol	1 fl. dr.
Water, sufficient to make	4 fl. oz.

The formula as written calls for 4 fluid ounces. The quantity wanted is a gallon, or 128 fluidounces. The ratio between 128 and 4 is 32 to 1. Thus if each quantity is multiplied by 32, the problem will be solved:

Glycerin	3 fl. dr.	× 32	=	96 fl. dr. or 12 fl. oz.
Phenol	1 fl. dr.	× 32	=	32 fl. dr. or 4 fl. oz.
Water, sufficient to make	4 fl. oz.	or		1 gallon

101. Calculate a formula for 100 Gm. of antiseptic powder prepared as follows:

Phenol	2 Gm.
Thymol	1 Gm.
Sod. benzoate	7 Gm.
Sod. salicylate	25 Gm.
Alum	115 Gm.
Totalling	150 Gm.

Now 100 Gm. is $\frac{100}{150}$ or $\frac{2}{3}$ of 150 Gm.

Each ingredient must be multiplied by $\frac{2}{3}$ so that there will be 100 Gm. of finished product instead of 150 Gm.

Phenol	2 Gm.	× $\frac{2}{3}$	=	$1\frac{1}{3}$ Gm.
Thymol	1 Gm.	× $\frac{2}{3}$	=	$\frac{2}{3}$ Gm.
Sod. benzoate	7 Gm.	× $\frac{2}{3}$	=	$4\frac{2}{3}$ Gm.
Sod. salicylate	25 Gm.	× $\frac{2}{3}$	=	$16\frac{2}{3}$ Gm.
Alum	115 Gm.	× $\frac{2}{3}$	=	$76\frac{2}{3}$ Gm.

102. The N. F. gives the following formula for Emulsion of Castor Oil:

Castor oil	35 cc.
Acacia	9 Gm.
Tincture of vanilla	2.5 cc.
Syrup	20 cc.
Water, sufficient to make	100 cc.

Calculate quantities for:

(a) 2 gallons
(b) 4 fl. oz.
(c) 2500 cc.
(d) 1 liter
(e) 1 pint

103. Following is a formula for an ointment:

Thymol iodide	1 drachm
Olive oil	30 minims
Wool fat	2 drachms
Petrolatum, sufficient to make	1 ounce

Calculate the quantities which must be used to make:

(a) 500 Gm.
(b) 2 pounds (avoirdupois)
(c) 2 pounds (apothecaries)

104. Calculate the dose of each ingredient in the following prescriptions:

A. ℞ Arsenic trioxide..... 1 grain
Strychnine sulphate..... ⅔ grain
Phenolphthalein..... 30 grains
Mass of ferrous carbonate..... 2 drachms
Mix and make into 60 pills.

The answer is obviously secured by dividing each ingredient quantity by 60.

B. ℞ Arsenic trioxide..... 1 grain
Strychnine sulphate..... ⅔ grain
Tincture of ferric chloride..... 2 fl. dr.
Aromatic elixir, q. s..... 6 fl. oz.
Mix and make a solution.
Teaspoonful every 3 hours.

Explanation: 6 fl. oz. = 6 × 8 or 48 fl. dr. (teaspoonfuls).

By dividing each ingredient quantity by 48 the answer is obtained.

In dividing fractions by 48 it is to be remembered that the same result will be obtained as by multiplying by the fraction $\frac{1}{48}$.

$$\text{Thus: } \tfrac{2}{3} \div 48 = \tfrac{2}{3} \times \frac{1}{48} = \frac{1}{72}$$

105. Calculate the dose of each ingredient in the following prescription:

℞ Codeine sulphate..... .5 Gm.
Ammonium chloride..... 8.0 Gm.
Brown mixture..... 240.0 cc.
Mix and make a solution.
Teaspoonful every 4 hours.

Give the answer in metric units.

Calculating Doses for Children

Young's Rule:

$$\frac{\text{Age}}{\text{Age} + 12} \times \text{adult dose} = \text{child dose}$$

The adult dose of salol is 5 grains. What is the dose for a four-year old child?

$$\frac{4}{4 + 12} = \frac{4}{16} = \tfrac{1}{4} \times 5 = 1\tfrac{1}{4} \text{ grain}$$

Cowling's Rule:

$$\frac{\text{Age}}{24} \times \text{adult dose} = \text{child dose}$$

The adult dose of salol is 5 grains. What is the dose for a four-year old child?

$$\frac{4}{24} = \frac{1}{6} \times 5 = \frac{5}{6} \text{ grain}$$

Note: Young's rule is almost universally used.

Thermometers and Hydrometers

Rules—(*Centigrade and Fahrenheit Thermometers*) As explained in the Chapter on Thermometers, page 103.

Degrees C. = degrees F. − 32 × 1.8
Degrees F. = (degrees C. × 1.8) + 32.

Centigrade and Reaumur Thermometers—

Degrees C. × .8 = degrees Reaumur
Degrees R. ÷ .8 = degrees Centigrade

Fahrenheit and Reaumur Thermometers—

(Degrees R. × 2.25) + 32 = Degrees F.
(Degrees F. − 32) ÷ 2.25 = Degrees R.

106. Convert: (a) 30 degrees C. into degrees F.
(b) 100 degrees C. into degrees F.
(c) −40 degrees C. into degrees F.

107. Convert: (a) 32 degrees F. into degrees C.
(b) 100 degrees F. into degrees C.
(c) 98.4 degrees F. into degrees C.

108. Convert: (a) 20 degrees R. into degrees C.
(b) 100 degrees C. into degrees R.

109. Convert: (a) 212 degrees F. into degrees R.
(b) 0 degrees R. into degrees F.

Hydrometers—The commonest form of hydrometer is the Baumé instrument. This is manufactured in two forms, namely, for liquids heavier than water and for liquids lighter than water, each marked in degrees.

Often it becomes necessary to convert the arbitrary hydrometer readings into terms of absolute specific gravity.

(a) For liquids lighter than water:
Rule: Sp. Gr. = 140 + (130 plus degrees B.)

(b) For liquids heavier than water:
Rule: Sp. Gr. = 145 + (145 minus degrees B.)

Problems

110. Reduce to specific gravity the following degrees Baumé on the lighter than water scale: (a) 15 degrees Baumé
(b) 30 degrees Baumé
(c) 55 degrees Baumé

111. Reduce to specific gravity the following degrees Baumé on the heavier than water scale: (a) 25 degrees Baumé
(b) 40 degrees Baumé
(c) 55 degrees Baumé

CHAPTER VI

OPERATIONS REQUIRING THE USE OF HEAT

Generation of Heat

THE consideration of the theories which have been advanced from time to time to explain the phenomenon of heat, although very interesting and instructive, cannot be treated extensively in a work of this character, and the reader is therefore referred to any of the recent works on physics, which are easily accessible. The view which is now almost universally accepted is that known as the dynamical theory of heat, in which it is assumed that heat is produced by the constant motion of the particles composing the body, and that heat varies in quantity dependent upon whether the body is *solid*, *liquid*, or *gaseous*.

There is a difference between heat and temperature which is frequently overlooked. Temperature is quality or degree, heat is quantity; thus, if one fluidounce of boiling water is in one vessel and one gallon of boiling water in another vessel both will have the same temperature but the amount of heat is vastly different and is in direct ratio to the respective volumes.

It will be convenient to consider the various practical operations and appliances for generating heat under four heads:

1. Operations and forms of apparatus in which *solids* are used in developing heat.
2. Those in which *liquids* are used.
3. Those in which *gases* are used.
4. Those in which *electricity* is used.

In the first three groups there are certain elements present upon which the combustion value of a fuel depends. These elements are carbon and hydrogen. When carbon predominates, as in some solid fuels, as charcoal, coke, and coal, the fuel may be termed *carbonaceous;* wood is a *carbohydrate fuel, i. e.*, one in which carbon, hydrogen, and oxygen are all present, the latter two elements in the numerical ratio of two to one. Some liquids and gases are *hydrocarbon fuels* in which carbon and hydrogen only are present.

Combustion is a process of oxidation. Carbon oxidizes to CO or CO_2, depending upon the access of air. Hydrogen always oxidizes to H_2O. *Smoke* is a visible evidence of incomplete combustion in which solid particles of carbon or partly condensed gases that have not been raised to the ignition point are present. A *flame* is another visible evidence of combustion in which gases that have been raised to the ignition point are visibly undergoing oxidation.

The heating value of fuels is generally stated in terms of *calories* or more commonly in terms of *British thermal units* (*b. t. u.*). Two calories are in use, the small and the large. The latter is most generally used in this country. The *large calorie* is the amount of heat required to raise the temperature of 1 Kilogram of water one degree Centigrade. The *small calorie* is the amount of heat required to raise the temperature of 1 Gm. of water one degree Centigrade. A British Thermal Unit (b. t. u.) is the amount of heat required to raise the temperature of a pound of water from 60° to 61° Fahrenheit, at sea level.

Operations and Forms of Apparatus in which Solids are Used in Developing Heat

Kinds of Fuel—Under this head is included the solid fuels, as wood, charcoal, anthracite coal, bituminous coal, coke, etc., and the forms of apparatus in which they are used.

Wood is seldom relied upon as fuel in pharmaceutical operations where a regular, well sustained heat is desired, yet from its wide distribution, ready inflammability, and comparative cheapness it is indispensable in kindling a fire. The large quantity of unconsumed carbon which is either lost in smoke or deposited upon vessels that are being heated, constitutes the chief objection to its use.

Charcoal is more convenient, although more costly, than wood. It ignites easily, burns readily, and leaves but little residue. On account of its ready combustibility, it is well fitted for operations requiring a quick, strong heat.

Coal, which is the most economical of the solid forms of fuel, consists largely of carbon. *Anthracite* or *"hard coal"* sometimes contains nearly 95 per cent of carbon. *Bituminous* or *"soft coal"* contains from 15 to 20 per cent of hydrocarbons in addition to carbon. *Ash* is present in amounts ranging from less than 5 per cent in the better grades to nearly 20 per cent in the poorer varieties. Anthracite coal is not readily kindled but burns freely without producing smoke. Bituminous coal kindles easily but gives off much unconsumed carbon when burned in ordinary stoves.

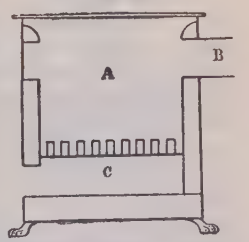
Coke, the residue obtained from the destructive distillation of soft coal, is an excellent fuel, and may be used either mixed with coal or by itself. It is more easily kindled than anthracite.

Methenamine (hexamethylenetetramine) is an interesting solid fuel, not at all economical, of course, but suitable for emergency use. A five grain tablet of this chemical if placed upon a suitable non-inflammable and non-conducting support and ignited with a match will burn with a non-luminous flame for a long enough time to heat 5 cc. of water in a test tube to the boiling point.

It affords an excellent and convenient fuel for heating small quantities of liquid for testing purposes as, for instance, in conducting a bedside test for albumin in urine.

Pharmaceutical Furnaces, etc.—Much ingenuity has been used in the contrivance of various forms of furnaces, ranges, stoves, etc., to meet general or special applications, yet in all there are certain fundamental principles of construction which must be well understood if faults are to be avoided. The elements of a furnace are the *airflue, combustion chamber*, and *vent* or *chimney*, and the relative proportions of these must depend upon the special object sought in the construction of the furnace, and the character of the fuel that is to be used. Fig. 57 represents a sectional view of a pharmaceutical furnace, —C being the airflue, A the combustion chamber, and B the vent.

Fig. 57



Pharmaceutical furnace, sectional view

The combustion or oxidation of coal requires the presence of a certain quantity of air in contact with the burning coal to furnish enough oxygen to combine properly with the carbon of the fuel. The result of the combination is carbon dioxide, CO_2, and carbon monoxide, CO, both of which are gases. It is very important to provide means of escape for these gaseous compounds, as they are both poisonous, and the former is a decided non-supporter of combustion. Theoretically, it has been calculated that one hundred

and fifty cubic feet of air are necessary to consume perfectly one pound of coal in an ordinary furnace, but practically, because of the obstruction of the ashes which prevents the thorough contact of the air with all parts of the glowing carbon, nearly double this amount is necessary.

Fig. 58

Portable furnace

Stoves and ranges are now so universally used that it would be needless to multiply illustrations of them. The proper selection of such as are suited to the special uses of the pharmacist must be left to individual decision, and will depend upon the space that can be spared and the character of the work that is to be done.

Fig. 58 illustrates a furnace suitable for heating large dishes and other apparatus. This is made by the J. L. Mott Iron Works, Trenton, N. J.

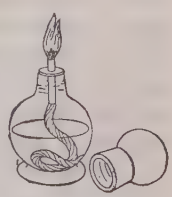
Operations and Forms of Apparatus in which Liquids are Used in Developing Heat

The liquids which are most used in pharmaceutical operations for heating are ethyl alcohol, denatured alcohol, methanol (methyl alcohol), petroleum or coal oil, and petroleum benzin, or gasoline. All of these liquids contain carbon and hydrogen, while ethyl alcohol contains 34 per cent and methanol 50 per cent of oxygen in addition.

Alcohol burns with a blue flame, which does not deposit soot, and the heat produced is intense. It is in many respects the best liquid fuel for generating heat in small operations, but the expense attending its use in this country is a serious objection, although this has been overcome in part through government regulations whereby *ethyl* or *grain* alcohol may be released from bond and sold for technical and industrial purposes if it has been denatured, that is, rendered unfit for use as a beverage. The denaturing must be under the supervision of Internal Revenue officers and the method used must have the approval of the Internal Revenue Department. The product is then known as *denatured alcohol*. In Great Britain it is called *methylated spirit*.

Refined *methanol* or *methyl alcohol*, also called *columbian spirit*, *colonial spirit*, etc., has nearly all of the advantages of alcohol when used for burning in lamps, and it is much cheaper than pure ethyl alcohol. It should, however, never be used as a solvent in pharmaceutical preparations, as it is very poisonous when taken internally and is dangerous even when applied externally or when inhaled; too much caution cannot be exercised to guard against its improper use. In burning alcohol, a glass spirit lamp, provided with a ground glass cap may be used (see Fig. 59). The cap prevents loss of alcohol by evaporation from the wick, when the lamp is not in use. In one of the simplest forms of alcohol stove, the alcohol is poured upon brass wire gauze, which covers a metallic box containing asbestos, by which it is absorbed; a lighted match is now applied to the gauze, which retains sufficient spirit to ignite, and a strong heat is at once obtained, the large extent of surface of the gauze producing a solid blue flame. The great advantages of spirit lamps of this kind are that, all parts being of metal, accidents from breakage are avoided, while explosions cannot occur, as neither the alcohol nor its vapor is confined in a tight receptacle, and if the lamp is upset accidentally no spirit can be spilled, because it is absorbed by the

Fig. 59

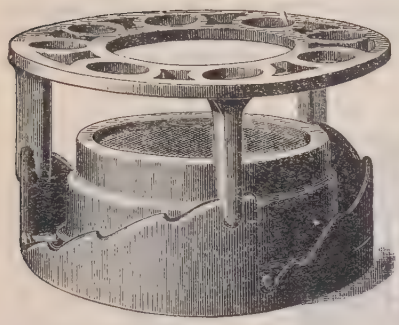


Spirit lamp

asbestos. Many modifications of this simple contrivance have been introduced which are elaborate and useful (see Fig. 60).

Fig. 61 shows a type of stove which is used for generating heat with denatured alcohol. The heated burner vaporizes the alcohol which burns very much

Fig. 60



Pocket alcohol stove

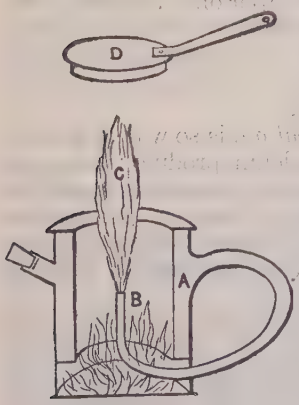
Fig. 61

Alcohol stove

like gas and the flame may be readily regulated by turning the knob which operates a needle valve and controls the flow of alcohol.

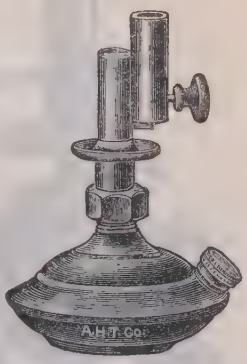
The so-called Russian blast lamp is one of the best contrivances for generating an intense heat. It is useful when glass tubes of large diameter are to be bent, or in crucible operations. A sectional illustration is seen in Fig. 62. It is made of sheet copper, and consists of a partially jacketed cylinder, A, with an opening on one side for introducing the alcohol, and on the opposite side a bent, tapering tube, B, which pierces the cylinder below the jacketed portion, and is turned upward as shown in the cut. The principle of action is that of the combustion of the *vapor* of the spirit.

Fig. 62



Russian blast lamp

Fig. 63



Alcohol blast lamp

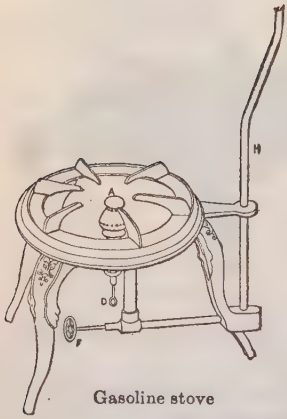
Despite the simplicity of its construction, the Russian blast lamp is not without danger. The intensity of its heat production has no regulation whatever. Modern alcohol blast lamps, however, are provided with a valve whereby the delivery of the heated vapor may be carefully controlled. A lamp of this type, known as the Barthel automatic burner, is illustrated in Fig. 63.

Denatured alcohol has also found extensive use as a fuel in the form of a *solidified alcohol*, known under such trade names as *sterno*, *smaragdin*, etc. Some of these consist of soluble gun cotton made into a paste with alcohol but a cheaper form is prepared by dissolving 1.35 Gm. of sodium hydroxide in

40 Gm. of alcohol and 8.5 Gm. of stearic acid in 50 Gm. of alcohol, mixing the two solutions, warming until the reaction is complete, and moulding into the desired form by pouring it into a suitable vessel.

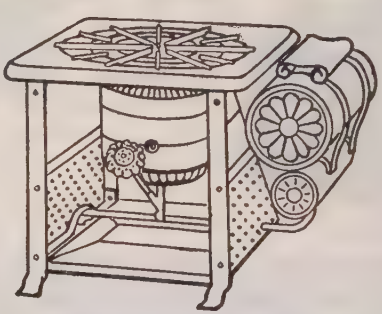
FIG. 64

Petroleum benzin, or *gasoline*, is now used for heating purposes, and Fig. 64 shows one of the most convenient stoves for employing this cheap but very volatile hydrocarbon. The difficulties in the use of the very inflammable and often dangerous liquids of this class for heating have been largely overcome. To avoid a smoky, luminous flame the *vapor is burned after being mixed with air*, while to prevent explosions the reservoir for the liquid is elevated and placed some distance away from the ignited vapor. The vapor only is burned, the gasoline being volatilized by the heat from the metal burner. It produces a blue and intensely hot flame, the size of which may be easily regulated.



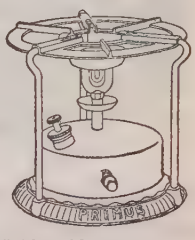
Gasoline stove

FIG. 65



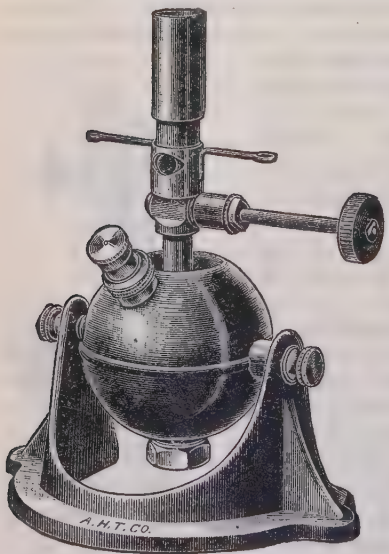
Wickless blue flame coal oil stove

FIG. 66



Wickless blue flame coal oil stove

FIG. 67



Benzene blast lamp

Kerosene, or *coal oil*, is so widely known as a refined petroleum product, that any extended notice of its properties would be superfluous; as it is heavier in specific gravity and has a much higher flashing and firing point[1] than gasoline, it is much safer for popular use.

The old form of coal oil stove, with wick burners, has been entirely replaced by the "wickless blue flame oil stove", in which the vapor of the oil is burned. Fig. 65 shows a good form, although three and four burner stoves are most frequently used. Fig. 66 shows a small, wickless, coal oil stove which is very efficient.

Benzol, or *benzene*, a hydrocarbon ob-

[1]By this term is meant the temperature at which any oil begins to give off inflammable vapor that forms an explosive mixture with air. This temperature for illuminating oils, fixed by the laws of different states, varies from 43.3° to 65.5° C. (110° to 150° F.).

tained by destructively distilling coal is employed for special purposes as a heating fuel. The lamp in which it is burned is of the Barthol type. It is shown in Fig. 67.

Crude oil is coming into use as a fuel to replace coal in heating furnaces. The more volatile constituents having been removed from crude petroleum, the resulting product may be burned in the form of a fine spray, by means of special burners.

Operations and Forms of Apparatus in which Gases are Used in Developing Heat

Gas—The extensive employment of manufactured illuminating gas and natural gas as sources of heat for pharmaceutical and other purposes, render necessary a somewhat extended notice of gas in this connection. Illuminating gas was formerly called carburetted hydrogen, but it is really a mechanical mixture of various gases, some of which produce luminous flames. Besides the hydrocarbon, CH_4 (methane or carburetted hydrogen), which is the principal constituent, it contains condensible hydrocarbons, hydrogen, carbon dioxide, carbon monoxide, aqueous vapor, and varying amounts of oxygen and nitrogen. The following analyses are typical of the illuminating gases used at the present time.

	Coal gas	Coke oven gas	Water gas	Flue gas
CO_2	1.1	2.5	5.6	8.7
Illuminant	2.3	1.7	8.5	0
O_2	0.9	0.8	0.7	0.3
CO	5.8	6.7	28.9	37.1
H_2	51.9	54.0	38.1	48.2
C_2H_6	0.7	0.8	1.6	0
CH_4	30.9	28.4	12.4	0.6
N_2	6.4	5.1	4.2	5.1
Total	100%	100%	100%	100%

The illuminant represents the light hydrocarbons from coal distillation added to the gas mixture to increase the candle power. The high carbon monoxide content of the water gas and the flue gas (which is non-carburetted water gas) accounts for the toxic character of these two gases. Death from coal gas is due to mechanical suffocation, whereas death from water gas or flue gas is due to a distinct physiological poison, namely, the carbon monoxide, which robs the blood of its oxygen carrying power, so essential to the continuation of life.

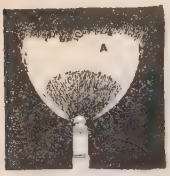
The odor of manufactured gas is usually a sufficient warning of a leak, and natural gas, which is frequently odorless, is given an odor, usually by the addition of sulphur compounds, to render it safer for domestic consumption.

Gas is usually produced by the destructive distillation of bituminous coal; coal tar, gas liquor, and coke are the liquid and solid by-products, and these are valuable sources for the manufacture of products in the chemical and other industries (see Part V). There are at present many kinds of gas which are used

for purposes of heating or illumination among which may be mentioned coal gas, water gas, producer gas, acetylene gas, and gasoline gas.

Gas which is fitted for illuminating purposes must have its composition modified by admixture with air before it is fit for heating purposes; this may be best illustrated by the examination of an ordinary fishtail gas flame. In Fig. 68 it will be noticed that three zones are visible,—the lower or dark central zone, which is not luminous and not at all hot, because the gas is fully ignited; A, the luminous zone, where the emission of light is due to the suspension of minute particles of incandescent carbon in the flame, caused by the incomplete combustion of the gas; and the outer non-luminous zone, or "mantle" which fringes the flame, and where the particles of carbon coming in direct contact with the air are entirely consumed. The products of complete combustion of illuminating gas are carbon dioxide and water vapor.

Fig. 68



Gas flame

The conditions necessary for the production of a flame with either solid, liquid, or gaseous fuels are as follows:

1. The material must be in the form of a vapor or gas.
2. This gas must be mixed with oxygen.
3. This mixture must be within certain limits as to proportions.
4. The mixture must be heated to the kindling temperature.

The blowing out of a flame is effected by either lowering the temperature of the burning mixture or scattering the vapor. This does not apply to glowing solids where blowing augments the burning by supplying oxygen.

Soon after gas came into use it was discovered that the properties which rendered it most valuable as an illuminant interfered with its use as a source of heat, because of the deposition of the particles of soot from the luminous portion of the flame upon vessels that were to be heated; indeed the luminous flame implies incomplete combustion whereas the non-luminous flame results from complete combustion. Doctor Duncan, of Edinburgh, showed that if gas properly mixed with air was made to enter at the bottom of a tall, tinned iron cylinder, the upper end of which was covered with wire gauze, it would burn when ignited above the gauze with a blue, smokeless flame. Bunsen, the famous chemist, improved upon Duncan's idea and in 1855, developed, in his Heidelberg laboratory, with the assistance of a local mechanic, the controllable burner which bears his name. The unnecessarily long cylinders (sometimes thirty inches) which were originally used were soon replaced by others of the length of five or six inches for the sake of greater convenience. This discovery was further utilized, in the construction of gas stoves and burners for various purposes.

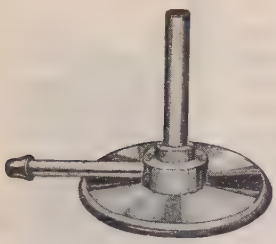
Fig. 69

Bunsen burner

Bunsen burners (see Fig. 69) are more frequently used in simple operations than any other form. The gas issues from a small orifice, near the base, passes up through a brass tube, four inches high, and is ignited at the top of this tube; large circular openings surround the small orifice at the base, and these may be closed either wholly or in part by a perforated brass ring; this permits the regulation of the supply of air, which mixes with the gas as it ascends the tube, and a blue, smokeless, intensely hot flame may be produced. If the perforated ring is turned so that the air openings are closed, a luminous, smoky flame results. One of the objections

to the ordinary Bunsen burner is that, after being used for a time under a low gas pressure, when the tube becomes hot the flame will sometimes recede and the gas become ingited at the lower orifice. This may usually be avoided by gradually turning the brass perforated ring, so as to admit less air to

Fig. 70

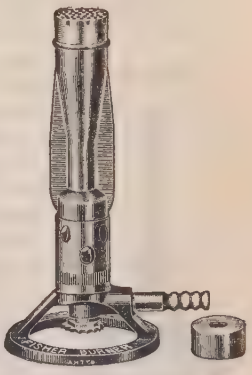


Micro burner

Fig. 71

Meker burner

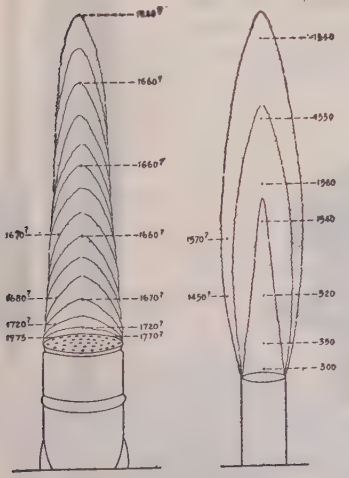
Fig. 72



Fisher burner

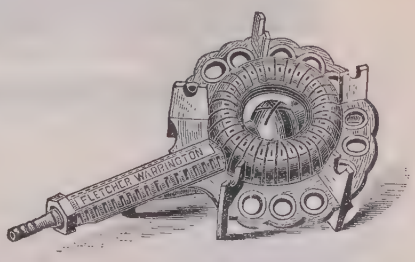
suit the diminished pressure. That the length of the perpendicular tube does not materially affect the smokeless character of the flame may be proved by means of the convenient little burner shown in Fig. 70, commonly called a "*micro burner*," which is very useful at the prescription counter. The newest development in this type of burner is seen in Figs. 71 and 72, representing the *Meker* and the *Fisher* burners. The special advantage afforded by these burners, which give a blast effect, is that the control of air and gas supply render it possible to have a flame entirely free of incompletely consumed carbon. A comparison of the temperatures obtainable from a Fisher burner and an ordinary Bunsen

Fig. 73



Comparison of Fisher and Bunsen burners

Fig. 74

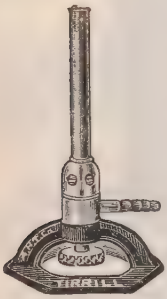


Fletcher's radial burner

burner, from the Scientific Materials Co., is illustrated in Fig. 73. The burners illustrated by Figs. 71 and 72, produce exceedingly high temperatures. This is the latest development of the grid top type of burner, giving greatly increased heating power and an absolutely homogeneous flame, all of which is available for heating from the top of the burner to the extreme point. The gas regulating device permits its use with any quality of gas delivered at any pres-

sure and permits regulation from the maximum to the smallest flame without back-firing. With blast attachment a temperature exceeding 1700° C. is obtained. Bunsen type burners with the tube arranged horizontally have grown in favor because they are less likely to be overturned, and if they have a broad base they will easily support a large vessel. Fletcher's radial burner (see Fig. 74) has the merit of having no loose parts, and as the casting is well annealed, it is well adapted for rough usage, the gas issuing from narrow slits cut radially in the raised circular burner; the flame is solid and non-luminous. No gauze is needed to distribute the heat.

Fig. 75



Adjustable Bunsen burner

In many localities outside of cities and towns, gas made by vaporizing gasoline and mixing air with it, is used for illuminating purposes. It is made by gas machines located in the cellar of the building, while the gas tank is buried underground at a safe distance. Special burners are required when this gas is used as an illuminant, and they require some adjustment at first to secure the proper proportion of air. Fig. 75 shows an adjustable laboratory burner, which gives a very hot, blue flame with this kind of gas, and it may also be used with ordinary gas. The milled head at the base of the burner is used to regulate the quantity of the gas admitted necessary to produce a blue flame.

Fig. 78

Gas furnace

Fig. 76

Gas stove

Fig. 79

Water heater

Fig. 77

Solid top gas stove

Gas stoves are now made in such variety that it seems difficult to make a judicious selection for general pharmaceutical work. The error most frequently made is in the choice of those which are intended to produce only very high temperatures. It is very seldom that a heat of great intensity is desired in pharmaceutical operations. The chief points to be secured in a good gas stove are—1, a smokeless flame; 2, a strong, firm, indestructible frame that will easily support a large or small vessel and is not easily overturned; 3, an easy and quick adjustment, whereby either a strong, well sustained heat or a low, diffused heat may be obtained. Fig. 76 shows a type of gas stove in

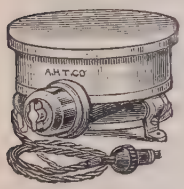
every way well suited for pharmaceutical operations. The solid top gas stove shown in Fig. 77 may be used for coal or natural gas. Its specific advantage is that its special construction renders it impossible to "smother" the flame when the entire top is covered or when liquids boil over. Fig. 78 illustrates a gas-heated furnace or caldron, capable of heating large quantities of materials to a high temperature. Fig. 79 shows a convenient hot water generator, well adapted for furnishing a supply of hot water in pharmacies if not otherwise available.

The advantages of the use of illuminating gas as a source of heat may be summed up as follows: 1. It may be adjusted to furnish a clean, smokeless flame. 2. It is cheap when compared with alcohol and other sources of heat. 3. The supply is unremitting, and the inconvenience of continually supplying fuel, which is always present in other forms of stoves, is not experienced. 4. The supply is under almost perfect control, and, after once regulating the flow suitable for a continuous operation, little apprehension need be felt, during the operator's enforced absence, of unexpected or unforeseen changes in temperature.

Operations and Forms of Apparatus in which Electricity is Used in Developing Heat

Electricity as a Source of Heat—The utilization of electricity as a source of light has naturally turned the minds of inventors to devising means of using it for heating purposes. In many localities it will often be found that for convenience, cleaniness, and ease of application electric stoves have an advantage. Fig. 80 shows a simple electric stove which can be used for small operations. The current flows through fine wires of highly resisting metal, and the heat produced by the resistance warms the top plate of the stove. Figs. 81 and 82 illustrate two forms of electric stoves. The heat may be regulated to "high", "medium", or "low", or may be turned off completely through the use of a switch operated by a button. The several stages of heat burn 880, 440, or 220 watts, respectively, of electric current, per hour.

Fig. 80

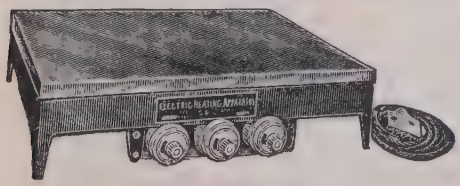


Small electric stove

Fig. 81

Electric stove

Fig. 82



Electric stove

Fig. 83

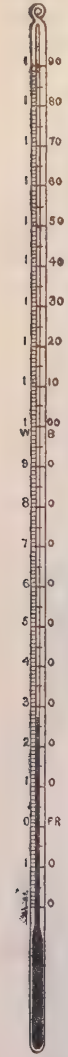
Immersion heater

Many other forms of electrically heated stoves are now available for heating ovens, sterilizers, jacketed kettles, and for general cooking purposes, etc.

A most convenient type of heater for small quantities of non-corrosive liquids is seen in Fig. 83. This heater is immersed in the liquid which it promptly heats when the current is turned on.

In certain industries electricity has been largely used as a source of heat, especially for high temperatures, or where a flame would be dangerous, and its ease of regulation and convenience has greatly extended its use in all laboratory operations requiring heat.

Fig. 84

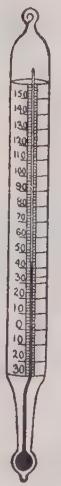


Centigrade thermometer

Fig. 85

Fahrenheit thermometer

Fig. 86



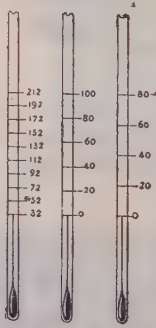
Paper scaler thermometer

Methods of Measuring Heat

To measure degrees of temperature in pharmaceutical operations, thermometers are used exclusively. A thermometer may be described as an instrument consisting of a glass tube having a capillary bore, with a cylindrical or globular bulb blown at the end, the bulb and a part of the stem containing a liquid (usually mercury), and the tube being mounted upon a graduated scale, or the tube itself graduated, in order to measure the degree of expansion of the liquid when subjected to the influence of heat. Unfortunately, the value of the degrees of thermometers in common use is not the same, there being no less than three arbitrary scales,—Centigrade, Fahrenheit, and Réaumur, the latter rarely used in English speaking countries.

The *Centigrade*, or Celsius, scale is best adapted for scientific work; it is given the first place in the U. S. P. (10th Rev.). The freezing point of water on this scale is zero, 0°, and the boiling point is 100°; the intervening space is divided into one hundred equal parts (see Fig. 84), and thus the system of decimal division, now so largely used in coinage and in weights and measures, is maintained for temperature. Most foreign scientific literature, especially the French and German, refers to the centigrade scale.

Fig. 87



Fahrenheit Réaumur Centigrade

The *Fahrenheit* scale is the most largely used in this country and Great Britain, and until the 1880 revision of the U. S. Pharmacopœia it was used exclusively in pharmacy. In this book the centigrade degrees of the Pharmacopœia are followed, methods for conversion to the Fahrenheit scale being given on pages 89 and 103. In Fahrenheit's thermometer the freezing point is 32°, and the boiling point is 212°, the intervening space being divided into one hundred and eighty equal parts (see Fig. 85). In Réaumur's thermometer the freezing point is 0°, and the boiling point is 80°.

Fig. 86 shows a convenient and cheap form of thermometer for pharma-

ceutical uses, but on account of its having a paper scale it should not be used for measuring temperatures above 300° F. as the paper will be charred.

In Fig. 87 the three thermometers are shown together to facilitate comparison. The lowest figures indicate the freezing points of each, the highest the boiling points.

RULES

1. *To convert Centigrade degrees into those of Fahrenheit*, multiply by 1.8 and add 32.

2. *To convert Fahrenheit degrees into those of Centigrade*, subtract 32 and divide by 1.8.

Another very simple rule is as follows:

To convert °C. into °F.—add 40, multiply by 9/5 and then subtract 40. Example: $100° \text{ C.} + 40 = 140 \times 9/5 = 252 - 40 = 212° \text{ F.}$

To convert °F. into °C.—add 40, multiply by 5/9 and then subtract 40. Example: $212° \text{ F.} + 40 = 252 \times 5/9 = 140 - 40 = 100° \text{ C.}$

By this method the confusing 32° is entirely eliminated.

Choice of Thermometers—It is important that the practical pharmacist should possess a good thermometer. The best form is one in which the graduations are made on the surface of the tube. The diameter of the instrument should be the same throughout its entire length; this permits its convenient use through perforated corks in distillations and other operations where it is necessary to observe temperature, and it is not so easily broken (see Fig. 84). The thickness of the glass of the bulb is not a matter of indifference. If too thick, the thermometer will not respond quickly to changes of temperature, while if too thin, the risk of fracture is very great. The bore of the tube should be flat or elliptical, and perfectly uniform throughout. Opaque, enameled glass behind the bore of the tube is of great assistance in reading the indication quickly. In many operations it is permissible to place a small section of rubber tubing over the mercury bulb to protect it from fracture. It is a good practice to send a thermometer to be officially tested,[1] and then to reserve it as a standard for correcting ordinary instruments. As glass usually reaches its limit of contraction in three years, such a thermometer should be at least this old before it is sent.

Care and Handling of Thermometers[2]—In the handling of thermometers it is often found necessary to manipulate the mercury within the capillary, in order to reunite with the main column a part of the mercury which has become separated, to remove gas bubbles from the mercury in the bulb or stem, or to separate a mercury thread for use in calibrating. There are four operations usually resorted to in manipulating the mercury, viz., (a) warming, (b) cooling, (c) tapping on the end, and (d) tapping on the side of the thermometer.

Warming the bulb of a thermometer may be done in water or oil or in air high above a gas or alcohol flame, but great care must be taken, especially with high temperature thermometers, not to heat the bulb to a temperature higher than the thermometer is intended to measure. The upper end of a thermometer stem may be warmed over a Bunsen burner if this is done very gradually. When the thermometer is warmed over a flame, it should be rotated about its axis.

Cooling may be accomplished in cold water, ice, a freezing mixture, or carbon dioxide snow, but such cooling should not be attempted while the thermometer bulb is still hot to the touch.

---

[1] Clinical and other thermometers are examined, and certificates are issued showing the corrections, by the U. S. Bureau of Standards, Washington, D. C.

[2] Extract from Circular No. 8 of the U. S. Bureau of Standards, on Testing of Thermometers.

Tapping or striking a thermometer on the end must be done carefully at all times and much more so when the bulb is only partially filled with mercury and the thermometer is inverted. This tapping may be soft, as when the thermometer is held vertically and the hand (not the thermometer) is struck on the table, or it may be sharp, as when the thermometer is held vertically and struck downward on a pad of paper.

Tapping on the side of a thermometer may be done softly with the hand or sharply with a pencil. Either must be done with care, as there is danger of breaking the stem. Different thermometers require different treatment, but the following procedure may serve as a guide in the manipulation of thermometers not filled with gas under pressure.

To remove mercury from the upper bulb when it is partially full, hold the thermometer vertically, bulb down. Tap softly on the side near the top and softly on the end, to bring the mercury to the lower part of the upper reservoir. Then try both tapping softly and sharply, on the end, and if this fails to bring the mercury down the stem, warm the bulb until the mercury rises and unites with that in the reservoir. Cool very slowly and probably the mercury will all come down. If not, try again, cooling more slowly.

To remove mercury from the upper reservoir when this is completely full or when the mercury persistently stays at the top reservoir, warm the upper end carefully over a Bunsen flame, beginning at the extreme tip. The mercury will be driven down the capillary by its own vapor pressure. If small mercury globules are left, warm a little more and they will condense farther down. Wait until the upper end cools to a temperature comfortable to the hand. Warm the lower bulb until the mercury rises and collects the small globules.

To find whether there is any residual gas in the thermometer bulb, warm the bulb until at least a few centimeters of mercury appear in the capillary; if mercury is already there, do not warm. Invert the thermometer and see whether the mercury runs down. If not, there is probably no gas in the bulb. If the mercury runs down, let it run a few centimeters and look for a bubble in the bulb. Right the thermometer and see whether this bubble entirely disappears when the mercury returns to the bulb. If this bubble disappears, no significant amount of gas is present.

To remove gas when found, invert the thermometer and run some mercury into the capillary. Right the thermometer and tap sharply on the side and on the end to bring the gas to the top of the bulb before the mercury all returns. Cool the bulb as much as possible, tapping sharply on the end when cold. Invert the thermometer and tap very softly on the end to bring down the mercury which is still separated by the air bubbles from that in the bulb. When this has come down, either tap "sharply" or warm to bring down the mercury from the bulb, but do not let the separated thread get into the upper bulb until the main mercury column is ready to join it. Get the two separated parts to join in any convenient enlargement or in the upper reservoir. Right the thermometer or hold it at an angle, with the top higher, and let the mercury run slowly into the bulb, watching carefully the point where the bubble is left, to be sure that the column does not separate. If the bubble begins to enlarge, run the mercury more slowly.

Bubbles can often be removed, even from high temperature thermometers, which are filled under pressure, provided there is an enlargement in the stem (*e.g.*, between the zero and 300° C. mark). If there is no such enlargement the gas can sometimes be removed by long, continued sharp tapping on the end, or sometimes by freezing the mercury by means of CO_2 snow, then warming

FIG. 88

Beckmann-type thermometer

the bulb (from the bottom) rapidly against the hand. Mercury will not break the bulb on freezing, as it does not expand.

Differential or *self-registering thermometers* are of great usefulness in certain analytic operations. The Beckmann type is illustrated in Fig. 88. This instrument has a range of 5° or 6° C., divided in 1/100°, reading either upward or downward and an auxiliary scale adjacent to the reserve reservoir, reading from −10° to+140° C., in 2° divisions.

The auxiliary scale under the reservoir permits the "setting" of the main scale at any desired temperature. For example, when the thermometer is to be used at 50° C., the bulb should be gently heated until the mercury in the reservoir reaches 50° C. on the upper or auxiliary scale. When setting for use at higher temperatures, heating the bulb is not desirable. This can be avoided by inverting the thermometer, and while holding the metal cap in the palm of the hand, with the inverted thermometer in a vertical position, jar the instrument by striking the hand (but not the cap) sharply from below. This will start the thread of mercury. The instrument should be turned to its normal position when the thread reaches the desired position on the auxiliary scale.

FIG. 89

Clinical thermometer

A sudden swing of the thermometer from left to right through an arc of about 45° while held in the vertical position, will break the mercury column and throw the superfluous mercury into the right arm of the reservoir.

The upper end of the mercury thread, which should appear in the main capillary about the middle of the main scale, will then be in the position equivalent to the temperature shown in the auxiliary scale at the moment of separation, *i. e.*, 50° C.

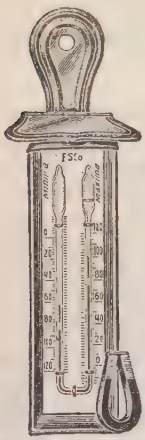
Fig. 89 illustrates one of the most valuable forms of the thermometer; it is called a *clinical* thermometer. The cross section is triangular instead of circular, and the capillary orifice is flattened so as to enlarge the diameter of the surface of the mercury, in order that it can be read easily. The normal temperature of the human body is 98.6° F. (37° C.). By inserting the bulb of the oral thermometer under the tongue, closing the mouth, and allowing the thermometer to rest there for a short time, from one to three minutes, depending upon the requirements of the thermometer, the body temperature may be determined.

Clinical thermometers are self-registering—that is, the mercury remains at the height to which it has risen until shaken down. It is therefore always necessary for them to be shaken down to about 95° after use. This is done by firmly grasping the upper half of the thermometer and giving a sharp quick jerk, repeating until it registers 95° F. Never force the mercury below 95° as this may prevent accurate registration, due to a slight contraction in the stem below this point. If this happens, it may be brought up again by placing it in warm water at not over 100° F. for a few moments.

Special clinical thermometers are also made for taking the rectal temperature which is 1° higher than by mouth.

Body temperature may also be taken by placing the thermometer in the axilla or in the groin where the normal temperature is 0.5° lower than by mouth.

FIG. 90.



Maximum and minimum registering thermometer.

Fig. 90 illustrates a *maximum and minimum registering thermometer*, of the Sixes type. The thermometer is "U" shaped with the high temperature at the top on one side and the low temperature at the top on the other side. Metal-floats rise with the mercury column; one remains at the lowest temperature reached, the other at the highest temperature. These floats are reset by means of the magnet supplied. The scales are on a milk-white glass plate, mounted in an enameled sheet metal case, with provision for hanging. Range, −10° to +120° F.

The specifications for thermometers established by the U. S. P. X are copied below.[1]

Melting Point—By this is meant the temperature at which a substance melts or fuses. It is used as a means of identifying a body or of proving its purity. The U. S. P. X cites the melting point of many bodies and has established an official method for their determination.[2] The official method for taking melting points is shown in Fig. 91. The melted substance is drawn into the small tube and allowed to cool, and

[1] **U. S. P. X Standard Thermometers**—*General Requirements*—The bulbs are to be normal glass or Corning normal thermometer glass, or of Jena 16 III. The stems may be made of other white enamel-back glass tubing having a circular cross section; the diameter of the capillary must not be greater than 0.1 mm. The diameter of the stem is to be 5.5 mm. (to within ±0.3 mm.), and the maximum diameter of the bulb must not be greater than the diameter of the stem. The thermometers are to have a pear-shaped reservoir at the upper end of the capillary having a volume at least equal to the volume of the entire graduated portion of the stem. The upper end of the stem is to have a small glass ring.

Graduation—The thermometers are all to be graduated in 0.5° (one-half degree) intervals. The 1° graduation marks are to be longer than those for the half degrees, the longer graduations preferably extending equally to the right and left of the shorter marks. The graduation marks are to be clean cut and fine, and to be uniformly well-filled with insoluble colored pigment.

Numbering—The 100° graduations (the 0°, 100°, 200°, 300° graduations on the different thermometers) are to be numbered in full and the intermediate 5° and 10° graduations are to be numbered 5, 10, 15, etc. . . . . 95, 100, 5, 10, 15, ... 95, 200, 5, 10, etc. The numbers must be distinct and easily legible, preferably in such position that they will be upright when the thermometer is vertical. The figures should not be unduly large. It is suggested that the figures opposite the 0°, 100°, 200°, 300° graduations be made about 2 mm. in height and the thermometer numbers 5, 10, 15, etc., somewhat less (about 1.4 mm.).

Annealing—The thermometers should be so thoroughly annealed that there will be no appreciable change in their indications after long continued exposure to the highest temperature on the scale.

Error of Scale—The maximum error at any temperature below 100° C. must not exceed 0.5,° nor exceed 1.0° in the interval 100° to 300° C.

Standardization—The thermometers should be submitted to the Bureau of Standards for standardization, or carefully compared with thermometers actually standardized by the Bureau of Standards.

Filling under Pressure—Thermometers reading over 200° C. must be filled under sufficient pressure to prevent the mercury column from boiling or breaking up into small pieces.

Thermometer No. 1—The thermometer is to be graduated from −10° to 150° C. in half degrees, the length of a 1° interval being 1.5 to 2 mm.

Thermometer No. 2—The thermometer is to be graduated from 95° or 98° to 300° C. in half degrees, the length of a 1° interval being 1.5 to 2 mm. The length of the thermometer between the lower graduation and the lower end of the bulb should not exceed 50 mm.

Auxiliary Thermometer—This thermometer is for emergent stem corrections. Use a standard thermometer from 15 to 20 cm. in length and graduated from 20° to 100° C., in degrees.

Thermometers for Boiling Points—In order to avoid the necessity of an emergent stem correction, it is advisable that an accurate standardized thermometer of the Anschütz type be used for boiling points. If such a thermometer is not available a thermometer such as is specified above (see Nos. 1, 2, or 3) may be employed, applying the emergent stem correction as described under *Melting Points* (see below), the length of emergent stem being measured, in degrees, from the lower end of the stopper to the highest point of the boiling temperature.

[2] **U. S. P. X Method for Determining Melting Points**

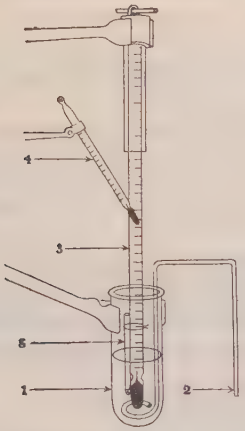
For the purpose of the Pharmacopœia the melting point is defined as that interval of temperature within which the substance is observed to melt when treated as directed below.

For the determination of the melting point, Pharmacopœial substances are divided into two classes:

Class I—Substances readily reduced to a powder.

the end of the tube is sealed. The tube is attached by a rubber band to a thermometer, and both immersed in a bath of some convenient liquid. The whole is gradually heated, and the point at which the substance melts is noted. Figs. 92 and 93 show Bensemann's method of collecting a fusible

FIG. 91



Taking a melting point

FIG. 92 FIG. 93

Bensemann's method of collecting fusible body

Class II—Substances not readily reduced to a powder, such as fats, fat acids, paraffin, petrolatum, and waxes.

Apparatus required (see illustration):

1. *A round-bottom, glass tube* of from 30 mm. to 40 mm. internal diameter and about 10 cm. long, flaring slightly at the top like an ordinary test tube. The walls of the tube are not more than 1.5 mm. thick at any point. The tube is made of glass which will permit heating over an open Bunsen flame.
2. *A stirring device*, which can be made from a glass rod of about 2 mm. external diameter. It is made circular at the end to fit the container (1) and is bent twice at right angles above the top of the container to bring its outer end within reach for convenient manipulation.
3. *A standard thermometer* covering the desired range of temperature (see above).
4. *An auxiliary thermometer* (see above).
5. *A capillary glass tube* about 6 cm. long and from 0.8 to 1.2 mm. internal diameter, the walls from 0.2 to 0.3 mm. thick and the tube closed at one end.

Procedure for Class I:

Reduce the substance to a very fine powder and, unless otherwise stated, render it anhydrous, when it contains water of crystallization, by drying it at the temperature given in the text, or, when the substance contains no water of crystallization, by drying it for twenty-four hours over sulphuric acid.

Select a bath suitable for the melting temperature to be determined and fill the container to a depth which will permit of such immersion of the thermometer that the upper end of the bulb will be from 2 to 3 cm. below the surface of the bath and the lower end of the bulb about equally distant from the bottom of the container.

Charge the capillary glass tube with sufficient of the dry powder to form a column in the bottom of the tube from 2.5 to 3.5 mm. high when packed down as closely as possible by moderate tapping on a solid surface. Attach the capillary tube to the thermometer by wetting both with the liquid of the bath or by means of a piece of platinum wire and adjust it so that the substance is centrally located by the side of the thermometer bulb. Heat the bath by means of a free Bunsen flame until a temperature 25° C. below the supposed melting point is reached, then carefully regulate the rate of rise in temperature to about 3° per minute until the substance begins to melt (the temperature at which the column of the substance is observed to collapse definitely against the sides of the tube at any point is defined as the beginning of melting) and from that time carefully regulate the rise in temperature to about 0.5° per minute until the melting is complete. (The temperature at which the substance becomes liquid throughout is defined as the end of melting.) The bath must be stirred constantly throughout the heating.

The result thus obtained as the melting interval must be adjusted by applying the calibration correction and that for the emergent stem, as follows:

Attach the auxiliary thermometer, as shown in the illustration, so that the center of its bulb is as close as possible to the stem of the main thermometer at a point midway between the surface of the bath and the supposed melting point. In order to prevent the heat from the burner or currents of cold air from affecting the temperature of the auxiliary thermometer, it is advisable to adjust to the stem of the main thermometer a movable platform made of stiff paper, having its edges folded so as to form a box-like shield surrounding the bulb of the auxiliary thermometer. Note the temperature registered by the auxiliary thermometer at the end of the melting of the substance and calculate the emergent stem correction by the following formula:

$$\text{correction} = 0.00015 \times N\ (T\text{-}t)$$

in which N represents the number of degrees of emergent stem from the bath, T the temperature at the end of melting, and t the temperature registered by the auxiliary thermometer; the correction to be added to the observed reading of the main thermometer.

To avoid the necessity of determining the emergent stem correction each time a melting point is taken, the corrections for intervals of 10° C. may be determined (at about 25° C. room temperature) and the

body by holding the tube horizontally until the melted body cools. When heated carefully the exact point at which it melts can be seen by the liquid flowing down the side.

Congealing Point—This physical factor is of value mainly in determining the purity of certain volatile oils and is dependent upon the presence of constituents which crystallize when cooled to the temperature indicated, known as the "congealing point". The official method is given below.[1]

---

results plotted on cross-section paper, the temperature of the bath represented by the abscissæ and the amount of correction by the ordinates. The correction for any intermediate temperature can then be interpolated.

NOTE: Suggestions regarding liquids to be used for baths in Class I:

For temperatures up to 200 °C., a purified, concentrated sulphuric acid is a suitable bath. For higher temperatures, up to about 350° C., a pure grade of cottonseed oil (almost colorless) will serve for a limited number of determinations. Other, though less desirable, substitutes for sulphuric acid at high temperatures are: (1) a pure grade of paraffin which has been freshly distilled; (2) clean, white, artificial (cottonseed) lard. A very satisfactory bath is prepared by cautiously boiling together, for five to ten minutes under a hood, a mixture of 70 parts of sulphuric acid and 30 parts of potassium sulphate, stirring constantly until the potassium sulphate is completely dissolved.

Procedure for Class II:

Carefully melt the substance to be tested at as low a temperature as possible and draw it into a capillary tube, which is open at both ends, to a depth of about 10 mm. Cool the charged tube at 10° C., or lower, for twenty-four hours, or in contact with ice for at least two hours. Then attach the tube to a standard thermometer by means of a rubber band, adjust and heat it in a water bath, as directed in Class I, except that, within 5° of the assumed melting temperature, the rate of rise of temperature is carefully regulated to about 0.5° per minute.

The temperature at which the substance is observed to rise in the capillary tube is taken as the melting point.

[1]U. S. P. X Method for Determining Congealing Points

Unless otherwise directed, about 10 cc. of the liquid to be tested is introduced into a dry test tube of from 18 to 20 mm. internal diameter, which is then cooled in water or a suitable freezing mixture, the temperature of which should be about 5° lower than the supposed congealing point of the liquid. To induce crystallization, rub the walls of the tube with a standard thermometer (page 106), or add a small crystal of the substance being tested. By alternated immersion of the tube in the bath, or removal from the bath and constant stirring with the thermometer, the temperature is so adjusted that the greater part of the liquid gradually congeals. The highest temperature remaining constant for a short time during the congelation is defined as the congealing point.

CHAPTER VII

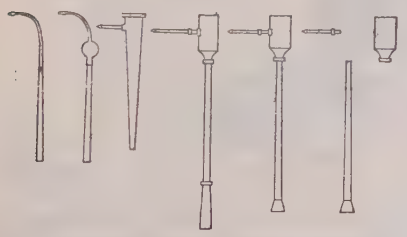
USES OF HEAT

THE consideration of the uses of heat in pharmacy naturally follows the preceding chapter upon its generation and measurement, and the subject may be properly considered under two classes: 1, Those operations in which comparatively high temperatures are required, and, 2, those which require moderate or low temperatures. It will be readily noticed that the latter class will embrace nearly all of the more important pharmaceutical operations in which heat is employed.

Operations in Which Comparatively High Temperatures are Required—In this class of operations must be placed some which seem to be in danger of becoming lost arts through the growth of special methods, now conducted on a large scale by manufacturers. It will, nevertheless, be found useful to refer briefly to these operations, for a certain amount of knowledge will frequently be of service to the practical worker in emergencies and on special occasions.

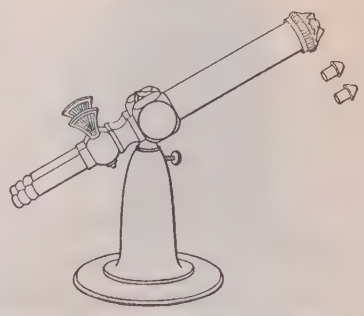
The Use of the Blowpipe—A blowpipe in its simplest form is a metallic tube, usually of brass or copper, slightly conical, gradually tapering to a minute orifice, the narrowest portion being curved or placed so that the axis of the orifice is at right angles to the principal portion of the tube. It is used by placing the widest end in the mouth, and inserting the other end into the edge of the flame, and forcing a current of air through the tube, with the effect of increasing the intensity of the flame by converting it into a miniature blast. Some skill and practice are required to produce an unremitting current of air, and this is effected by keeping the muscles of the cheeks distended and constantly supplying air from the lungs as it is needed. When the blowpipe is used with a luminous flame, the interior of the flame, owing to the carbon not being wholly oxidized, has the power of deoxidizing or reducing oxides, while the outer flame has opposite or oxidizing properties. A piece of lead glass tube held in the inner flame will be blackened through the reduction of the lead oxide to the metallic state; if this stain is held in the outer flame the metal is reoxidized, dissolves in the glass, and the glass again becomes transparent. The blowpipe is useful in pharmacy in working and bending glass, in testing fusible chemical substances, in soldering apparatus, etc. The various forms of blowpipes in common use are shown in Fig. 94.

FIG. 94



Plain blowpipe | Bulb blowpipe | Black's Berzelius' | Plattner's | Plattner's (dissected)

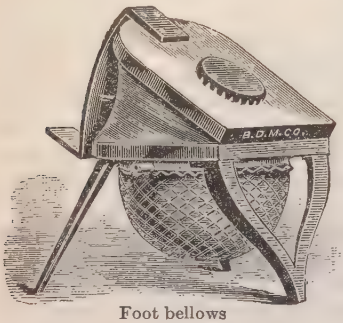
FIG. 95



Gas blowpipe

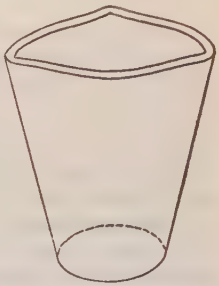
The gas blowpipe, shown in Fig. 95, furnishes an excellent and very powerful blast which is capable of delicate adjustment. It has a universal ball and socket joint, which enables it to be used in any position. The convenient foot bellows, shown in Fig. 96, may be used in connection with it for producing the blast or an electrically driven blast may be used.

Fig. 96



Foot bellows

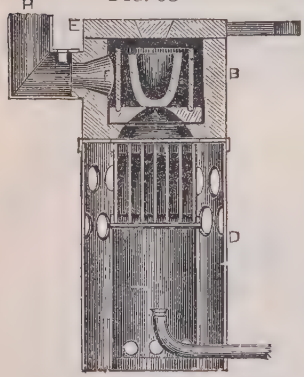
Fig. 97



Hessian crucible

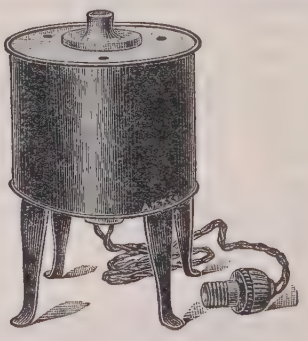
Crucible Operations—A crucible is a cup-shaped vessel made of platinum, silver, nickel, fused silica, graphite, iron, porcelain, or clay, and intended to withstand a very powerful heat. It is used in fusing metals or in determining ash or incombustible matter, and is indispensable in chemical analysis. The Hessian clay crucible (see Fig. 97) is the cheapest. It is unfitted for finer operations, for, although capable of withstanding great heat, its porous character permits the ready absorption of many substances. The graphite crucible is more expensive. It is less porous, is infusible, and has the merit of bearing great changes in temperature without risk of fracture. Porcelain crucibles are fragile, and have to be very gradually cooled to prevent breakage. A gas crucible furnace (see Fig. 98) is very useful in this connection. Electric crucible furnaces (see Fig. 99) are largely replacing all other forms. Of the metals used in making crucibles, platinum is superior to all. Its well-known power of resisting fusion, its cleanliness, and its non-liability to be acted upon by most chemical substances render it invaluable to the chemist, notwithstanding its costliness (see Fig. 100). Platinum substitutes, for high temperature crucibles, are now available, one of the most valuable of these being gold-iridium alloy.

Fig. 98



Fletcher's gas crucible furnace

Fig. 99



Electric crucible furnace

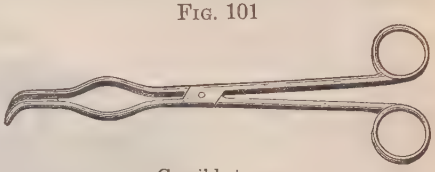
Fig. 100

Platinum crucible

Crucibles made from fused silica are now often used to replace the more expensive platinum. Such crucibles are not affected by mineral or organic acids, except by hydrofluoric acid and, at temperatures over 400° C., by phosphoric acid. They are non-porous, insoluble in water, may be heated up to

1200° C. without injury, and possess a low coefficient of expansion so that they are not readily broken by sudden changes in temperature. They are readily affected by alkali hydroxides, however, and have a limited use on that account. The other crucibles such as silver, nickel, and iron are used in analytical work for special operations. For lifting a hot crucible from the furnace, crucible tongs are employed (see Fig. 101).

Fig. 101



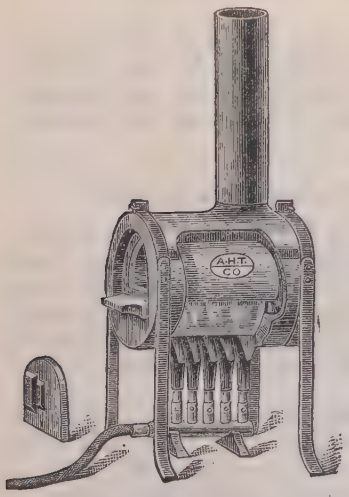
Crucible tongs

Torrefaction (known also as roasting) is the process whereby organic substances have some of their constituents modified by the application of a degree of heat somewhat less than that necessary to carbonize them. The most familiar example of this process is the roasting of coffee. Rhubarb in coarse, dry powder, when subjected to torrefaction, loses its cathartic properties, but retains its astringent qualities, and is known as *torrefied rhubarb.*

Carbonization is the process of heating organic substances *without* access of air until the volatile products are driven off, and the residue assumes the black color characteristic of free carbon or charcoal. The manufacture of bone-black and wood charcoal afford good illustrations.

Ignition, in the sense in which it is used in the Pharmacopœia and by chemists generally, is the process of strongly heating solid or semisolid substances to a definite and limited degree, the residue left at the conclusion of the process being the object sought. The U. S. P. X special assay for alkali salts of organic acids is a good example of ignition.

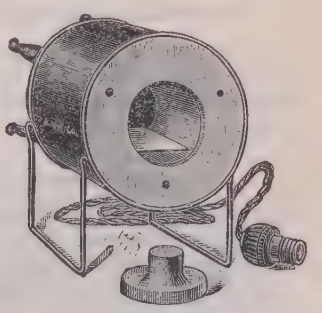
Fig. 102



Gas muffle furnace

Incineration is the process of strongly heating organic substances *with* access of air until

Fig. 103



Electric muffle furnace

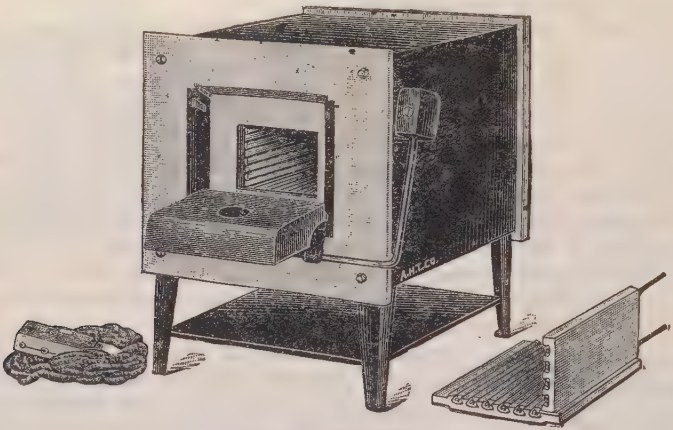
all the carbon is consumed, the ash which remains being the object sought. The process is frequently used in analysis to determine the amount of fixed or non-volatile matter in a substance. The muffle furnace illustrated in Fig. 102 is an excellent device for incinerating substances for analytical purposes. A battery of six wing burners furnishes the heat which, because of the special construction, is evenly distributed all around the material which is being incinerated. Electrically heated muffle furnaces (see Figs. 103 and 104), however, are largely replacing other forms.

Calcination is the process of separating volatile substances from fixed in-

organic matter by the application of heat without fusion. Its principal use in pharmacy is in the expulsion of water and carbon dioxide from carbonates, as in making magnesium oxide from magnesium carbonate. Its name is derived from "calx" (CaO) which is made from limestone, $CaCO_3$, by this operation.

Fusion is the process of liquefying solid bodies by the application of heat without the use of a solvent, as in the melting of wax.

FIG. 104



Electric muffle furnace

Deflagration is the process of heating one inorganic substance with another which is capable of yielding oxygen (usually a nitrate or a chlorate); decomposition ensues, accompanied by a violent, noisy, or sudden combustion. Deflagration is used in making some of the salts of antimony and arsenic, and in some qualitative work.

Operations requiring Heat in which Lower Temperatures are used

In this class of operations will be found the most important of those requiring the application of heat; almost all medicinal substances have their properties altered by the action of heat, and in many cases it is necessary to moderate the heat carefully in order to prevent the decomposition or destruction of the active constituent. For the purpose of controlling and distributing heat, various baths are used, as the sand bath, oil bath, solution bath, steam bath, water bath, air bath, etc.

Baths—The *sand bath* is usually an iron vessel of hemispherical or other convenient shape, containing dry, clean sand (see Fig. 105); the vessel to be heated is embedded in the sand, and the bath is then heated to the required degree. The object of this form of bath is to distribute and equalize the temperature, and to prevent a too sudden rise or fall of heat whereby unequal expansion or contraction might cause the fracture of a glass or porcelain vessel being heated. Iron wire clippings have sometimes been substituted for sand, with doubtful advantage, however.

FIG. 105

Sand bath

The error usually made by inexperienced operators in the use of the sand bath is in permitting too large a body of sand to rest between the bottom of the vessel to be heated and the flame; this results in an unnecessary waste of heat.

The *oil bath* is designed to furnish a regulated temperature below 260° C. (500° F.). A fixed vegetable oil is the medium usually employed for communicating the heat, but a mineral oil is more satisfactory for many reasons. Of course it is necessary to use mineral oils which have had the lighter fractions removed. Most fixed animal and vegetable oils, when heated above 177° C. (350.6° F.), evolve disagreeable fumes.

In fractional distillation on a large scale, oil baths are often used to control temperature, and the fumes arising from the heated oil are carried off through a flue.

The *glycerin bath*—In order to avoid the disagreeable odors arising from hot oil, glycerin is sometimes substituted. Acrolein, an acrid, volatile product is produced, however, if glycerin is heated nearly to boiling. A temperature of 250° C. (482° F.) can be maintained in a glycerin bath without much inconvenience.

Salt water baths are sometimes used in special operations; their principle of action depends on the fact that the boiling point of a liquid is raised in proportion to the quantity of salt dissolved in it. Water, as is well known, boils at 100° C. (212° F.), but if common salt is dissolved in water until it ceases to take up any more, and a saturated solution is produced, it is found that this solution does not boil until the temperature of 108.4° C. (227.1° F.) is reached. The following table shows the boiling point of certain saturated salt solutions as determined by Legrand and others:

Table of Boiling Points of Saturated Solutions of Various Salts

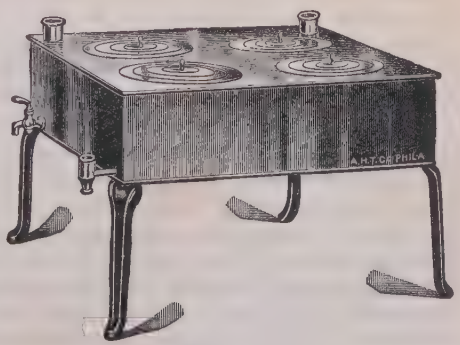
Salt	Boiling Point		Salt	Boiling Point	
	C.	F.		C.	F.
Sodium Chloride	108.4°	227.1°	Sodium Acetate	124.4°	256°
Ammonium Chloride	114.2°	237.6°	Potassium Carbonate	135°	275°
Potassium Tartrate	114.7°	238.5°	Calcium Nitrate	151°	303.8°
Potassium Nitrate	115.9°	240.2°	Potassium Acetate	169°	336.2°
Sodium Nitrate	121°	249.8°	Calcium Chloride	179°	354.2°

The *water bath*, often abbreviated "*b. m.*" in the older literature, from *balneum marinæ*, because sea water was used in the earlier forms, is one of the most useful of all the forms of pharmaceutical apparatus for regulating temperature, and the frequency with which it is directed to be used in works of authority indicates its importance as a necessary imple-

Fig. 106

Water bath

Fig. 107

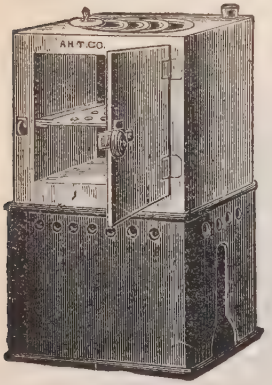


Water bath

ment in the equipment of every pharmaceutical laboratory. The water baths used by pharmacists are often extemporized, and these are generally crude and inconvenient; two dishes usually suffice, one of them somewhat larger in

diameter than the other. Water is poured into the larger dish, and the other dish, containing the liquid to be heated, is placed in the water and the heat applied; the steam escapes in the room and the plan is not very satisfactory.

Fig. 108

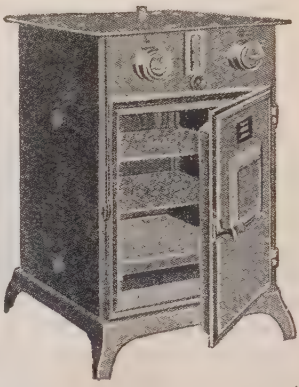


Gas-heated, water-jacketed air bath

Figs. 106 and 107 show the form of water bath used in most laboratories. The different sizes of the apertures render it convenient for vessels of various sizes.

An *air bath* is largely used in the chemical laboratory for drying chemicals for analysis. These are frequently arranged with a thermostat to maintain an exact temperature. Figs. 108 and 109 illustrate two modern types, gas and electrically heated.

Fig. 109



Electrically-heated and regulated air bath

The Use of Steam in Pharmaceutical Operations

The scope of this work will not permit of any extended consideration of the use of steam in technical pharmacy, yet it is of vital interest to be acquainted not only with the theories underlying its employment, but also with the apparatus used in its practical application.

When water is heated to the boiling point and steam is produced, a certain amount of heat is absorbed (or apparently lost). This has been termed *latent heat.* When steam comes in contact with surfaces having less heat than itself, it is condensed, water is produced, and the latent heat becomes *sensible* (or reappears), thus proving the well established physical law that *when a liquid assumes the gaseous state, a certain fixed and definite amount of heat disappears; and, conversely, when a gas or vapor becomes a liquid, heat to a corresponding extent is evolved.* Watts has illustrated this as follows: "When water at 0° C. is mixed with an equal weight of water at 100° C., the whole is found to have the mean of two temperatures, or 50° C. On the other hand, 1 part by weight of *steam* at 100° C., when condensed in cold water, is found to be capable of raising 5.4 parts of the latter from the freezing point to the boiling point, or through a range of 100° C. Now, $100 \times 5.4 = 540$; that is to say, steam at 100° C. in becoming water at 100° C. parts with enough heat to raise a weight of water equal to its own (if it were possible) 540° of the centigrade thermometer, or 540 times its own weight of water one degree of the same". When water passes into steam, the same quantity of sensible heat becomes latent. A consideration of these facts in physics leads to the practical application of steam as a transmitter of heat, whereby heat from any source may be absorbed by steam and carried through suitable pipes to the vessel designed to be heated. If this vessel is filled with a cold liquid, the latent heat of the steam is rapidly communicated to the liquid, the steam is condensed, and the result is this most convenient and economical method of producing a temperature which is capable of being regulated with great exactness.

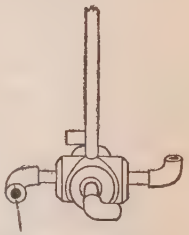
Steam Baths—These may be divided into two classes: 1, those in which steam is used without pressure; 2, those in which steam is used under pressure.

1. *The Use of Steam without Pressure*—In many cases open steam, as it is termed, is used (see Fig. 110). The pipe which conveys the steam from the boiler is conducted to the bottom of a hemispherical kettle, and the liquid to be heated is poured into a dish of larger diameter, which is placed upon the top; the steam is turned on, and as it condenses is carried off by the drip pipe. A temperature of about 100° C. (212° F.) can usually be maintained by this method.

Fig. 110

Open steam bath

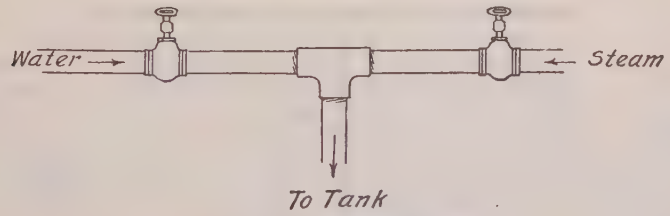
Fig. 111



Steam distributor

Sometimes the steam pipe is conducted directly from the top into the liquid to be heated. A steam distributor, as shown in Fig. 111, may be used at the end of the pipe near the bottom of the kettle; it is made by screwing a cross upon the end of the pipe, and an elbow to each arm of the cross; the steam issues usually with some force from each elbow and effectually stirs up the liquid, and rapidly produces a uniform temperature in it. The principal disadvantages of using steam in this way are the noise at first produced by the contact of the hot steam with the cold liquid, and the increase in bulk of the liquid through the condensation of the steam as well as the contamination likely to be produced, for the condensed distillate from the average steam boiler is by no means pure. The noise attending the running of steam into cold water may be largely overcome by mixing the steam with a small stream of water, in a T pipe, before allowing it to flow into the water, as illustrated in Fig. 112.

Fig. 112



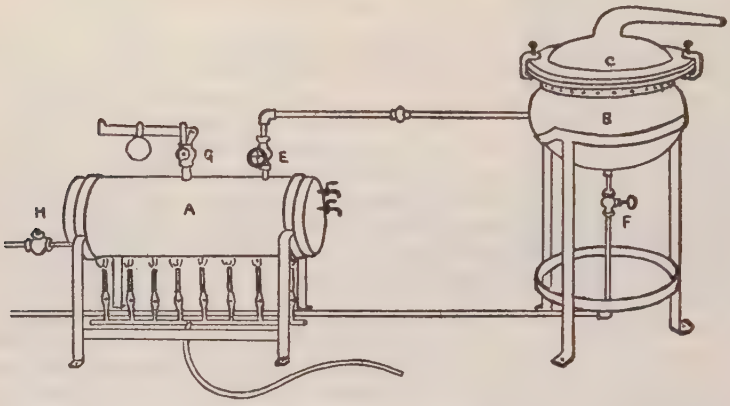
Live steam to tank without noise

2. *The Use of Steam under Pressure*—This is by far the most convenient method of using steam practically as a means of transmitting heat. It has been stated that steam produced in open and unconfined vessels, with the ordinary pressure of the atmosphere, has the temperature of 100° C. (212° F.). If water is heated continuously in a boiler capable of withstanding pressure, the water is prevented from boiling by the pressure of its own vapor, and the temperature of the steam rises in proportion as the pressure increases. It is usually stated that the pressure of the atmosphere is 14.7 pounds to the square inch. The following table shows the increase in temperature of steam when the pressure exceeds that of the atmosphere. Of course, the opposite effect is produced when the pressure is removed, and the water boils below the temperature of 100° C. (212° F.). (See vacuum apparatus, page 126).

The principle of the use of steam under pressure is shown in the apparatus (see Fig. 113). It was designed by Joseph P. Remington in 1872 to illustrate the subject practically upon the lecture table. A cylindrical copper boiler, A, supported by a stout iron stand, is heated by a row of six Bunsen burners;

water is forced into the boiler from the hydrant through a rubber hose attached to the pipe connected with the check valve, H. The steam passes into the jacketed kettle, B, and is controlled by the steam valve, E, the exhaust steam and condensed water passing through the pipe controlled by the valve F. The

FIG. 113



Use of steam under pressure

safety valve, G, warns the operator by "blowing off" steam when the pressure has reached the highest point desired. C shows the dome which may be attached when a liquid is to be distilled.

Table of the Temperatures of Superheated Steam

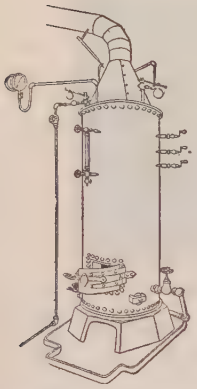
Pressure	Temperature of Steam		Pressure	Temperature of Steam	
Pounds per Square Inch	C.	F.	Pounds per Square Inch	C.	F.
14.7	100°	212°	55	141.6°	287°
17	104.2°	219.6°	60	144.7°	292.7°
20	108.8°	228°	65	147.7°	298°
23	113°	235.4°	70	150.5°	302.9°
25	115.6°	240.1°	75	153°	307.4°
30	121.3°	250.4°	80	155.5°	312°
35	126.2°	259.3°	85	157.8°	316.1°
40	130.7°	267.3°	90	160°	320°
45	134.6°	274.4°	95	162.2°	324°
50	138.3°	281°	100	164.4°	327.9°

An upright tubular steam boiler, suited to operations in the pharmaceutical laboratory, and a sectional view of the same, are shown in Figs. 114 and 115. An automatic steam boiler made by the Wm. Kane Mfg. Co., of Philadelphia, a sectional view of which is seen in Fig. 116, is adaptable to small laboratories without central steam supply. This boiler is gas heated, equipped with an automatic gas regulator which can be set to maintain any desired steam pressure simply by adjusting a weight on an arm.

The usual form of steam kettle is shown in Fig. 117. A copper pan, tinned inside, having flaring sides to facilitate evaporation, is securely connected about midway from the bottom with another copper pan, both being riveted together. An opening for the steam pipe is made in the jacketed side to admit steam, and at the lowest point of the bottom another pipe is attached to carry

off the water produced by the condensation of the steam. The upper edge of the kettle is protected by a flat brass ring, which is soldered and riveted to it, and which also serves to support the still top when the steam kettle is used for distillations. (See Chapter on Distillation.) Care should be exer-

Fig. 114

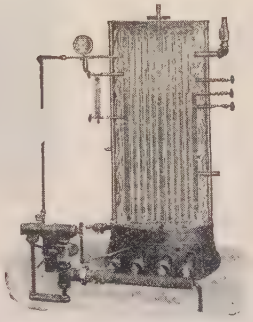


Steam boiler

Fig. 115

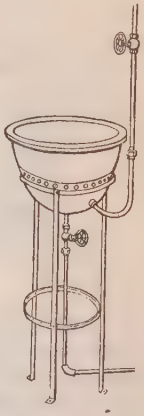
Sectional view

Fig. 116



Gas-heated boiler

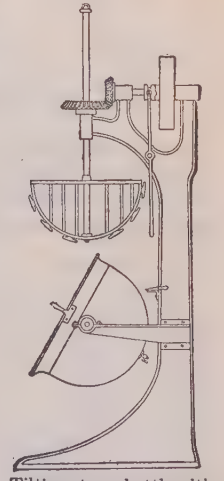
Fig. 117



Steam kettle

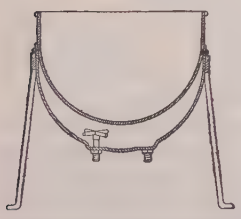
cised to have the bottom of the kettle made of copper heavy enough to resist the greatest amount of steam pressure that will be likely to be used on it, as instances have been known of collapse when this was neglected. In using the steam kettle, the liquid that is to be heated is run into it by a syphon or by other means; the drip or exhaust valve below is opened partially, and the steam slowly turned on. Steam valves should always be opened cautiously, as accidents and strains to steam apparatus often arise from the sudden shocks due to want of care in this respect. While the liquid is becoming heated, the condensed water should be allowed to escape freely, and when the proper temperature is reached, the steam valve should be carefully

Fig. 120



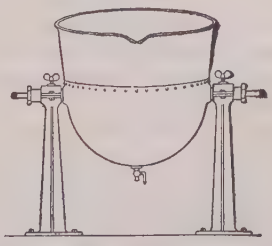
Tilting steam kettle with stirrer

Fig. 118



Steam kettle (sectional view)

Fig. 119

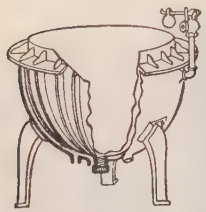


Steam kettle on trunnions

adjusted and the exhaust valve turned so that, while all the condensed water may escape, no steam shall be allowed to go to waste by its being opened too widely. One of the greatest objections to the use of tinned copper kettles is that the coating of tin soon wears off, and the contamination of an evaporating liquid with copper is almost certain to result.

Fig. 118 represents a sectional view of a steam kettle, showing the space for steam and a four-arm steam distributor with outlet. Fig. 119 shows a steam kettle mounted on trunnions. This form is very convenient when the operator wishes to pour out the contents. In the ordinary form of the kettle the con-

Fig. 121



Enameled steam kettle

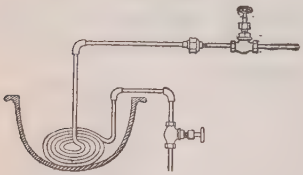
Fig. 122

Glass-lined steam kettle

tents have to be removed with a dipper. Fig. 120 shows a modern form of steam kettle with a stirring apparatus which is easily removed when not in use. The tilting kettle is very convenient.

The enameled cast iron kettle shown in Fig. 121, is preferred to plain iron kettles, although the injurious cracking of the enamel from overheating and

Fig. 123



Kettle with steam coil

Fig. 124

Zig-zag steam coil

Fig. 125

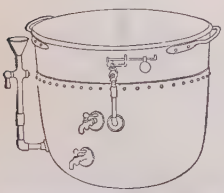
Horizontal steam coil

Fig. 126

Upright steam coil

the resulting exposure of the liquid to the iron surface beneath is an objection. It is proper to state that with care the enamel may often be retained for years in perfect condition. A great improvement in the process of enameling has now rendered this type of kettle very serviceable and satisfactory.

Fig. 127



Steam kettle for use over naked fire

Fig. 122 illustrates a kettle of this type which is termed "glass-lined". These kettles are made in many styles and of varying capacity, by the Pfaudler Co. of Rochester, N. Y. The J. L. Mott Iron Works, of New York, also manufacture similar kettles.

Pressure steam is frequently passed through coils of iron, block tin, or lead, which have been immersed in the liquid to be heated. Fig. 123 shows the usual form. It will be found very useful to the practical worker to use block tin pipe. Steam valves may be soldered to both ends of the pipe, and on account of the flexibility of the pipe it may be readily adjusted and coiled to suit available space, while the absence of danger from contamination when used for heating most medicinal liquids is an advantage which should not be overlooked. Steam, when passed through coils of various shapes, zig-zag pipes, etc., is also largely used in heating liquids in special operations, in drying drugs,

chemicals, etc. Figs. 124, 125, and 126 illustrate these forms. Zig-zag coils of silica have been used for evaporating permanganate solutions.

Pressure Steam without the Use of a Boiler—In Fig. 127 is shown a water bath jacketed kettle, which generates its own steam; it may be used over a gas burner, coal oil stove, or naked fire. Two gauge cocks indicate the quantity of water in the kettle, and the safety valve the amount of steam pressure; the funnel pipe is used for charging the kettle with water. The advantages of this kettle are apparent, the principal one being that it can be used by a pharmacist who desires to use steam heat without incurring the inconvenience and expense of installing a boiler in his store, laboratory, or cellar. A practical application of this principle is seen in sterilization by steam under pressure (see Chapter on Sterilization and Ampuls).

CHAPTER VIII

VAPORIZATION

THOSE pharmaceutical operations are included under this head in which volatile substances are separated from fixed bodies, or from others which are less volatile, usually with the aid of heat at varying temperatures. Vaporization is frequently employed in pharmacy, and it will be most convenient to consider its applications in the order of their importance: 1. To Liquids. 2. To Solids.

1. When vaporization is used to separate a *volatile liquid* from a *less volatile liquid*, it is called *evaporation*. This may be accomplished either with or without *ebullition* or boiling.

2. When the object sought is the *volatile liquid*, it is called *distillation*.

3. When it is used to separate a *volatile liquid* from a *solid*, it is called *desiccation* (*dehydration*), *exsiccation*, or *granulation*.

4. When it is used to separate a *volatile solid* from a non-volatile solid, it is called *sublimation*.

The following diagram may serve to impress the definitions on the memory:

Vaporization

Object Sought		Process
Liquids:		
Fixed or less volatile		Evaporation with or without ebullition
Volatile		Distillation with ebullition
Solids:		
Fixed		Desiccation (dehydration)
		Exsiccation
		Granulation
Volatile		Sublimation

The subjects of evaporation, distillation, sublimation, and desiccation will be considered in the chapters which immediately follow. Vaporization, as applied to granulation and exsiccation, will be more appropriately considered after the chapters on Solution and Crystallization.

The methods adopted by the Pharmacopœia are copied below.[1]

---

[1] **U. S. P. X Methods for Determining Distilling and Boiling Points**

Method I

For the purposes of the Pharmacopœia and general chemical analysis, a boiling point is defined as that range of temperature within which at least 95 per cent, by volume, of the substance distils, when treated as directed below.

Apparatus Required—A distilling bulb of from 50 to 60 cc. capacity to the lower part of the neck; the length of the neck is from 10 to 12 cm. and its internal diameter from 14 to 16 mm. The outlet tube of from 4 to 5 mm. internal diameter is to be attached to the neck at approximately its midpoint, forming an angle of from 70° to 75° with the lower end of the neck.

A straight glass condenser with a water jacket from 40 to 60 cm. in length; the distance from the upper end of the water jacket to the neck of the bulb being from 18 to 25 cm.

Thermometer—In order to avoid the necessity for emergent stem correction, it is advisable that an accurately standardized thermometer of the Anschütz type be used. If such a thermometer is not available, a thermometer used for melting points (page 106) may be employed, applying the emergent stem correction as described under *Melting Points* (page 107), the length of emergent stem being measured, in degrees, from the lower end of the stopper to the highest point of the boiling temperature. When placed in position, the lower end of the thermometer is from 2 to 3.5 cm. below the center of the orifice of the outlet tube.

An asbestos board of from 12 to 15 cm. square and from 3 to 5 mm. in thickness, having a circular perforation, located centrally, for the reception of the bulb. The edge of the asbestos around the perforation should fit closely to the bulb when the latter is set into it. The size of the perforation should be such that when the bulb is set into it the portion of the bulb below the upper surface of the asbestos will have a capacity of from 3 to 4 cc.

Procedure—Place the asbestos board on a tripod or other suitable support. Introduce into the distilling bulb 25 cc. of the liquid to be tested, insert the thermometer, stand the bulb in an upright position in the perforation of the asbestos board, and connect it with the condenser. Then distil the liquid at the rate of 1 cc. for each fifteen to twenty seconds, noting the temperature as soon as 5 drops of the liquid have distilled into the receiver and when 95 per cent of the original volume has distilled. Correct the reading for any variation

Evaporation

Although this term has in its more popular sense the signification of the separation of moisture from any body, whether solid or liquid, in pharmacy the word has a more restricted meaning, and signifies the driving off of the more volatile or less valuable portions of a liquid by the application of heat, with the object either of purifying or of concentrating it for the purpose of obtaining the less volatile portion. Illustrations are found in the concentration of syrups and liquids intended for crystallization, and in the treatment of weak percolates in making fluidextracts and extracts.

As *ebullition*, or *boiling*, is an important form of evaporation, it will be necessary first to consider its essential points. Ebullition in a heated liquid is caused by the formation of bubbles of vapor upon the surface of the vessel, which, rising to the surface of the liquid and bursting, permit the vapor to become diffused in the space above the boiling liquid. The *boiling point* of a liquid may be defined as the temperature at which the tension of its vapor is equal to the pressure of the atmosphere, this point being *definite*, while *evaporation* may take place in the same liquid at nearly all degrees of heat and hence the evaporating point is an indefinite temperature. The point at which a liquid boils varies with the composition of the liquid, other conditions being equal.

The boiling point of a liquid is affected by the cohesion of the liquid and the degree of pressure upon its surface. Water under the ordinary pressure of the atmosphere boils at 100° C. (212° F.). When confined in a steam boiler, it has been shown that water can have a temperature considerably over 200° C. (392° F.) without boiling, the bubbles being prevented from forming by the pressure of the steam in the confined space above the liquid. On the other hand, the creating of a partial vacuum by the removal of pressure causes a liquid to boil below its normal boiling point.

---

in the barometric pressure from the normal (760 mm.) by allowing 0.1° C. for each 2.7 mm., adding if the pressure is lower, and subtracting if higher.

NOTE: In order to have the entire volatile portion distil over at the prescribed rate, it is best to make a preliminary distillation of a separate portion of 25 cc. of the liquid, during which the source of heat (a Bunsen burner) is regulated so that the distillation proceeds at the prescribed rate. Having thus regulated the burner, temporarily remove it, clean the bulb, recharge it with a fresh portion of 25 cc. of the liquid, and conduct a new distillation as described above.

Method II

This method is to be used with liquids for which the permissible range in boiling temperature exceeds 5° C.

Apparatus Required—A 200 cc. distilling bulb with an outlet tube at approximately the center of the neck, forming an angle of from 70° to 75°, with the lower end of the neck. The length of the neck is from 10 to 12 cm. and its inside diameter is from 18 to 24 mm. The length of the outlet tube is from 10 to 12 cm. and its inside diameter is from 5 to 6 mm.

A straight glass condenser, a thermometer, and an asbestos board as in Method I. The diameter of the perforation in the asbestos board is 25 mm.

Procedure—Place the distilling bulb in an upright position in the perforation in the asbestos board and connect it with the condenser. The outlet tube is to extend from 25 to 35 mm. into the condenser beyond the connecting stopper.

Measure 100 cc. of the liquid* to be tested, using a cylinder having 1 cc. graduations. Note the temperature of the liquid and transfer it as completely as possible to the distilling bulb. Use this cylinder as the receiver for the distillate without rinsing out any of the adhering liquid. Insert the thermometer through a stopper in the position described in Method I and heat with a Bunsen burner protected from drafts until the liquid begins to boil, then distil at the rate of from 4 to 5 cc. per minute. The temperature when 5 drops of the liquid have distilled into the receiver is the minimum distillation temperature and, unless otherwise specified, the maximum distillation temperature is the temperature at which 95 per cent of the liquid has distilled over. Bring the distillate to the same temperature at which the liquid was originally measured, and note the volume. Correct the temperature reading for barometric pressure and apply the emergent stem correction as described in Method I.

Liquids which begin to distil below 80° C. are cooled to 10° or 15° C. before measuring the 100° cc. for the test. The end of the condensing tube is fitted with an adapter bent at a suitable angle and the end of the adapter is passed through a cork inserted into the receiving cylinder. The cork has a small perforation to permit the exit of air. The receiving cylinder is kept immersed in ice to within 2.5 cm. of its height during the distillation.

---

*For the determination of the distillation range of creosote from creosote carbonate and of cresol from compound solution of cresol, use the volume of the creosote or of the cresol obtained as described under the respective monographs.

Determination of Boiling Points—One of the simplest unofficial methods of ascertaining the boiling point of a liquid is illustrated in Fig. 128. The liquid is introduced into a test tube, and a glass tube is selected of such diameter as will permit a chemical thermometer to pass easily through it and leave a small space between; the tube should be about one inch shorter than the thermometer. A short piece of wire is passed through the glass ring of the thermometer, and slightly bent to hold it in position; a perforated cork should now be fitted tightly to the test tube, and the tube carrying the thermometer tube pushed through the perforation in the cork until the bulb of the thermometer is just above the liquid; heat should be applied cautiously by a sand bath or water bath. The vapor from the boiling liquid passes upward through the whole length of the thermometer, escaping at the top, and thus the error common to some methods, due to the difference in temperature between the portion of the thermometer in the test tube and that outside of the test tube, is measurably avoided.

FIG. 128

Boiling point test

Tension of Vapors—If a glass tube, thirty-six inches long, closed at one end, is filled with mercury, and the open end, after closing it with the finger, carefully inverted in a beaker containing mercury, it will be found that the mercury will run out from the tube into the beaker until a column of mercury about thirty inches in height is left. This column is sustained by the pressure of the atmosphere, and is, in fact, the well known *mercurial barometer* tube sometimes called the *Torricellian tube* on account of its discoverer (see Fig. 129). The six inches of space in the tube above the level of the mercury is, of course, empty, or vacuous. Now, if a few drops of water are passed into the tube by a dropper, they immediately rise to the level of the mercury in the tube and, although the temperature has not been increased, a portion of the water is vaporized, and the column of mercury is proportionately depressed. This depression is due to the elasticity or tension of the aqueous vapor. If the tube is forcibly pushed down into the mercury, the increased pressure will be found to have liquefied the vapor, and the original quantity of water is recovered; but the depression in the column of mercury may be increased by heat, and when a sufficient amount of heat has been applied to the tube to expel the mercury until none is left in the tube, it will be found that the temperature marks 100° C. (212° F.), which is exactly the boiling point of the liquid (water), showing that this point must be reached in order to overcome the pressure of the atmosphere. If alcohol or ether is substituted for water, it will be found that the mercury will be depressed in a far greater ratio,—this being due to the greater volatility and lower boiling point of these liquids. The *maximum density* of the vapor of a volatile liquid in a confined space in contact with the corresponding liquid is reached when its elastic force attains the limit beyond which pressure produces the liquefaction of the vapor. When this limit is reached, the vapor is said to be *saturated*. Maximum density varies with the temperature. If a saturated vapor in an enclosed tube is not in contact with an excess of liquid, increase of temperature lowers its density or expands it. On the other hand, when a saturated vapor is cooled, liquefaction

FIG. 129

Mercurial barometer

gradually takes place, the vapor above the liquid remaining in the condition of maximum density until converted into the liquid, so that cold and pressure have the effect of *converting vapors into liquids*, while heat and the removal of pressure have the reverse effect,—*i. e., the conversion of liquids into vapors.* A consideration of the foregoing facts leads to the following deductions:

1. The quantity of vapor that will form in a confined space depends primarily upon the amount of pressure and heat to which the liquid is subjected, but when the point of saturation of the surrounding space with the vapor is reached, evaporation ceases if the pressure and temperature remain the same.

2. The rapidity of evaporation of an aqueous liquid in the open air is influenced by the amount of the aqueous vapor always present in the air. If the saturation is at or near the maximum, evaporation is retarded; but if the aqueous vapor in the atmosphere is much below the state of maximum saturation, as is usually the case, evaporation is accelerated.

3. Rapidity of evaporation is increased by removing the pressure of the atmosphere.

4. Increase of temperature obviously accelerates evaporation by increasing the formation of vapor.

Humidity—Humidity is the term used to describe the amount of water vapor in the atmosphere. It may be "absolute" humidity, in which case the actual weight of water in a given unit volume of atmosphere is meant; but the more common application of the term is that of "relative" humidity. By this we mean the ratio of the actual humidity of the atmosphere at any given temperature to the absolute humidity of the atmosphere if it were saturated at the same temperature.

Fig. 130

Wet and dry thermometer

The atmosphere is said to be saturated or to have reached the saturation point, sometimes called the dew point, when it contains as much water vapor as it can possibly contain at any given temperature. For example, the absolute humidity of air at 70° F. is about eight grains of water vapor per cubic foot. At 0° F. it is only one-half grain per cubic foot. If the atmosphere of a room, the temperature of which is 70° F., contains four grains of water vapor per cubic foot, the relative humidity would be four-eighths or, as commonly expressed, fifty per cent.

Humidity, therefore, has a direct and important bearing upon evaporation and in many laboratories it is determined as a preliminary step to the successful carrying out of certain kinds of operations, as manufacturing granular effervescent salts, which cannot be made of uniform quality except when the humidity is below a certain figure. The instrument used in determining relative humidity is called a hygrometer. There are several types and forms of instruments used for the purpose. One form, known as the *hair hygrometer*, shows the relative humidity directly upon a dial. It is operated by taking advantage of the fact that a strand of human hair lengthens with dampness and shortens with drying.

Another form is known as the *wet and dry bulb thermometer* (see Fig. 130). Two thermometers are mounted a short distance apart on the same board. One of these is exposed to the free air, the other has its bulb covered with loosely twisted wicking which extends into an attached water reservoir. The bulb which is surrounded with moist wicking will show a lower temperature

than the dry bulb and this difference is directly proportional to the rapidity of evaporation of the water, which in turn is directly dependent upon the relative humidity or percentage of saturation of the atmosphere with water. A table accompanies such a thermometer which gives the relative humidity when the dry bulb temperature and the difference in the readings of the two thermometers are known.

A third form, giving more rapid results than the foregoing is known as the *sling psychrometer* (see Fig. 131). This form has the two thermometers mounted upon a whirling handle and placed so that one has the bulb considerably below the other. The lower bulb is covered with muslin and then moistened with water and whirled about the hand, readings being made every half minute until the difference in temperature between the two thermometers is constant. The same table may be consulted as is used in connection with the preceding instrument.

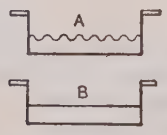
FIG. 131

Sling psychrometer

Evaporation of Liquids by Boiling—In evaporating by boiling, temperature, pressure, etc., being equal, the rapidity of the process depends upon the *extent of surface exposed to the heat.* Fig. 132 represents a cross section of two evaporators, *A* and *B*. The corrugated bottom of *A* gives twice as much surface as the smooth bottom of *B*, and hence if the same quantity of a liquid is made to boil in each, at the same temperature, the bubbles of vapor given off from the corrugated bottom will be twice as numerous as those formed on the plain bottom. The superiority of the tubular boiler over the ordinary plain or Cornish boiler also affords a good illustration of this fact (see Fig. 115).

When a pure, volatile liquid is heated to the boiling point in the open air, its temperature remains the same

FIG. 132



Evaporation by boiling

FIG. 133

FIG. 134

Evaporating below boiling point

until the whole of the liquid has evaporated. If, on the other hand, solid matter is dissolved in the liquid, the temperature of the solution is gradually increased until saturation is reached. This fact is well illustrated by considering boiling points of saturated solutions of various salts (see page 113), and it shows the importance of controlling and regulating the heat in the evaporation of solutions of organic substances as evaporation progresses, as, for example, in the making of extracts, etc.

The cohesion of a liquid affects its boiling point, dense, thick, and sticky liquids offering more resistance to the escape of the bubbles of vapor than mobile, or thin liquids.

The relative depth of a liquid also influences the boiling point. Shallow vessels favor ebullition, because they afford proportionally less weight of

liquid above the bottom of the dish, through which the bubbles escape, than deep ones. Rough metallic surfaces favor evaporation by boiling, and are better than smooth surfaces, because they expose a greater amount of surface to the source of heat.

Evaporation Below the Boiling Point—In evaporating liquids below their boiling point, temperature, pressure, etc., being equal, rapidity of evaporation depends upon the extent of surface exposed to the air. Figs. 133 and 134 show two vessels of exactly the same diameter, but of different capacity, containing water. Both expose the same amount of surface to the air, but that of Fig. 134 contains eight times more liquid than that of Fig. 133.

Fig. 135 Fig. 136

Porcelain evaporating dish Glass evaporating dish

If both be subjected to the same temperature, *provided it be below* 100° C. (212° F.), the water will evaporate as rapidly from one as from the other.

Proper Shape of Vessels for Evaporating Liquids—Broad, shallow vessels should be used for evaporating because the extent of surface is proportionally greater in vessels of this shape. Fig. 135 is an illustration of a porcelain evaporating dish having the proper shape. The chief objection to dishes of this kind is their liability to breakage. Care should be taken to dry the bottom of the dish thoroughly before placing it over a gas flame. A glass evaporating dish is shown in Fig. 136. This should always be used in a sand bath, or should be otherwise protected from direct heat. Enameled cast iron dishes (Fig. 137) are very useful, notwithstanding the lack of durability of the enamel. Enameled sheet iron dishes, called "agate ware", are very light, and are much more lasting than the ordinary enameled cast iron dishes (see Fig. 138).

Fig. 137

Enameled cast iron dish

Fig. 139

Fig. 138

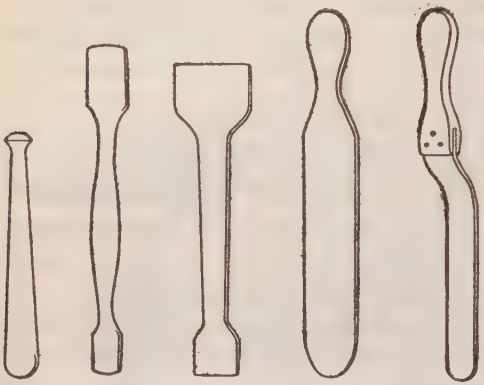
"Agate ware" evaporating dish

Pfandler glass-lined open crystallizing pan

For larger operations, cast iron, glass or acid-resisting, enamel-lined vessels of excellent quality and of varying capacity are now available (see Fig. 139 and also Fig. 122, page 118).

Use of Stirrers—By stirring an evaporating liquid the surface is largely increased, while the currents of air produced at the same time greatly assist in dissipating the vapors which rise. Upon the small scale, porcelain, horn, or wooden stirrers are used (see Fig. 140), while mechanical stirrers are usually employed in the laboratory in more extensive operations (see Fig. 117), page 117.

Fig. 140

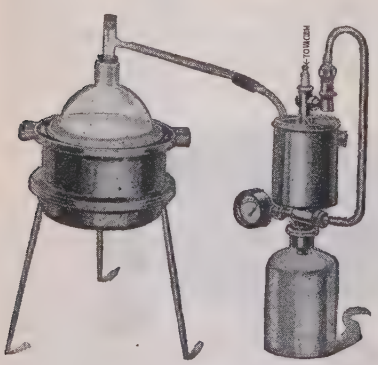


Porcelain stirrer | Double stirrer | Horn stirrer | Wooden stirrer | Bent horn stirrer

Vacuum Apparatus—On page 144 it is shown that the boiling point of liquids is lowered by removing the pressure of the atmosphere. This fact is easily proved by placing under the receiver of an air-pump some alcohol in a test glass containing a few pieces of broken glass, when, upon exhausting the receiver, many bubbles of vapor will rise from the surface, and the liquid will boil at the ordinary room temperature. Water will boil at 84° C. (183.2° F.) on the top of Mont Blanc on account of the diminished pressure of the atmosphere, and allowance must be made for such differences in temperature, due to increased altitude, in cooking food, as well as in preparing pharmaceutical and chemical preparations.

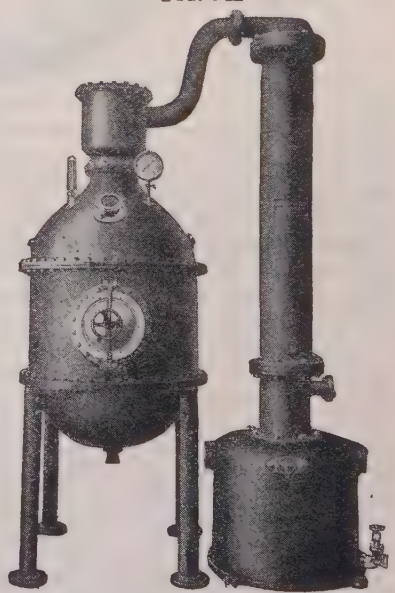
The practical application of these principles is of great importance in pharmacy, and vacuum pans are almost invariably used in the larger laboratories for concentrating solutions which are injured by heat under the ordinary pressure of the atmosphere,

Fig. 141



Small vacuum still

Fig. 142

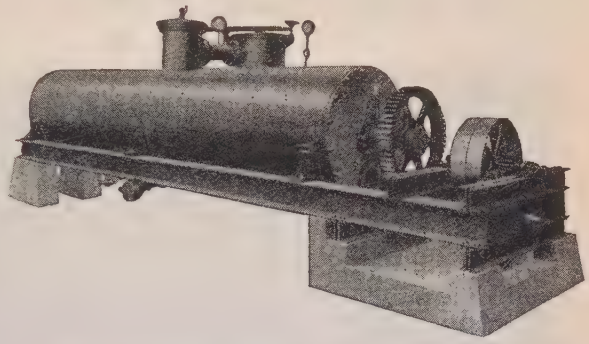


Vacuum still

especially in evaporating solutions of organic substances, for these are almost without exception injured by heat. Vacuum evaporators have the added advantage of lessening the time required for an operation and thus become an economy factor.

In Fig. 141 a vacuum apparatus is shown which illustrates the principle of this method of evaporation. Fig. 142 shows a larger vacuum apparatus adapted for manufacturing laboratories. At the left is seen a jacketed copper still containing manhole, eye glasses, aircock, and drain valve, the top being enlarged to provide for the frothing of the liquid in the still. The condenser is mounted on the receiving tank which is furnished with a water gauge, drain valve, and with inlets and outlets for the vacuum pump. Such stills are used to concentrate the percolates from vegetable drugs, at very low temperatures, and at the same time to recover the alcohol for use in another operation. Fig. 143 illustrates an apparatus in which the alcohol may be recovered directly from an exhausted drug by emptying the contents of a percolator into the still. Vacuum pumps operated by steam are to be found in all well equipped pharmaceutical laboratories, and pipes and attachments are just as easily connected with various forms of apparatus as are the pipes used for conveying steam under pressure.

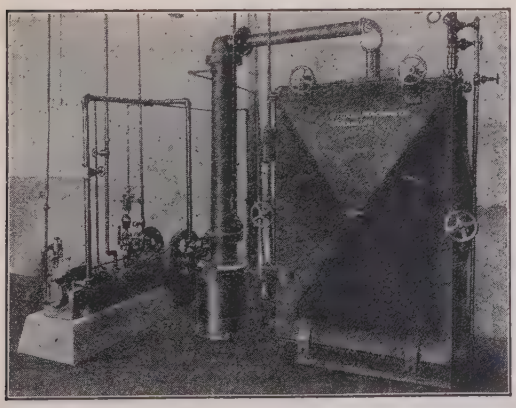
Fig. 143



Apparatus for recovering alcohol from exhausted drugs

The F. J. Stokes Machine Company, of Philadelphia, has perfected a vacuum drying apparatus of much value. Fig. 144 shows in detail the application of the vacuum applied to drying moist substances; the vapors may be condensed and reclaimed by the use of the condenser. These vapors may sometimes be injurious or objectionable if allowed to escape into the laboratory, and hence this plan of disposing of them is effective; the condenser may be disconnected, if found advantageous. Substances which require days to dry in heated rooms can be dried in several hours with this apparatus.

Fig. 144



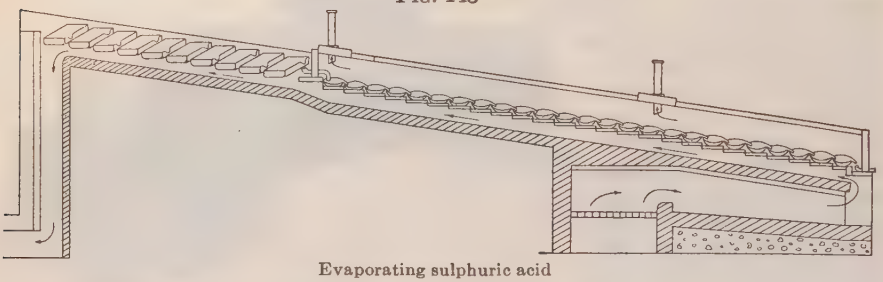
Vacuum dryer

Economical Surface Evaporation — In large industries where economy in operating is an essential factor, various forms of apparatus are constructed to meet this need. In Fig. 145 is shown a method of concentrating sulphuric acid.

Spontaneous Evaporation—By this term is meant the evaporation of a liquid at the ordinary temperature of the atmosphere, or without the application of strong, direct heat. It is used in cases where the residue or less volatile liquid is liable to injury or loss by the application of much heat, or in crystallization, when, by the slow vaporization of the volatile liquid, finely

formed crystals may be secured, and in other less important operations. Spontaneous evaporation is usually conducted in drying rooms or closets when they are accessible; these, as will be subsequently described, are rooms or closets which are very slightly heated by the use of exhaust steam or other means; or the liquid may be placed in shallow dishes or trays and the surface exposed to the rays of the sun during fine weather. Upon the small scale, one of the most convenient methods is to support the dish upon a tripod or shelf

FIG. 145



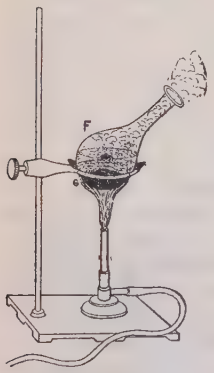
Evaporating sulphuric acid

above a coal stove, at a sufficient distance above the stove to avoid injury or to place it in the oven of a gas stove, the door being left open and a very low heat applied.

In industrial processes many forms of apparatus have been devised for accomplishing rapid evaporation and the drying of materials. Sugar, gelatin, granular chemicals, extracts, wash waters, and many other substances are handled on a large scale by special machinery.

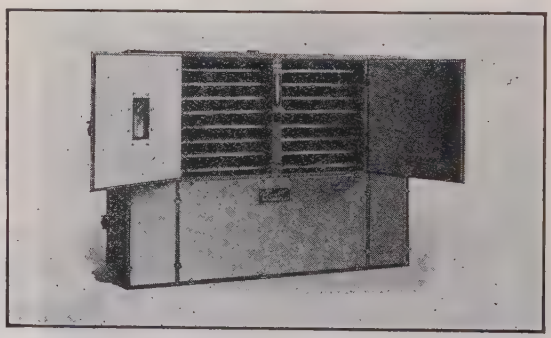
Evaporation by Direct Heat—This method usually requires the greatest amount of care in order to avoid loss or injury by overheating. It is, there-

FIG. 146



Flask evaporation

FIG. 147



Drying closet

fore, to be preferred only in cases where the residue is not easily injured by such an accident. The evaporation of saline solutions in crystallization, or of weak aqueous organic solutions, may usually be performed by the application of direct heat. Careful watching, however, is necessary, and also frequent stirring, to prevent the formation of a crust upon the bottom. Fig. 146 shows a method of evaporating by direct heat by using a flask, F, supported on a piece of brass wire gauze, G, on a retort stand.

Drying closets are used in many operations in the manufacturing labora-

tory. Usually they are heated by steam pipes or a gas stove and the air drawn through by an electric fan. Figs. 147 and 148 illustrate Proctor dryers.

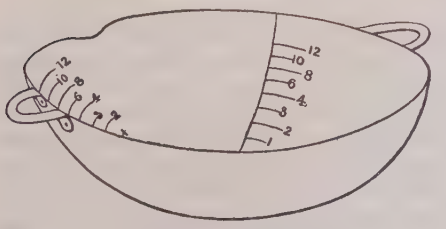
Evaporation to a Fixed Volume—This operation cannot be performed accurately without inconvenience, and hence it is much more satisfactory to evaporate a liquid to a definite weight,—all that is necessary in the latter case being to use a tared dish, and weigh the dish and contents when evaporation has progressed to the desired point. In evaporation to a definite measure, a

FIG. 148

Drying closet with trays on portable frames

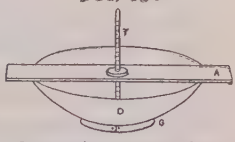
graduated evaporating dish (see Fig. 149) may be employed, care being taken to level it by noticing that the height of the liquid is the same on each side, or the expedient illustrated in Fig. 150 may be resorted to. An ordinary evaporating dish, *D*, is placed upon a grommet, *G* (see page 130), and subjected to heat (in this case the temperature is intended to be that of a warm room); a perforated wooden strip, *A*, is placed across the dish, and a glass thermometer, *T*, is supported in an upright position in the liquid by a perforated cork. Sufficient water is poured into the dish to equal the final measure of the liquid, and a small rubber band is slipped on the thermometer (or a piece of string tied on) to indicate the desired level of the liquid; the water is replaced by the liquid to be evaporated, and evaporation proceeds until the liquid has been lowered to the mark on the thermometer. When the use of the thermometer is unnecessary, a notched stick may be substituted. In order to arrive at results approaching accuracy by these methods, the liquid must be allowed to cool to the temperature of the water which was used as the measure of the liquid in the beginning.

FIG. 149



Graduated evaporating dish

FIG. 150

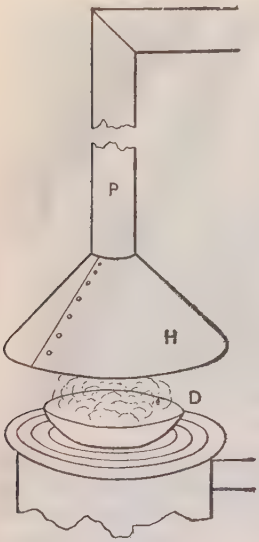


Measuring evaporation

Use of Hoods—A hood is a contrivance of a conical shape or in the form of a closet, usually called a *fume closet*, intended to collect and dispose

of vapors which, from their disagreeable odors or their suffocating effects, render the atmosphere of the store or laboratory unwholesome. Fig. 151 shows a form of hood which has been found useful on the small scale. It is made of galvanized iron, and connects by galvanized stove pipe with the strong draught of a good chimney; the stove pipe running horizontally to the chimney should have a damper in it. If any condensation of the vapors takes place in the stove pipe, the larger diameter of the circular hood will cause the drops of liquid to fall outside of the evaporating dish, and thus contamination of the contents of the dish is avoided. Hoods are usually made of wood or galvanized iron when intended for large scale operations.

Fig. 151



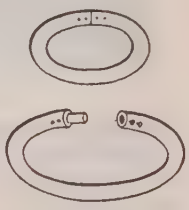
Hood

Fig. 152 illustrates a laboratory hood or *fume closet* such as is used in analytical laboratories where

Fig. 152

Fume closet

Fig. 153



Grommet

acid and other obnoxious fumes must be carried away. Such hoods are often equipped with specially constructed acid-resisting suction fans, electrically driven and placed somewhere in the flue pipe making the device more efficient.

Use of Grommets—One of the inconveniences in using round bottomed evaporating dishes is due to the shape, serious loss often occurring from tilting the dish and spilling the contents. To obviate this, *grommets* should be used. These may be economically made from straw, formed into a circle and tied, or from a cast off piece of rubber hose or tubing by bending it into a circle, placing a wooden plug in one end, tacking it securely, and inserting it in the other end and fastening it in the same manner (see Fig. 153). An elastic ring is thus formed upon which an evaporating dish or round bottomed vessel may be safely placed. They may also be purchased made of cork or other non-conducting material. Grommets serve another very important purpose, that of preventing the fracture of a porcelain or glass dish containing a hot liquid, by being placed between the hot dish and the cold surface of a table or counter.

CHAPTER IX

DISTILLATION

The first part of the process of *distillation* is identical with that of evaporation, for it is simply the vaporization of the volatile liquid through the application of heat. The second step of the process is the opposite of vaporization, and consists in the conversion of this vapor into a liquid by the application of cold. This part of the process is called *condensation*. The subject of vaporization was treated of in the preceding chapter. Condensation is to be considered here.

Condensation—It has been already shown (page 114) that when a liquid is vaporized a certain amount of heat disappears or is rendered latent, and when a vapor is liquefied a corresponding degree of heat is evolved or reappears. While the practical application of this law is of great service in the use of steam for heating purposes, the opposite process, namely, that of condensation, has its disadvantages, because of the relatively large quantity of cold water necessary to convert vapors into liquids.

The greater the difference in temperature between the condensing surface and the vapor, the more rapid is the condensation; and it has been computed that steam at 100° C. (212° F.) requires about twenty-five times its weight of water at 20° C. (68° F.) to condense it. The proper relation between the heating and condensing surfaces of apparatus used in distillation can only be known by careful study of the laws governing vaporization and condensation, or by practical experience.

Apparatus used in Distillation—In considering the many kinds of apparatus used in distillation, two typical forms are presented: 1, the *alembic* form (from the Arabic *al ambig*, the still), in which the vapor is condensed in an enclosed space immediately above the heated liquid, and, 2, the *retort* form (from the Latin *re-tort* to turn or twist again), in which the vapor is condensed in a vessel placed at one side of that containing the heated liquid, and connected with it by a suitable tube or pipe.

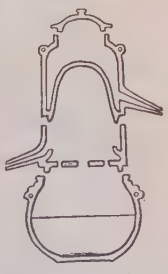
The Alembic—This is also called a *lambik* or *limbek* in the older literature of pharmacy. It is probably the most ancient kind of distillatory apparatus, but in its original form it is now rarely employed. The body, or *cucurbit*, is usually globular or oval in shape, and at its junction with the hemispherical head or dome there is a gutter or groove. This serves to collect the condensed vapor or distillate, which is carried off by a tube, as shown in the illustration (see Fig. 154).

Fig. 154

Alembic

Fig. 155 shows an old form of Japanese alembic. Into the boiler is fitted a short cylinder. This has a perforated bottom, and the gutter communicates with the spout; the condenser has a cover, and is also furnished with a spout for carrying off the water used in cooling the dome after it has been heated by the vapors rising from the boiling liquids in the bottom. This still, or, as it is called by the Japanese, *lambik*, is shown because it represents the alembic probably in one of its best practical forms, and the advantages possessed by this kind of distilling apparatus are seen to be compactness and simplicity.

Fig. 155



Japanese lambik

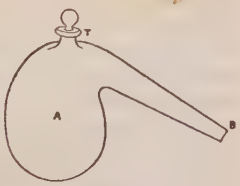
It is, however, not fitted for distilling very volatile liquids; is very inconvenient and troublesome, because of the necessity for constantly replacing the water used in the condenser, and distillation is slow and tedious. The *pelican* referred to in the older literature of distillation is an obsolete form of alembic with two beaks recurving into the still body for the purpose of promoting cohobation.

The Retort—This form of distillatory apparatus has many advantages over the alembic, which it has almost entirely replaced. A retort, in its simplest form, may be described as a long necked glass flask in which the neck is bent over until its axis makes an acute angle with that of the bowl of the flask. Retorts are of two kinds,—plain and tubulated. A plain retort is shown in Fig. 156. If it has a tubulure or orifice at the top of the bowl for the purpose of introducing the liquid to be distilled, it is said to be tubulated (see Fig. 157).

Fig. 156

Plain retort

Fig. 157



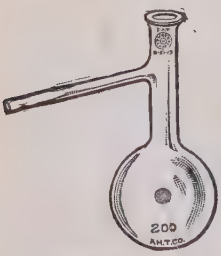
Tubulated retort

Retorts are made of glass, porcelain, earthenware, fused silica, platinum, iron, lead, copper, etc., according to the purposes for which they are to be used.

Porcelain and earthenware retorts are used in the distillation of phosphorus, mercury, etc.; platinum and iron retorts, in destructive distillation; leaden retorts, in making hydrofluoric acid, ether, etc.

The glass retort is the only kind, however, which will be considered here in detail. The shape of a retort is an important point to regard in its selection. Retorts having deep bowls are best suited for very volatile liquids. The lower surface of the neck of the retort should form a decidedly acute angle with the surface of the bowl if tubulated; a line drawn from the center of the stopper should touch the center of the bowl, A, so that when a funnel is introduced into the tubulure, T, to charge the retort, the contents may all be delivered into the bowl without soiling or splashing the neck. The neck of the retort should gradually taper to the end, and the beak, B, should never be larger in diameter than any other portion of the neck, otherwise difficulty may be experienced in making joints with adapters, receivers, or condensers (see Fig. 157). Such a fault may prevent the use of a cork ring in joining, for this ring should be made tight by forcing it up the gradually increasing diameter of the neck. The glass forming the retort should be carefully annealed and have a uniform thickness. Extremes should be carefully guarded against. If the glass is too thick, the sudden changes in temperature, to which retorts are constantly subjected in distillation, may cause fracture; on the other hand, if too thin, they are easily broken in cleaning. Retorts with scratches or imperfections in the bowl should be rejected. The objections to the use of retorts are mainly due to their peculiar shape, the principal one being the difficulty of cleaning them thoroughly. The necessity for having a variety of different shapes and sizes to suit special operations is greater than when distillation is performed with flasks and bent tubes.

Fig. 158



Distilling flask

Flask distillation will be usually found most practicable for pharmaceutical work. The best shape for a flask is shown in Fig. 191. The neck should have a sufficient diameter to admit a large cork, so that there will be room for a wide bent tube, a thermometer, and a safety or charging tube. The advantages of using a flask instead of a retort for all distillations suited to it are several: it is

easily cleaned, it is useful for other purposes, for instance, as a measure, as a container, or as a receiver for the distillate; the tubes are readily replaced in case of breakage. One of the most important parts of this apparatus is the bent tube for conducting the vapor to the receiver or condenser. The diameter of the bent tube should be as large as the receiver or condenser will conveniently accommodate.

Tubulated distilling flasks are now available and are superior to the extemporized apparatus described in the foregoing paragraph. They may be procured made of the low expansion borosilicate glass (Pyrex) which is highly resistant to heat and chemical action (see Fig. 158).

Steam Distillation—Where steam is to be used as the vaporizing agent in a distilling operation, the apparatus may be very conveniently assembled by adding to the regular distilling outfit a container for generating the steam. It will be recalled from a previous chapter, that steam possesses a great many advantages over direct heat and frequently in distilling operations it is necessary that no direct flame come in contact with the material being vaporized. The distillation of volatile oils and aromatic waters affords a notable example of such operations.

In the small laboratory a steam generating flask may be connected with the retort bowl or distilling chamber. In that event the only heat applied will be that necessary to generate the steam. In large operations live steam from a boiler may be made to pass directly into the still head.

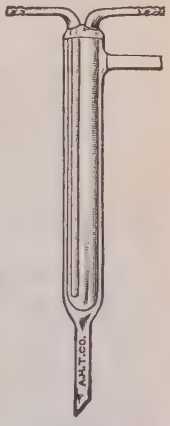
Fig. 159

Soxhlet apparatus

Reflux Distillation—Distillation is often used as a secondary process, that is, it is used simply as a means of recovering a solvent that has been vaporized and which is to be condensed and used over and over again, for the purpose of extracting the soluble material from a given substance. When it is so conducted the term reflux or continuous distillation is applied to it.

An example of this type of distillation is shown by the ingenious Soxhlet outfit illustrated in Fig. 159. *A*, representing the vaporizing chamber, *B*, the extracting chamber and *C*, the condenser. The special advantage of this type of distilling apparatus, or, more correctly, extraction apparatus, is economy of solvent and safety from fire hazard. The material to be extracted is placed in a porous thimble in *B*. The solvent is placed in the flask *A*. Heat is applied and the vapors of the solvent pass through the large side tube of *B* into the condenser where it is condensed and drops into *B*. There it will remain until the upper level of the condensed liquid reaches the tip of the small siphoning tube on the other side of *B*, when it will empty over into the vaporizing chamber *A* ready to be vaporized over and over again.

Fig. 160



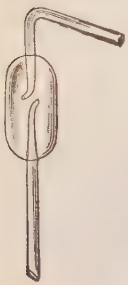
Special form of glass condenser

A quickly assembled reflux distilling outfit may be prepared by fitting a flask with a perforated rubber stopper through which is passed a glass tube one meter long, which will serve as the condenser. This form of apparatus is used when a substance is to be digested or boiled with a volatile solvent over an extended period. A condenser suitable for use used as a reflux condenser or as a regular condenser, is illustrated in Fig. 160.

Frothing—Frothing is a phenomenon which may occur in the distillation of liquids, particularly those which are alkaline or contain soap or one of the saponins. Various remedies have been suggested, none of which is infallible

for all cases. The presence of a film of mineral oil or of melted paraffin is sometimes effective. As it is a condition which is most troublesome at the onset of the heating and frequently disappears entirely after the operation has been continued for some time, the best method of obviating or controlling the trouble is to use a distilling flask of about ten times the volume of the liquid to be distilled and also to provide a trap bulb or overflow bulb (see Fig. 160 *a*), between the flask and the condenser.

Fig. 160 *a*



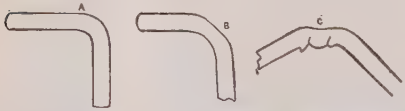
Trap bulb

Bumping—Another phenomenon frequently experienced in distillation operations, especially when a flask or retort is used, is known as bumping. It is caused by a sudden release of vapor and frequently throws the liquid through the condenser into the receiving flask, contaminating the distillate. It is most frequently experienced with resinous liquids but may occur in any distillation. Pieces of pumice, hard coal, broken glass, clay pipe stems, or short pieces of glass tubing are frequently added to retard this tendency by introducing the vapor phase, in the form of air which is occluded on these irregular pieces, down into the liquid where the heat is applied. The trap bulb is the surest device to prevent contamination of the distillate.

Cutting Glass Tubes—The glass should be moderately thick and of the proper length. A glass tube may be broken neatly by scratching it across with a sharp three-cornered file (a file cuts more effectively when moistened with a little oil of turpentine), and then grasping it with both hands, one on each side of the scratch, and making a slight outward pressure, which will generally produce a clean fracture. By holding the sharp edges for a few moments in a Bunsen or blast flame the edges may be rounded so that they will pass through a cork without cutting it and making a ragged opening.

Bending Glass Tubes—A tube may be bent by heating it properly over a gas flame. To make a symmetrical curve in a tube of large diameter requires

Fig. 161 Fig. 162 Fig. 163



Tube properly bent | Tube unequally heated | Tube hastily bent

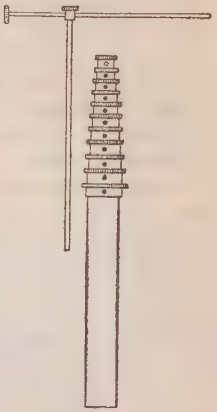
Fig. 164

Holding the tube

considerable skill and practice. One end of the tube should be closed by a cork, and the part of the tube that is to be bent held just above the flame and gradually rotated between the fingers, so that it may be heated evenly throughout. It should also be passed to the right and left through the flame for the space of an inch or two on each side of the middle of the proposed bend, and very slowly allowed to curve in one direction, so that the bend shall not be too abrupt. The object of closing one end with a cork is to prevent a current of air from passing through, and, in case collapse from overheating occurs, by gently blowing in the tube the softened glass may be swelled to its proper curve. Fig. 161 shows a tube properly bent, while Figs. 162 and 163 illustrate some of the defects produced by unskilled work. In Fig. 162 the tube was not rotated evenly, and at the top of the bend, *B*, it was hot enough to collapse. Fig. 163 represents the effects of hurry and unequal heating, the operator having forced the bend, *C*, before the tube was heated uniformly. A gas burner having a solid, steady flame is the best kind to use (see Figs. 71 and 72), and draughts of air should be avoided.

In Fig. 164 the method of holding a tube while "drawing it out" over the flame to make a tapering tube is shown. The line in the center shows the proper place to scratch it, when cold, with a fine, sharp, triangular file when it is to be broken apart. Fig. 165 shows a "well drawn" tube; Fig. 166, one which has not been revolved evenly or heated uniformly. Fig. 167 shows the same fault and careless work besides.

Fig. 168



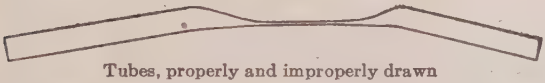
Cork borers

Cork Fitting—Corks for joining apparatus should be of the best quality. They are perforated for the passage of the glass tubes by the use of cork borers (see Fig. 168). These are cylindrical brass tubes of various sizes, sharpened at one end, and surmounted by a milled brass cap. They are furnished in sets. A small hole is drilled through

Fig. 165

Fig. 166

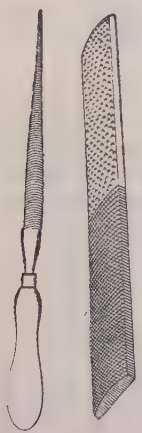
Fig. 167



Tubes, properly and improperly drawn

both sides of the brass cap, so that an iron rod may pass directly through it and form a convenient handle. They are used by holding the cork firmly with the left hand and pushing the borer through with the right hand, using a twisting motion at the same time so as to cut a smooth round hole. The mistake frequently made in using cork borers is due to haste. The attempt to force the borer through quickly without rotating it sufficiently always ends in breaking off pieces of the cork. The cutting edge of the borers should always be kept sharp and in good condition by the use of a grindstone or emery paper. Cork borer sharpeners are also available. When the cutters do not bore a hole of the exact size needed for the glass tube, which of course should fit tightly, it is best to select a borer which will cut a smaller hole than that desired, and then to enlarge the hole by filing with a rat tail file (Fig. 169), or, if the hole is large, with a half round file. When the tubes have been fitted, the cork should usually be thoroughly soaked in hot water, for the purpose of swelling and softening it. It should never be soaked before cutting or filing. The rasp and file shown in Fig. 170 will be useful in fitting up large flasks. Rubber stoppers can often be used to great advantage, and they may be readily perforated by dipping the cork borer in solution of sodium or potassium hydroxide or in strong ammonia water before beginning to use it. If rubber stoppers are well dried by wiping them thoroughly, they may be filed easily with a sharp, flat file. The main advantage of rubber stoppers is that they are practically impervious to vapors or gases, and hence require no luting. Moulded rubber stoppers already perforated for small glass tubing with either one or two holes, are also obtainable. Substitutes for rubber stoppers may be made by keeping dry corks in melted paraffin or wax until the pores are thoroughly filled, and then cooling.

Fig. 169 Fig. 170



Rat tail file Rasp and file

Lutes—A lute is a form of cement used for making water-tight joints in distillatory apparatus. The most satisfactory lute for ordinary distillations is made by adding flaxseed meal to boiling water and stirring until a thick, sticky mass results. When the perforated and soaked cork containing the tubes is inserted in the neck of the flask, a small quantity of lute should be pressed into the joints, and then followed by sufficient lute to make the joint vapor-tight. If future trouble from leaking is to be avoided, it is usually better to throw away a cork which will not make an almost perfect joint without lute, rather than trust to cover up serious deficiencies with lute. A neat finish may be given to the joint by dipping a finger into water, and with it smoothing the surface of the lute.

Bladder Joints—One of the most useful substances for the joining of tubes is a strip of moistened bladder. Hogs' bladders are usually preferred, and it is now possible to get them of excellent quality, prepared by being thoroughly cleaned and then soaked in an alkaline solution or in petroleum benzin to deprive them entirely of fat. In connecting two tubes of different diameters which are not to be subjected to a high heat, a bladder joint is especially useful. For an ordinary joint of each glass tube, a strip about six inches long and an inch and a half wide should be moistened and wrapped around the proposed joint; the upper end of the bladder is then tied tightly with strong linen twine, leaving the short end of the twine at least six inches long (see Fig. 171); this end is carried along the top of the bladder and tied tightly around the lower end of the joint; the long end of the twine is then wrapped spirally and regularly around the bladder until the lower end is reached, and both ends should be there tied tightly (see Fig. 172). Strips of writing paper soaked for a few moments in water, and then coated with ordinary, smooth flour paste to which 10 per cent of glycerin has been added, may also be used for joining apparatus, as may also parchment paper.

Fig. 171

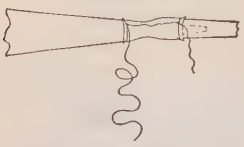


Fig. 172

Bladder joints

Rubber joints are preferred to bladder joints when there is no likelihood of vapor or high heat dissolving or softening the rubber, and when the tubes to be joined are nearly of the same diameter. The ease and celerity with which such joints can be made are their strong points. A piece of rubber tubing is moistened on the inside with water, and stretched over one end of the glass tube, and then over the end of the other glass tube. Success largely depends upon having the rubber tube slightly smaller in diameter than the glass tube, so that the elasticity of the rubber alone will be sufficient to make a tight joint, otherwise the rubber tube must be tied on, and then the advantage over a bladder joint is lost (see Fig. 173). In all cases it is preferable to select tubes which differ slightly in diameter, so that one may slip into the other, the smaller, of course, having the higher position, so that the vapor or liquid shall not come in direct contact with the rubber.

Fig. 173

Rubber joint

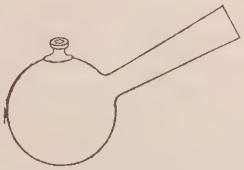
Receivers are glass vessels, usually globular in shape, intended to receive distillates. They are of three kinds,—*plain*, *tubulated*, and *quilled* (see Figs. 174, 175 and 176). When a plain receiver is required, an ordinary flask will answer, but if difficultly condensable vapors are produced, it is necessary to provide for their escape, or an explosion may occur from the accumulated pressure. This may be done in a tubulated receiver by occasionally removing

the stopper, or, better, by connecting a bent glass tube with the receiver and allowing the end of the tube to dip into water, or into an acid solution if the vapors are alkaline, or into an alkaline solution if the vapors are acid. A quilled receiver is useful where the distillation is to be carried to a definite

Fig. 174

Plain receiver

Fig. 175



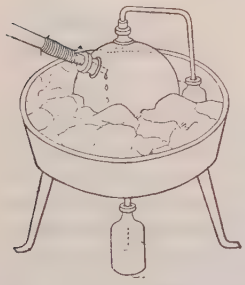
Tubulated receiver

Fig. 176

Tubulated and quilled receiver

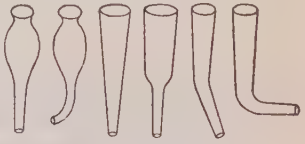
point and a certain amount of distillate is to be received, or, as in the preparation of hydrocyanic acid, the end of the quill is made to dip below the surface of cooled diluted alcohol or water, in order to condense all of the gas. In the distillation of very volatile liquids an effective mode of using a quilled receiver is shown in Fig. 177. A hole is cut in the bottom of a rather shallow tin pan and a short tube soldered into it; a perforated cork will permit the quill of the receiver to pass through it, and at the same time a tight joint should be made; ice is heaped up over the receiver, and any uncondensable gases may escape from the bent tube in the tubulure or be absorbed by the liquid into which the tube dips.

Fig. 177



Mode of using quilled receiver

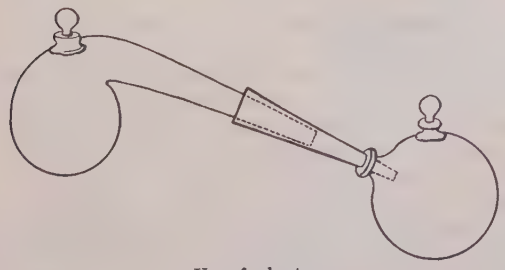
Fig. 178



Adapters

Adapters are tapering tubes of glass which are used to connect retorts with receivers. Fig. 178 shows the various shapes. Good adapters may be made from retorts having broken bulbs by cutting off the broken portion, scratching the tube with a file, and extending the crack thus made entirely around it by slowly passing a red hot iron over the line marked for the fracture. Fig. 179 shows an adapter of this kind in position. Adapters are also employed to deliver the distillate from condensers into receivers or flasks.

Fig. 179

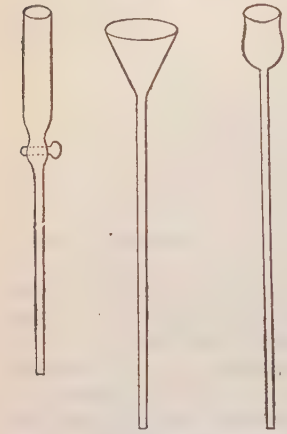


Use of adapter

Charging Retorts—Plain retorts must be charged by using a funnel tube; this may be a funnel with an elongated tube, or a modification of it, as shown in Fig. 180, or one may be improvised by selecting a tube of sufficient diameter to permit of the introduction of a small funnel (see Fig. 181). The object of using a funnel tube is to prevent the soiling of the neck of the retort; as the object of distillation is

usually to purify the liquid, the latter must be delivered into the bowl of the retort without touching the neck. Fig. 182 shows the method of charging a plain retort; a small piece of rubber tube is sometimes placed on the end of the funnel tube to guide the liquid safely and guard against fracture. Tubulated retorts are charged by simply placing a funnel in the tubulure and pouring the liquid through it.

Fig. 180



Stoppered funnel tube | Funnel tube | Thistle top funnel tube

Fig. 181

Improvised funnel tube

Fig. 182

Charging a plain retort

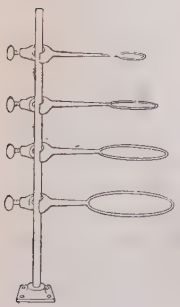
Fig. 183

Safety tube

Safety Tubes—It is sometimes impossible to avoid sudden evolutions of vapor during distillations and at times the pressure produced is sufficient to break the apparatus. When there is a likelihood of this occurrence, it is advisable to insert a safety tube (Fig. 183) into the tubulure of the retort. The bulb shown on the loop of the tube is partly filled with mercury, and when undue pressure occurs, the mercury is forced into the thistle top and the vapor escapes; when the retort has been thus relieved, the mercury descends into the bulb and the distillation proceeds.

Retort Stands are used to properly support retorts, flasks, receivers, etc., during distillation, although they are also employed by pharmacists for a variety of other purposes, as in filtration, percolation, evaporation, etc. Fig. 184 shows a retort stand which has been used with much satisfaction in the laboratory of the Philadelphia College of Pharmacy and Science. It is more substantial than those that are commonly furnished by the chemical apparatus makers. The clamp (see Fig. 185) is made upon the principle of one originally devised by S. Floyd Wiegand, and is hook shaped, so that any of the different sizes of rings may be unscrewed from the upright rod without disturbing the rest. The almost universal fault of the retort stands in common use is their extreme lightness and want of stability; the rings frequently bend under such weights as should be easily borne, and, owing to the base being too light and small, the whole stand is sometimes upset during an operation (see Fig. 186). Fig. 186 *a* illustrates another form of stand much used in the chemical laboratory. In the stand shown in Fig. 184 the base plate is per-

Fig. 184



Retort stand

Fig. 185

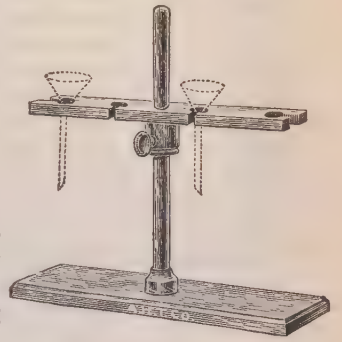
Retort ring clamp

manently fastened to the operating counter in a place known to be the most convenient; if the counter is one that must be used for other purposes, the base plate may be screwed to the under side of the counter, and a five-eighths inch hole bored through the counter, so that the center shall coincide with the center of the hole in the base plate. When the retort stand is not in use, the hole in the counter may be closed with a cork. The upright is made of half-inch iron tubing, and can be quickly screwed into the base plate with the hands without the use of pipe tongs. The rings and clamps are all in one piece, and are made of malleable iron, so that if dropped on the floor they are not likely to break. These retort rings are made on request by J. M. Maris Co., Philadelphia, and the pipe and stand are readily obtainable from any plumber. When used for holding a glass percolator or funnel, the danger of fracture on account of the contraction of the iron ring may be avoided by stretching three split sections of rubber tubing upon it (see Fig. 187).

Fig. 186

Portable retort stand

Fig. 186*a*



Funnel stand

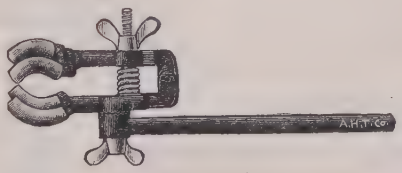
Fig. 188 illustrates a Universal clamp extension, which is very useful for holding condensers, retorts, etc.; the jaws of the clamp are lined with rubber to serve as non-conductors and protectors against fracture. Fig. 189 shows a clamp holder for attaching extension clamps, rings, etc., to apparatus supports.

Leibig Condensers—Many forms of condensers are available. The older form known as the Leibig, or variants of this form, is still largely used. This form, although now bearing the name of the great chemist, was used before his time. It consists of a long glass tube, surrounded by another tube of larger diameter; two small openings are made, one near the bottom and the other near the top of the large tube. Connection is

Fig. 189

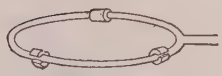
Clamp holder

Fig. 188



Clamp extension

Fig. 187

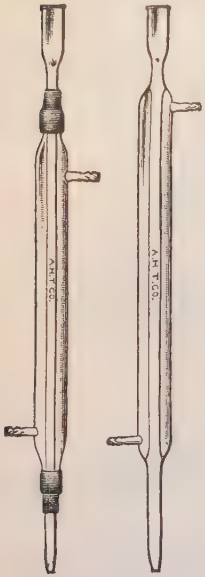


Ring with split sections of rubber tubing

made with the tube leading to the bottom with a cold water supply, and the water circulates in the space between the inside of the large tube and the outside of the smaller tube, and finally has its exit at the opening near the top. Various forms of glass condensers are illustrated in Fig. 190. The distilling outfit illustrated in Fig. 191, still largely used in the chemical laboratory, was much in use a decade or so ago, for the purpose of preparing distilled water, and a great many varieties were placed on sale, each having some special feature. Their use is now largely discontinued through the fact that distilled

water is an available commercial article throughout the country. Occasionally, however, the pharmacist finds use for a water still and the types described, namely the Barnstead (see Fig. 199), the Stokes (see Fig. 198), and the Colton stills, have won their way into the laboratory because of compactness and practicability.

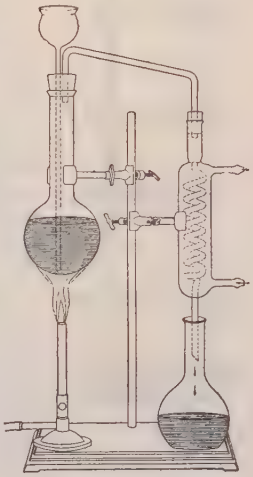
Fig. 190



Various forms of Leibig condensers

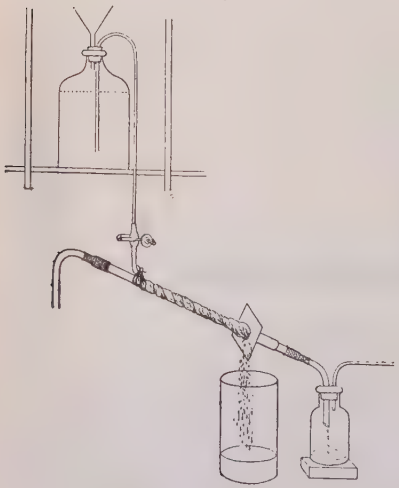
Fig. 192 shows a method of refrigeration which may be used in an emergency when the ordinary condensers and a steady supply of water are not to be had. A wide tube is connected with the distilling flask, and some lint, lampwick, or other absorbent material is wrapped spirally around it and tied at the ends; a square piece of cardboard is perforated so that it will fit tightly upon the tube, and it is pushed upon the lower end until it is in close contact with the lint. If water can be supplied from a faucet, a rubber tube is connected with it and conducted to the upper part of the condensing tube, and tied in such a position that a stream of water will trickle from it and be carried down by the lint until it reaches the cardboard, where it falls into the vessel prepared to receive it. If a continuous supply of water is not available, a large bottle containing water may be placed upon a shelf, and a syphon, having a rubber tube and pinchcock, attached, as shown in the cut. Figs. 193 and 194 illustrate two convenient types of pinchcocks. These are slipped over rubber tubing and by opening and closing, the rate of flow of liquid through the tube may be easily regulated.

Fig. 191



Flask distillate

Fig. 192



Tube condenser in use

The Condensing Worm—The method of condensing by the use of the worm is very old, and its advantage in securing economy of space and its ease of appli-

Fig. 193

Pinchcock

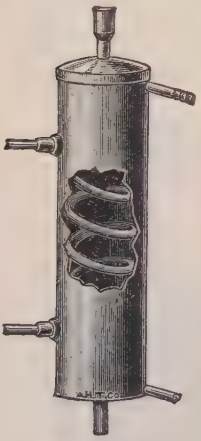
Fig. 194

Pinchcock

cation are very apparent. Fig. 195 affords a good illustration of this kind of condenser. Block tin pipe is the best that can be used for general pharma-

ceutical work. Copper or tinned copper tubing should be avoided, because it is impossible to prevent the action of acid vapors or liquids upon the copper. Soluble salts of copper would thus be formed and the distillate often rendered poisonous. An iron tube is not admissible, on account of contamination from the formation of iron salts. Pure tin is not affected so easily, and the salts that possibly would be formed are not so objectionable. Block tin pipe may be wound spirally around a convenient cylindrical vessel, such as a tin can or similar object, to give it the proper shape, and then fastened to three notched uprights and placed in position. Earthenware condensing worms of all sizes, of excellent quality, are available for condensing acid vapors, as in the manufacture of ethyl nitrite by distillation; these condensers are undoubtedly superior to metallic ones. Glass worm condensers are especially efficient for small operations.

Fig. 195



Metallic worm condenser

Glass worm condensers are largely used in laboratories and are superior to the straight tube type because of the large surface which they expose to the condensing liquid (see Fig. 196).

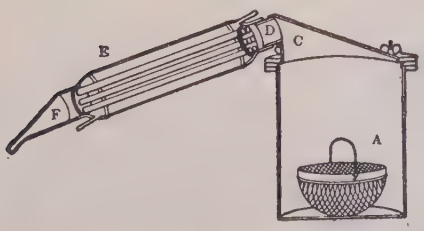
Fig. 196

Glass worm condenser

Pharmaceutical Stills

Metal stills are preferred in all distillatory operations where the liquids or vapors do not act chemically upon the metals of which they are made. Tinned copper is the best material to use in the construction of stills, for, although tinned iron is cheaper, the greater durability of the former renders them in the end more economical. The same typical forms are used in the construction of pharmaceutical stills as in glass distillatory apparatus,—*i. e.*, the alembic and retort. The older forms of stills described in earlier editions of the Practice of Pharmacy, and devised by such well-known pharmacists as Procter, Wiegand, Curtman, Stevens, Rice, and Remington are no longer available.

Fig. 197



Remington still (sectional view)

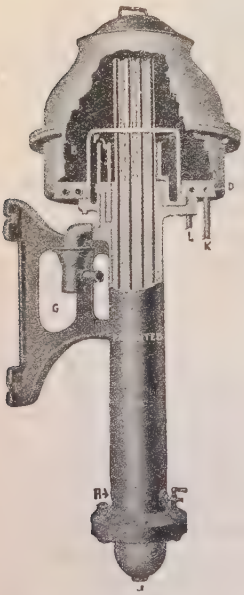
The *Remington still*, a sectional view of which is illustrated in Fig. 197, was devised by Professor Joseph P. Remington and possessed a great many advantages over the forms which were in use at the time of its invention. It is not now commercially available. Unlike the Stokes and the Barnstead still it is to be noted that this still could be used for the purposes of distilling volatile oils, or preparing aromatic waters, etc., for which uses the other named stills are not designed.

The Stokes' still (Fig. 198) is made by the F. J. Stokes Company of Philadelphia and may be obtained in various sizes and styles with a capacity of from one-half gallon to one hundred gallons per hour. Gas, gasoline, or live steam may be used to supply the heat. The principle upon which it operates is as follows: The feed or raw water enters at *H*, surrounds the condenser

tube *C* and serves first to condense the steam generated in the still *B* as it descends the condenser tubes, converting it into distilled water. In so doing the raw water becomes heated to the boiling point by the time it reaches the top of the condenser where the ammonia and other gases escape into the air through an opening in the cover. A part of this feed water escapes over the goose-neck, either into a waste pipe or cistern, and the balance passes into the still.

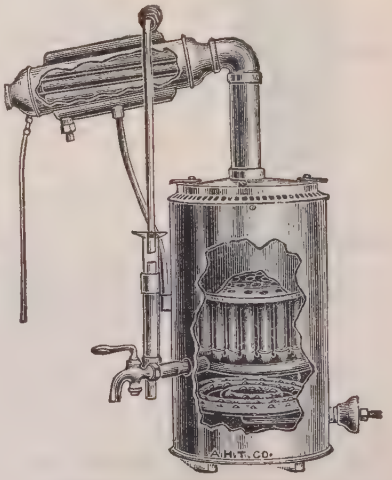
In the illustration, it will be seen that there is a zone of water at the top of the condenser, which being above the outlet to the overflow *G*, is not drawn off except to replenish the water in the still as it evaporates. This zone of water at the top of the condenser is constantly kept boiling by the steam from the still descending the condenser tubes, and it is here the ammonia and other gases are liberated. The still in the illustration is heated by live steam with a pressure of twenty pounds or over, which circulates in the copper coil *D*, and serves to boil or evaporate the raw water. The distilled water comes out at *J* and can be piped to any receptacle. The condenser tubes extend to the extreme top of the steam chamber and high above the water level, so there is no danger of water being carried over by steam.

Fig. 198



Stokes' automatic water still

Fig. 199



Barnstead water still

The Colton Mfg. Co., of Detroit, also manufactures an automatic water still similar in design to that just described.

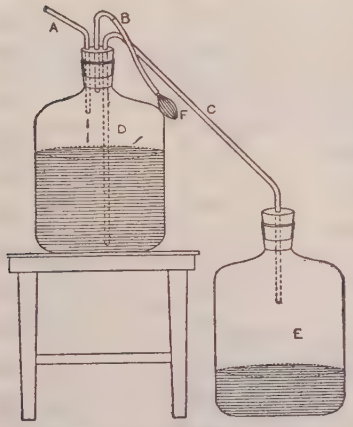
The Barnstead Still Company, Boston, Mass., manufactures an efficient water still (Fig. 199) which may be had in various capacities and equipped for steam, gas, or electric heat. The small laboratory type ranges in capacity from 1 to 10 gallons per hour. The boiler is of the tubular evaporator type, thus presenting to the flame a maximum of heating surface in a minimum of space, and the condenser consists of a series of parallel tubes similar to the Remington still. The water is supplied automatically and is preheated by the condenser before entering the still. A small opening at the extreme end of the condenser permits the escape of the more volatile gases so that an exceptionally pure water is obtained.

Fig. 200 illustrates an ingenious plan for receiving distilled water from an automatic water still. It was suggested by Paul S. Pittenger. The water from the still flows into the glass container at *A*. A second container is provided at a lower level and connected with tubing as illustrated. Should the attendant [illegible] that the first container is almost full the siphon may be started by pumping in by pressing *F*. Should the upper jar not be emptied before

it is full it will automatically empty itself through the siphon *C*. When full, container *E* must be replaced by an empty container.

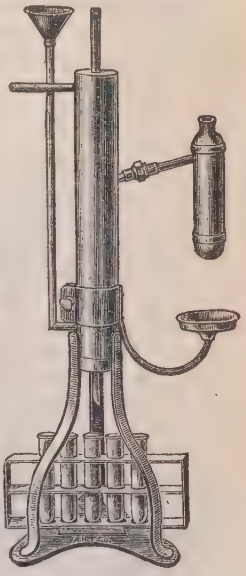
Fractional Distillation—By this term is meant the process of separating by distillation liquids having different boiling points or vapor densities. When a mixed liquid, or one consisting of liquids of unequal volatility, is distilled, the first portion of the distillate contains a larger proportion of the most volatile constituent than of the others; hence the boiling point is observed to rise as the distillation proceeds; and if a means is provided for collecting the distillate in several portions, or fractions, as they are called, fractional distillation offers a process by which liquids may be purified or separated. Fig. 201 illustrates the Regnault still designed for the fractional distillation of small quantities of liquids. It is impossible, however, in a single operation to effect a sharp separation of the component parts of a mixed liquid, because the distillate obtained at any period of the process is nearly identical with the vapor that is rising from the hot liquid, and therefore it is made up of the condensed vapor of that part of the liquid having a boiling point at or below the temperature registered by the thermometer, plus the smaller amount of condensed vapor that is given off from the constituents having higher boiling points, but which emit sensible vapors much below the point at which they actively boil. The relative proportions of the constituents of the mixed liquids have also a bearing in determining the composition of the distillate. By collecting the fractions carefully at stated temperatures, and redistilling each by itself, a more thorough separation may be effected, and this method is usually followed when such a separation is necessary.

Fig. 200



Receiving distilled water from automatic still

Fig. 201



Regnault still

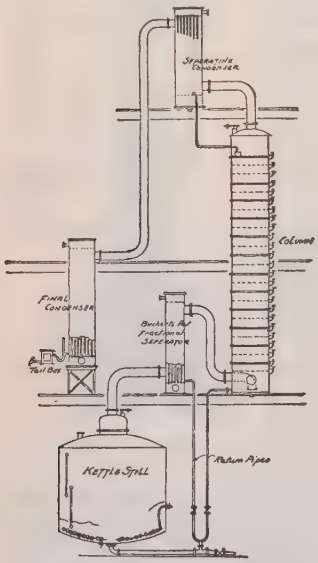
On the small scale a simple form of apparatus for fractional distillation is made by taking a glass flask having a bent lateral tube in the neck, adjusting a perforated cork in the neck of the flask to receive a thermometer, and passing the tube from the flask into a loosely-stoppered test tube, which is placed in a vessel surrounded with ice or otherwise properly refrigerated. A more efficient method is to connect the lateral ascending tube of a flask with the end of a worm, or a condenser so arranged that the liquid condensed at a certain temperature may run back into the flask. Vapors having lower boiling points pass through it uncondensed until they reach the second condenser, which is refrigerated to a degree sufficient to condense all the vapor.

Special forms of glass distilling apparatus for fractional distillation are listed by apparatus dealers. On the large scale the most perfectly devised forms of fractional distillation are found in the alcohol, coal tar, and petroleum

industries. In these the fractionating or rectifying column is utilized to increase the effectiveness of condensation. The concentration of the distillate is enhanced by the special construction of the column which utilizes a series of interfering "baffles" to aid the process of condensation (see Fig. 202). The more easily condensable liquid, such as water, is thus separated from a less readily condensable liquid, such as alcohol, the special construction of the upright column causing the condensation of the aqueous vapor which is returned to the distilling chamber while the alcohol or other volatile liquid passes into the receiving vessel.

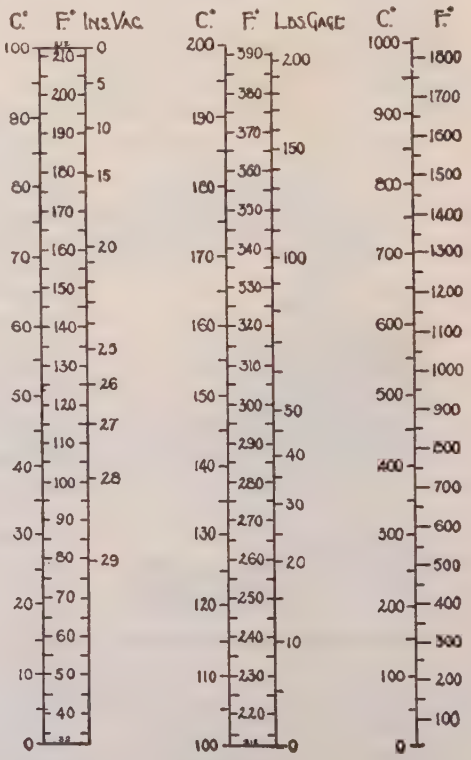
Vacuum Distillation—The removal of air pressure from the distilling chamber greatly facilitates the vaporization of the contained

FIG. 202



Redistilling outfit with rectifying column

FIG. 203



Temperature under vacuum

Temperature under pressure

liquid, at the same time permitting the operation to be conducted at a lower temperature (see Fig. 142). Apparatus for the conduct of vacuum distillation on a small scale may be assembled without much need for special parts other than an aspirator. Dealers in laboratory supplies, however, list special outfits for the purpose. Such an apparatus is shown in Fig. 141.

It is upon the large scale that the special advantages of vacuum distillation are capitalized and elaborate installations may be seen in industrial establishments such as gasoline refineries, distilleries, and factories for the manufacture of solvents. The first column in Fig. 203 graphically illustrates the changes in temperature within a still when a vacuum is applied, indicating the low temperature at which liquids may be boiled or evaporated. The second column shows the increase in temperature under pressure, and the third column gives a comparison of Centigrade and Fahrenheit thermometer scales. This table was supplied by the F. J. Stokes Co.

Destructive Distillation is the process of heating dry organic matter in a distillatory apparatus until all volatile substances are driven over. The residue is said to be carbonized. Destructive distillation is a process which is rarely employed by the pharmacist; hence it is not necessary in this work to treat the subject in detail. Glass vessels are not adapted to the process, because they will not usually stand the heat required without fracture, and the solid residue frequently fuses, is insoluble in water, and becomes so firmly attached to the bottom and sides that it cannot be removed without great difficulty. The best form of apparatus is an open vessel of cast iron, like a crucible, having a flange at the top, a dome with a corresponding flange, and a bent tube for carrying off the gaseous products. The connection is made with fire-clay lute and iron clamps. The manufacture of acetic acid, creosote, methyl alcohol, etc., affords illustrations of the use of this process, which is nearly always performed on a large scale.

The application of the process of destructive distillation to wood results in the production of many valuable products, as acetone, methanol, acetic acid, creosote, tar, etc., while charcoal remains in the still. When applied to coal, the distillate yields illuminating gas, ammonia products, coal tar, from which is obtained numerous phenol bodies, cresols, benzene, toluol, dye color bases, etc., coke remaining in the still. When applied to animal matter such as bones, etc., the distillate contains ammonia and characteristically offensive empyreumatic products used as denaturants, etc.

The distillate from this operation represents a decomposition product,—*i. e.*, a substance which did not exist in the original matter placed in the still, but which results from the application of heat without the presence of air. A characteristic smoky odor, called empyreuma or more often spoken of as an empyreumatic odor, is usually recognized in the distillate but may be removed by purification.

Registration of Stills—The regulations of the U. S. Department of Internal Revenue require that all pharmaceutical stills, other than the small, glass, analytical laboratory type, be registered with the department. Application should be made to the nearest Commissioner of Internal Revenue and appropriate blanks will be supplied.

CHAPTER X

SUBLIMATION

SUBLIMATION is the process of distilling *volatile solids*. The product is termed a *sublimate*.

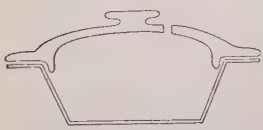
The objects of sublimation are as follows: 1. To purify volatile solids from admixed and fixed impurities. 2. To provide a convenient means of collecting volatile solids resulting from chemical reaction at either high or low temperatures. The retorts or apparatus used may either be of iron or glass, or of stoneware if the degree of heat necessary will admit of the use of the latter.

Sublimation as a manufacturing process is almost exclusively confined to operations conducted on a large scale, as the production of ammonium chloride or flake naphthalene. As a purifying operation it is frequently employed in analytical chemistry. A process was formerly official for the sublimation of benzoic acid. It consisted in placing benzoin in a shallow tinned iron pan, and pasting over the top a sheet of filter paper. A pasteboard hood, shaped like a hat box, was then fitted to the pan and tied or pasted with paper to make a tight joint. The apparatus was placed on a hot plate and subjected to a low but uniform heat. The vapors of benzoic acid, passed through the pores of the filtering paper, were separated from impurities, and, coming in contact with a cooler atmosphere in the hood, slowly condensed, often forming crystals of great beauty.

The temperature at which the condensation of the vapor is effected in sublimation has a very important influence in determining the physical character of the sublimate, and three kinds of sublimates are produced—1. Cake sublimates, illustrated by camphor and corrosive sublimate, etc. 2. Powder sublimates, illustrated by calomel, sublimed sulphur, etc. 3. Crystal sublimates, illustrated by iodine, naphthalene, etc.

Cake Sublimates—If the temperature of the condensing surface and of the air in contact is but slightly below that at which the volatile body is capable of subliming, the particles will be deposited in compact masses, like corrosive sublimate, commercial sal ammoniac, or ammonium carbonate. Fig. 204 shows simple apparatus for obtaining sublimates in cakes or masses. A shallow sheet iron dish, having its upper edge turned out so that it forms a flat ring, is provided with an earthenware cover (it will be usually found more convenient to have the iron dish made to fit the cover than the reverse), through which a hole is drilled to permit the escape of air (this may be done with a three cornered file). After the substance which is to be sublimed has been placed in the iron dish, a piece of asbestos twine, slightly longer than the circumference of the ring, is laid upon it, and this is covered with a lute composed of equal parts of potters' clay and flaxseed meal with sufficient water; the earthenware cover is pressed upon it until it adheres, and, when necessary, iron clamps are used to make a tight joint. The aperture in the cover is loosely covered with a cone of cardboard, the dish is placed in a sand bath and gradually heated. The aperture is kept open during the sublimation by occasionally probing it with a glass rod. After cooling, the sublimate will be found adhering to the earthenware top in one cake or mass, and may be removed by a spatula. The earthenware top may be replaced by

FIG. 204



Subliming apparatus (cake)

a sheet iron one in cases in which the former would be likely to be fractured by excessive heat. In the production of phthalic acid anhydride a cast iron dish, provided with a *"dur-iron"* cover is employed. Dur-iron is an iron containing a high proportion of silicon and hence highly resistant to the action of acids.

Powder Sublimates—If the apparatus for conducting sublimation is so contrived that there is a marked difference between the temperature of the air in contact with the vapor and the subliming point of the volatile body, the sublimate will be deposited very rapidly and in small particles, like calomel, sulphur, etc.

Crystal Sublimates—Some substances sublime in beautiful distinct crystals, the size of which depends largely upon the time during which the condensation is allowed to take place and the temperature of the condensing surface. Some substances, as camphor, which under ordinary conditions occur as cake or powder sublimates, according to the type of apparatus employed, may be obtained in the form of crystals if the conditions of condensation are suitably altered. Other substances as iodine, menthol, naphthalene, and benzoic acid normally sublime in distinct crystals in any form of apparatus, the size of the crystals depending upon the rapidity of condensation of the vapor. For iodine, earthenware vessels are always employed.

In the nomenclature of pharmacy sublimed products are frequently called *"flowers"* as *"flowers of sulphur"*, *"flowers of benzoin"*, etc. This is a relic of oriental imagery of early times, the development of a sublimate, often from a dark unsightly substance, being likened to the blossoming of a flower.

CHAPTER XI

DESICCATION

Desiccation is a dehydration process for depriving solid substances of moisture, and in pharmacy should be effected at as low temperatures as possible. (See Exsiccation.) The moisture thus driven out is known as *hygroscopic moisture* as distinguished from that combined in chemical salts as water of crystallization.

The objects of desiccating medicinal substances are threefold: 1. To aid in their preservation. 2. To reduce their bulk and weight. 3. To facilitate their comminution.

1. To Aid in Preservation—Vegetable drugs soon become mouldy or undergo bacterial decomposition if allowed to remain in a moist condition, and desiccation is absolutely necessary to preserve them unless they are made up into galenical preparations immediately, as is done in fresh drug tinctures.

2. To Reduce Bulk and Weight—If desiccation is performed successfully,—*i. e.*, at properly regulated temperatures under certain precautions,—the substance is merely deprived of water without suffering any loss of medicinal activity, and the reduction in bulk and weight that follows is a practical advantage which results in adding to the strength of the medicinal substance and materially reducing the cost of transportation and storage.

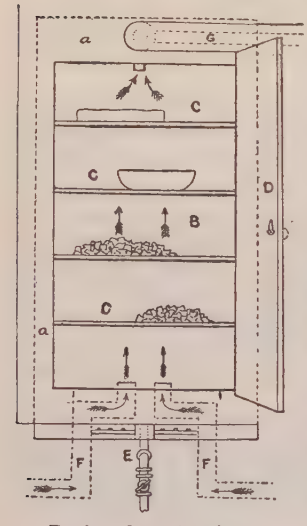
3. To Facilitate Comminution—The presence of water gives to drugs an elasticity which makes it difficult to bruise, grind or powder them. One of the first steps in comminution is to dry the substance thoroughly in order to make it brittle or crisp.

The apparatus employed in desiccation is frequently of the simplest character, and the heat is usually not especially created for the purpose, for it is most economical to use the waste heat from kitchen fires or cellar furnaces or the diffused heat in lofts or unused attics. There can be no objection to this if care is taken to provide protection for the substance from dust, light, and other injury during desiccation. Herbs may be dried by tying them in bunches and suspending them to the attic ceiling or to the rafters of a barn during summer weather, and this is an excellent method usually, notwithstanding its slowness, because there is no danger of the heat being strong enough to cause loss of valuable volatile principles. Roots, barks, and leaves may be dried by spreading them out upon clean tables or floors in a dry room and turning them repeatedly, so as to expose fresh surfaces to the dry air. On the large scale, and in the laboratory, special apparatus must be employed such as is illustrated under Vaporization, page 128. The Grinnell dryer or the Proctor dryer, Figs. 147 and 148, are admirably adapted for operations on a large scale. Smaller dryers of the same type may readily be built by a local carpenter. Live steam is passed through the pipes when higher temperatures are needed, but waste or exhaust steam from steam kettles is economically and properly used. Trays of suitable size, containing the substance to be dried placed on thin muslin, become the shelves of the rack. It is an important factor in drying to provide for a current of air to pass over or through the material to be desiccated and out through a suitable ventilator. This is often overlooked, but it is essential for effective or rapid drying.

Fig. 205 shows a pharmaceutical drying closet which is simple, economical,

and easily made. The heat may be derived from a gas or electric stove. The frame which supports the closet is made of half inch steam pipe, and the retort rings (see Fig. 184) may be clamped to the uprights, and the filtration of chilled oils in winter time, or warm filtration, or percolation may be carried on. The sides of the closet are of galvanized sheet iron or of asbestos cloth, wired to the iron frame, and cleats at convenient intervals are arranged for the trays to slide upon. A stovepipe connects with the flue to create a draft and carry off the moist air. Lozenges, crystallized salts, extracts, filters, etc., may be dried in this cheap and simple closet. One practical point about desiccation is frequently overlooked; it is that substances which are being dried must be repeatedly stirred or turned over, to expose the parts underneath to the dry atmosphere. In the case of salts, crystals, and other bodies, if this is not done, a hard crust is formed upon the surface which is often difficult to break up and which prevents the interior from properly drying.

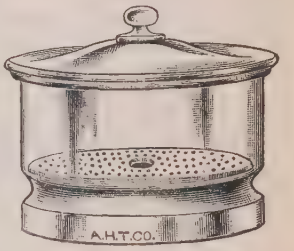
Fig. 205



Drying closet (gas heat)

A drying oven, intended for drying precipitates, etc., in analytical work, but very useful for desiccating small quantities of pharmaceutical substances, pills, lozenges, or drugs like squill, saffron, Castile soap, etc., is shown in Fig. 147. Automatically regulated and electrically heated air baths (see Fig. 109) have largely replaced other forms.

Fig. 206



Desiccator

In Fig. 206 is shown a desiccator for use in chemical laboratory operations. A suitable dehydrating agent, such as concentrated sulphuric acid, calcium chloride, or unslaked lime, is placed in the lower part of the desiccator and the crucible or vessel carrying the material to be dried rests upon the perforated porcelain plate which is held in place by the projecting ledge. The cover has ground edges and is usually greased with petrolatum to insure an air-tight joint.

Loss in Drying Medicinal Substances—When drugs are powdered, loss is always experienced. This arises partly from the escape of fine particles, but principally from loss of moisture in drying. In the powdering of most drugs, a small portion remains which resists disintegration. This is called by the miller "gruffs" or "tailings," and the Pharmacopœia directs that this shall be kept and ground with the next lot of the same drug. The dose of a powdered drug is usually somewhat less than that of the same drug before it was pulverized, because the weight it has lost generally represents inert matter, water, etc. Powdered ipecac is a good illustration of this. The active principle, *emetine*, resides in the starchy cortical portion of the root; the internal ligneous cord constitutes the "gruffs" of ipecac, and is inert. The exception to this is the case of those drugs containing an active volatile constituent, as the aromatics, clove, cinnamon, nutmeg, or asafetida, myrrh, cubeb, etc. These drugs, when powdered, generally contain less of their active constituents than they did before they were ground. The volatile oils to which their virtues are due are driven off to a greater or less extent by the amount of heat

necessary to make them brittle enough to be readily pulverized. The U. S. Pharmacopœia recognizes the importance of this fact by directing myrrh "in moderately coarse powder", not fine powder, in tincture of myrrh, and asafetida, not powdered asafetida, in emulsion of asafetida. If care is exercised in desiccating, the powders of most drugs possess all their medicinal properties, and in many cases will retain indefinitely these properties unimpaired if they are properly preserved and not unduly exposed to air, light, or moisture.

The practice of some drug millers of establishing a loss in the weight of a drug as a regular standard, and then making up the deficiency by adding the same amount of some inert substance, is reprehensible and a drug thus treated would be legally considered adulterated.

Dehydration is a term which has come into recent use to describe an operation which up to the present time has been applied only to edible vegetables and fruits and not to drugs. They are distinctively different from sun dried products or those dried by a low artificial heat, in that the operation is conducted in a confined space in connection with a vacuum and is so rapidly accomplished and under such peculiarly favorable conditions that the resulting fruit or vegetable, when restored to its original hydrated condition by soaking, can hardly be distinguished in texture or quality from the fresh fruit, or vegetables. The name "dehydrated", therefore, applied to such fruits and vegetables as have been successfully marketed, implies a distinctively different product from that described by the term "dried" or by the frequently and incorrectly used term "evaporated".

When this process shall have developed to the extent that it can be applied to the dehydrating of fresh vegetable drugs, greater interest will probably be taken in drug therapy by those who appreciate the fact that drugs as ordinarily handled in commerce lose much of their value as compared with the fresh plant tissue which they represent.

Another ingenious process for desiccating liquids has been developed in which the fluid is vaporized by blowing it through a small orifice into a large room which is heated to a high temperature. The moist vapor is dried almost instantaneously and the dried material falls as a fine powder. This process has been applied commercially to milk and to lemon juice. Products so dried are exceptionally free from foreign odor or taste and when rehydrated produce products much like the fresh material.

CHAPTER XII

COMMINUTION

COMMINUTION is the process of reducing drugs to particles, or breaking up their state of aggregation.

Medicinal substances in their natural state require to be mechanically divided in order to facilitate the action of menstrua or solvents, or to permit their administration in the form of fine powders.

A simple illustration is offered in the case of alum. A solid lump of alum weighing one ounce, if added to a pint of water, will not dissolve nearly so quickly as will one ounce of the same alum in the same quantity of water *if finely powdered*. Vegetable substances offer varying degrees of resistance in powdering, owing to the proportion and toughness of their ligneous fiber and the amount and kind of cellular tissue.

Under the head of *comminution* will be grouped the various mechanical operations used in pharmacy by which the surface of solid substances is increased, whether by trituration, levigation, elutriation, contusion, rasping or grating, cutting, slicing, chopping, stamping, grinding, pulverizing, or by other processes.

A great number of substances employed in medicine are derived from the vegetable kingdom, and, while many of the processes of comminution used for these are also applicable to the chemical and animal substances of the materia medica, it will be necessary in the following chapter to note the apparatus specially adapted to each class.

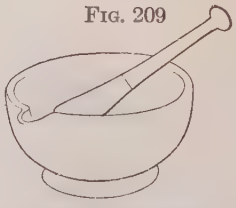
FIG. 207

Trituration

FIG. 208

Spiral track of the pestle

FIG. 209

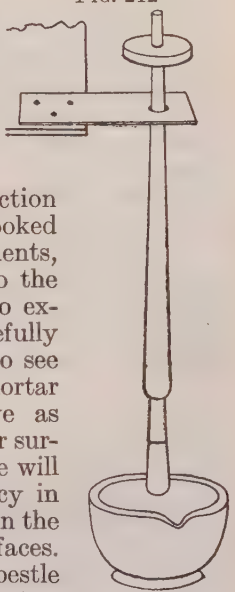


Mortar for trituration

Trituration is the process of reducing substances to fine particles by rubbing them in a mortar with a pestle. It is also used to designate the process by which substances in fine powder may be intimately mixed. The pestle is given a circular motion, accompanied by downward pressure, and the most effective method of using the pestle is to begin in the center of the mortar and describe a circle of small diameter with the pestle on the substance, and gradually increase the size of the circle with each revolution until the side of the mortar is touched, when the motion is reversed and circles continually smaller in diameter are described until the center is reached. The powder is frequently scraped from the sides of the mortar and pestle by the use of a spatula and the trituration repeated until pulverization is effected. By this treatment all the particles are brought under the action of the pestle. Fig. 207 shows the manner of holding the mortar during trituration and Fig. 208, the spiral, showing the direction traversed by the pestle in trituration as described above. The mortar and pestle best adapted for this operation have the shape shown in Fig. 209. Mortars with pestles having flattened ends are the best. Wedgwood ware is very serviceable, but is difficult to keep clean. As triturating mortars

are rarely subjected to blows, porcelain mortars of proper shape are preferred. One of the principal annoyances in the use of wedgwood or porcelain mortars and pestles is that of the continual loosening of the handle of the pestle. The cement employed by the manufacturer is frequently of inferior quality, and in using the pestle the particles of loosened cement often drop into the mixture in the mortar during trituration. The best plan is to pull the handle out of the pestle entirely as soon as possible and reset it. This is easily done by heating the end of the pestle in a sand bath until the cement has softened so that the handle may be extracted, then some hot cement (made by fusing three parts of beeswax with one part of shellac) is poured into the pestle hole, and the wooden handle is at once pressed forcibly in place and held by wedging or by other means until the cement has hardened. A pestle with a hard rubber handle, which is made to screw accurately into the head (see Fig. 210), is a great improvement over the ordinary form of pestle, and the additional cost is more than repaid by the comfort of using it. Solid porcelain pestles are not well adapted to trituration. Where trituration is combined with contusion, as frequently happens in effecting solutions of crystalline chemical substances, a wedgwood mortar of the shape shown in Fig. 211 is well suited for the purpose. In furnishing a pharmacy, the selection of good mortars and pestles is frequently overlooked amidst the many items of detail; but few implements, if properly selected, bring more satisfaction to the operator. It is a safe rule to examine every purchase carefully before accepting it finally, to see whether the pestle fits the mortar accurately. It should have as much bearing on the interior surface of the mortar as its size will permit, because its efficiency in trituration depends largely on the amount of contact of the surfaces. The use of a round surfaced pestle in a flat surfaced mortar is just as great a waste of labor as that of a flat surfaced pestle in a round surfaced mortar. Trituration, as a distinct method of preparing a class of preparations, is officially recognized in the U. S. Pharmacopœia, and a general formula is given in which 10 per cent of active ingredient and 90 per cent of lactose are to be uniformly combined by trituration.

Fig. 212



Triturating with a loaded pestle

Fig. 210

Pestle with hard rubber handle

Fig. 211

Wedgwood mortar and pestle

The proper procedure for making triturations or mixtures containing a very small proportion of a very powerful ingredient, so as to insure uniformity, consists in weighing the medicinal substance and diluent separately, placing the substance previously reduced to a moderately fine powder, in a mortar, and adding about an equal measure of diluent. This should be mixed well with a spatula, and the two powders should be thoroughly triturated together. Fresh portions of diluent are added from time to time, until the whole is combined, the trituration being continued after each addition until the substance is intimately mixed with the diluent and reduced to a fine powder.

Fig. 212 shows a device for facilitating trituration. It was suggested by Charles Rice, and is simpler and more effective than similar contrivances which have been described. It consists of an ordinary mortar and pestle, the

latter having been lengthened by cutting down the mushroom top of the handle so as to admit of its being inserted into the large end of a wooden handle shaped somewhat like a ball bat, and between two and three feet long. The upper end of this handle should be about an inch in diameter, and during the use of the pestle is to be kept upright and steady by passing through an opening in a piece of wood which may be tacked to the under side of some convenient shelf. The mortar should stand on a counter about three feet from the floor.

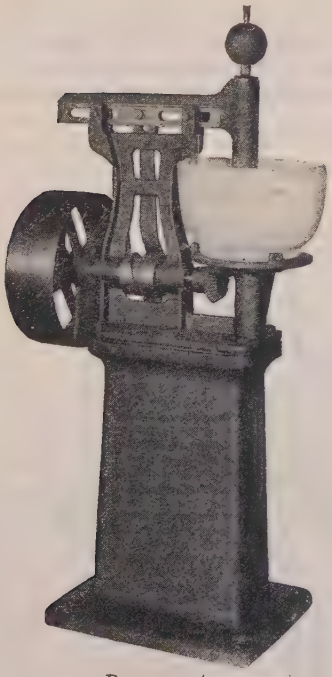
Mortars and pestles are sometimes made of green or white glass. The former are to be preferred because they are stronger; the latter, however, present a handsomer appearance. Glass mortars are not as well suited for trituration as for dissolving certain chemical substances directed in prescriptions, like corrosive sublimate, the alkaloids, etc., or for making solutions of iodine which would stain wedgwood or porcelain mortars.

Fig. 213

Porcelain mortars and pestles

Porcelain mortars and pestles (see Fig. 213) are, however, more generally useful as solution or emulsion mortars. Pestles entirely of porcelain are objectionable, because they are easily broken.

Fig. 214

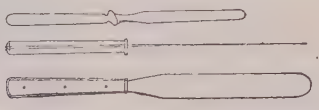


Power mortar

Fig. 214 illustrates a power mortar which is very useful in the preparation of small lots of tablet triturates or other mixtures requiring extended trituration. The pestle revolves and also rises and falls to conform to the contour of the mortar which is made to pass through a figure-of-eight movement. A scraper continuously returns the material to the center of the mortar.

Spatulas—The process of trituration as ordinarily performed requires the use of spatulas. These consist of flexible steel blades attached to handles, and in trituration they serve to loosen the substance as it becomes packed upon the sides of the mortar. Spatulas are largely used in extemporaneous pharmacy,

Figs. 215, 216



Solid handle and balanced handle spatulas

and they will be alluded to frequently under various special heads in Part V. The blade of a spatula is sometimes broken when too much pressure is applied, but if the broken blade remaining in the handle is rounded by grinding or filing it may often be useful.

Spatulas may now be had of excellent quality. The best form is the balanced handle spatula (see Figs. 215 and 216). In this the metal of the handle and that of the blade are continuous and of the same width, so that the annoyance of the tang becoming loose in the handle, as in old style spatulas, is avoided. The flat metal handle is enlarged by riveting smooth, flat pieces of hard wood to it to insure convenience in using. The balanced handle derives its name from the fact that when lying upon the counter the weight of the handle is sufficient to

overcome the weight of the blade, so that contact of the blade with the counter is prevented. Solid handled spatulas (see Fig. 214) are also made, the whole being of one solid piece of metal, and the handle being nickel plated. A pocket spatula, which closes like a clasp knife, is also furnished by dealers.

FIG. 217

Spatula, blade coated with hard rubber

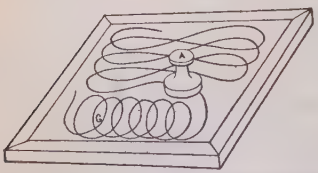
FIG. 218

Solid hard rubber spatula

Fig. 217 shows a spatula coated with hard rubber for making ointments which contain corrosive substances, or substances acting on steel. Solid hard rubber spatulas are also made (see Fig. 218).

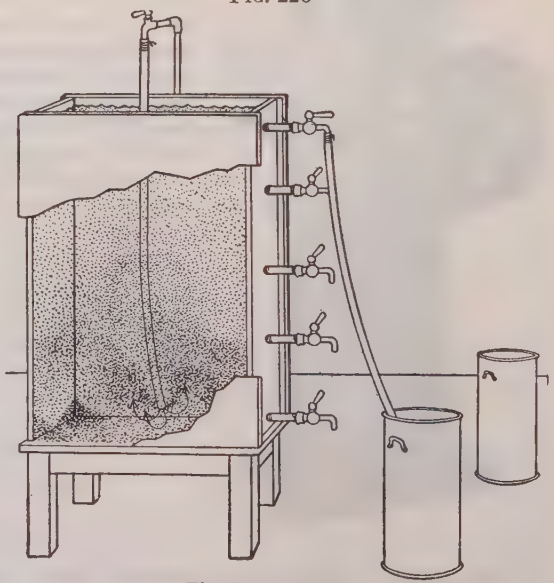
Levigation is the process of reducing substances to a state of minute division by triturating them after they have been made into a paste with water or other liquid. This is effected in a shallow mortar with a properly fitting pestle, or upon a ground glass slab with a flat surfaced glass muller (see Fig. 219). The motion imparted to the muller, *A*, closely resembles the figure 8; this is frequently varied with that of oval loops which intersect each other, the object being to vary the motion so that all particles of the powder may be brought under the action of the muller upon the slab *G*. Certain substances like red mercuric oxide and zinc oxide, if made into a paste with alcohol or water are more readily reduced to fine powder in this way than by the action of the mortar and pestle. The process is termed *porphyrization* when performed with a slab and muller made of the hard rock material called porphyry.

FIG. 219



Slab and muller

FIG. 220



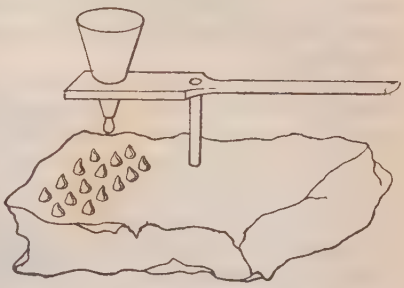
Elutriating apparatus

Elutriation is the process of obtaining a substance in fine powder by suspending an insoluble powder in water, allowing the heavier particles to subside, and decanting the liquid containing the lighter particles into another vessel, and there collecting them. It is a form of *water-sifting* wherein the greater weight of the larger particles is used as a means of separating them from the smaller. Fig. 220 illustrates elutriation. The stopcocks on the side of the tank are intended to be used for drawing off a fraction of the liquid after the heavier particles have subsided; these fractions may be transferred to other

vessels wherein the fine particles are permitted to settle. Prepared chalk is a familiar illustration of an elutriated powder.

Trochiscation is the process of shaping the pasty mass or magma obtained by elutriation into dry, conical masses. This is usually accomplished by the use of the form of apparatus shown in Fig. 221. This consists of a tinned iron cone, supported in a circular wooden frame which has one short wooden leg and a handle. A slab of chalk or other porous substance is provided, and after filling the cone with the pasty mass the handle is taken in the hand and the leg of the frame is tapped gently upon the slab of chalk. The shock causes a conical mass of the substance to fall upon the slab, whereupon the moisture present soon becomes absorbed, so that the little cone dries quickly. A succession of taps with a slight lateral movement, deposits the cones in regular rows, and when the slab is full the first cones are found to be dry enough to be transferred and the process becomes practically continuous. Chalk and other insoluble powders are formed into conical nodules in this way.

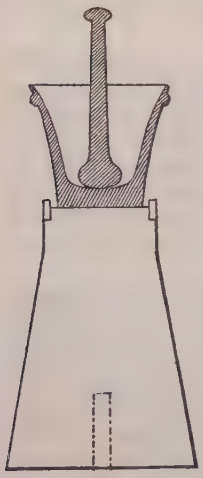
Fig. 221



Trochiscator

Pulverization by intervention is the process of reducing substances to powder through the use of a foreign substance, from which the powder is subsequently freed by some simple method. No general process can be given for this method of pulverization, as the character of the substance must determine the method. Metallic gold may be powdered by rubbing gold leaf in a mortar in contact with potassium sulphate. The latter is subsequently dissolved out with water. Camphor may be pulverized through the addition of a few drops of alcohol, chloroform, or other solvent. The foreign substance in this case is disposed of by evaporation. Metallic tin may be granulated by melting it and pouring it into a box containing powdered chalk, followed by prompt agitation. The chalk is subsequently dissolved out with diluted acetic acid. Phosphorus may be pulverized by placing it in water contained in a small flask, then heating the water gradually until the phosphorus is melted, and shaking the flask while the phosphorus is cooling. The agitation in the presence of water keeps the particles from cohering.

Fig. 222



Contusion mortar and pestle

Contusion or the operation of bruising, is resorted to occasionally. It may be defined as the process of reducing a drug to particles by striking it a succession of blows. The instrument generally employed is a form of the well-known mortar and pestle, which, for contusing drugs, should be made of cast iron, bell metal, or brass. The shape best adapted for this purpose is shown in Fig. 222, the mortar being represented on a *mortar block*. The bottom of the mortar should be flat and heavy, so that it may rest firmly upon whatever base it is placed; the sides should flare slightly, but the mortar should be so deep that substances will not be easily scattered by the blows of the pestle. A leather or wooden cover may be used upon the mortar when corrosive or irritating substances are contused. The pestle should be heavy

and so shaped on the under surface as to coincide with the concave surface of the bottom of the mortar. The inner surface of the mortar may be tinned, to prevent rusting and facilitate cleaning. It is important that such a mortar be supported by a firm base such as a concrete block or turned wood mortar block (see Fig. 222). This will provide a solid foundation for resisting the blows of the pestle, and jarring and vibration are prevented which are so destructive to balances and fragile apparatus. Sometimes this block extends through the floor in the form of a post, and is set in the ground floor, to avoid all jarring.

When it is necessary to use an iron mortar and pestle for a continuous operation, for a considerable length of time, it will be found advantageous to connect the upper part of the pestle with an elastic $\frac{3}{32}''$ copper wire spring attached to the ceiling, so that the labor of lifting the pestle will be lessened. The spring should be of such length that the pestle barely touches the bottom of the mortar when the spring is stretched to its utmost tension. On account of the large number of mills established over the country, established for grinding drugs, and the increase of facilities for grinding and powdering drugs on the large scale, the skilful use of the mortar and pestle by the pharmacist must be regarded as a lost art. The necessity for thoroughly drying drugs before subjecting them to comminution has already been mentioned. (See Desiccation.)

Wooden mortars and pestles are occasionally used for contusing soft bodies, like prune pulp, almonds, fresh fleshy roots and leaves, substances that are affected by iron, etc. Lignum vitæ is a very hard and suitable wood for this purpose, although boxwood is preferable when it can be procured, because it has less tendency to split. Lignum vitæ mortars must not be used for powdering alkaline substances which extract the resin from the wood.

Marble mortars are also used for operations of a similar character on a somewhat larger scale; but such mortars are not suitable for acid substances, on account of the reaction upon the marble and the consequent contamination of the product.

Rasping or Grating—A half round rasp (see Fig. 170) or a nutmeg grater is very useful at the prescription counter, as it frequently enables the pharmacist to prepare a small quantity of a crude drug powder for a prescription in case the regular stock bottle is found empty or a very fresh powder is needed. The small pocket pepper mills for grinding whole pepper at the table will be found especially useful.

FIG. 223

Rotary grater

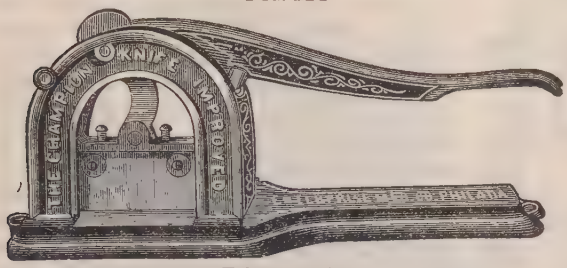
The inexpensive rotary grater (Fig. 223) is a convenience at the prescription counter, especially for grating oil of theobroma for suppositories.

Cutting, Slicing, and Chopping—This process is used principally in bringing roots, barks, leaves, herbs, etc., to the proper condition for treating with suitable solvents. For very small operations either the pruning knife or pruning shears works very well. The tobacco knife or herb cutter shown in Fig. 224 is well adapted for the purpose. It should be observed, however, that the principle upon which a knife operates successfully should be carefully carried out in constructing apparatus designed for cutting. Direct pressure without a slight drawing or sawing motion is not effective; therefore those knives which have guides arranged so that the blade has a horizontal as well as a vertical movement are greatly preferred. Fig. 225 shows a roller knife which is very serviceable. The circular blades or knives are made of the same quality of steel that is used for saws, and are mounted upon a shaft, being separated by a series of spools or collars. The handles are of wood and

mounted loosely on the ends of the shaft, thus permitting them to be grasped tightly while the knife blades revolve. The substances to be cut are placed upon a smooth board and the roller knives passed over them with more or less pressure. This instrument is useful in preparing the "Species" of the National Formulary.

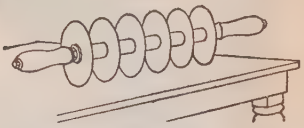
Upon the large scale drugs are cut with silage or fodder cutters, implements usually consisting of four or more circular blades fastened to a shaft and revolving at the end of a trough, down which the substance that is to be cut is gradually fed. Sarsaparilla

Fig. 224



Tobacco cutter

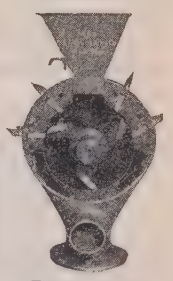
Fig. 225



Roller knife

root is cut in this way before it is contused or ground. Fig. 226 shows a rotary cutter made by the Abbé Engineering Company, of New York. A cylinder to which five blades are attached revolves in a circular case, upon the inside surface of which are fastened six blades; the blades are straight but are set at a slight angle, so that a "shearing action" is exerted on the substance to be cut. The bottom of the case consists of a perforated plate, which can be replaced, and as the blades revolve a portion of the cut substance drops through the perforations. What remains is carried around and again subjected to the action of the cutters. By selecting the perforated plates the product may be cut coarser or finer as required.

Fig. 226



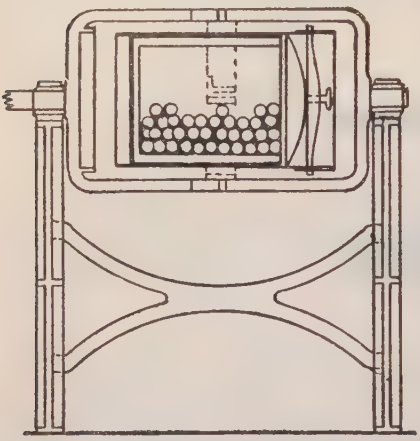
Rotary cutter

Grinding and Pulverizing—The former term is applied to the reduction of a substance by mechanical means to *coarse* particles, the latter to the production of *fine* particles. These processes are the most important considered under comminution. At present they are very largely carried on by drug millers. It is necessary for the pharmacist to be familiar with the methods employed, however, if intelligent judgment is to be exercised in the subsequent treatment of the vegetable and mineral substances of the materia medica. Before pulverizing a substance it must be dried and the desired fineness of the powder determines the character of the preliminary treatment. In order to properly grind or powder substances upon the large scale, special knowledge and experience are required; previous acquaintance with the methods best suited to accomplish the object on the small scale, while useful to some extent, will be found inadequate. If a drug is to be coarsely ground, the necessity for thoroughly drying it is generally not so important as when a fine powder is to be made of the substance; drugs containing volatile oils are apt to be rendered worthless if they are dried sufficiently to enable them to be ground to a fine powder. Myrrh, clove, cubeb, nutmeg, etc., afford a good illustration of this; hence such drugs are preferred when coarsely powdered. Within the last few decades an important change in pharmaceutical practice in this respect has been effected, and preparations in which, formerly, very fine powders were directed are now ordered to be

made from coarse powders. The processes for extracting the soluble principles having been greatly improved, the necessity no longer exists for using the very fine powders, and, hence, volatile principles are not lost.

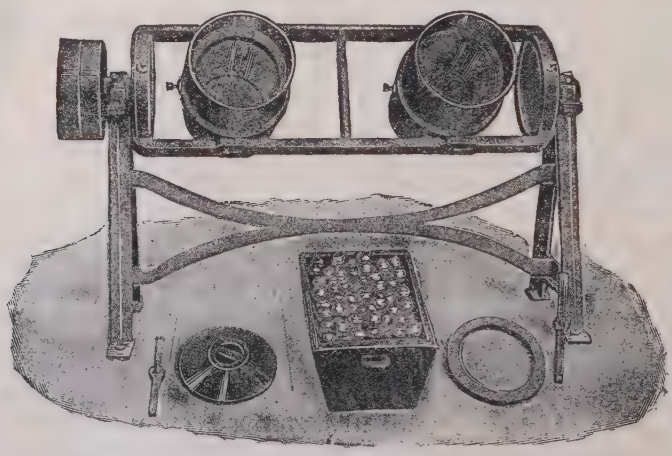
Pebble or Ball Mills—These mills, which are also called "pot mills" or "jar mills", are operated on the principle of attrition and percussion, the grinding being effected by placing the substance in jars or cylindrical vessels, lined with porcelain or a similar hard substance and containing "pebbles" or "balls" of flint or porcelain. These cylindrical vessels then revolve horizontally on their longer axis and the tumbling of the pebbles or balls over one another and against the sides of the cylinder quickly effect pulverization with a minimum loss of material. The advantage of such mills is that they afford a large grinding surface within a limited space. They are cleanly in their action, economical, and, on account of the simplicity of their construction, not liable to get out of ordêr. Much depends however, upon the hardness of the pebbles; for it must be seen that these are continually striking against each other while in action. Such mills are adapted for grinding hygroscopic substances, extracts, and expensive chemicals. Fig. 227 shows a sectional view of a single jar mill. Fig. 228 illustrates a double jar mill, and the number of jars may be increased indefinitely. The advantage of multiplying the jars is that four, six,

Fig. 227



Single jar mill

Fig. 228



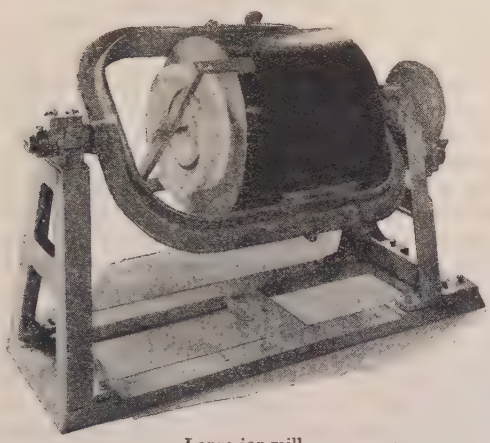
Double jar mill

or a dozen different substances may be ground at one time. Fig. 229 shows a picture of a large jar mill used in the laboratory of Eli Lilly and Company. It was built for special requirements and has a capacity of 25 gallons. It has the advantage of triturating large quantities of material in a short time.

A larger size mill of this type, lined with sheet iron and containing iron balls (cannon balls) is used under the name of a *barrel mill* or *cannon ball mill.*

The so-called "pot mills" are more or less pumpkin shape (Fig. 230). They are built of iron, and steel balls are used to accomplish the pulverization. Some of the mills of this type, however, are lined with a vitreous wall and porcelain balls are used. In some instances the axis about which the mill rotates

FIG. 229



Large jar mill

FIG. 230

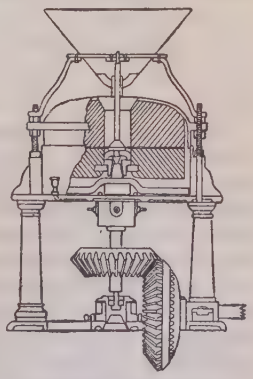
Pot mill

is set at an angle of 45°, while in other cases the axis is parallel to the floor. The pot mill is also used in the preparation of ointments on a large scale and for the extinguishing of mercury for the ointment or mass.

Drug Mills

The buhrstone mill is very extensively employed in drug milling. There are two kinds, termed respectively under runners and upper runners. The principle upon which this type of mill operates is that of reducing the substance to particles by the friction and contusion that follow the delivery of the substance in the contracted space formed by a rapidly revolving stone disk, brought into close contact with a similar disk which is stationary. In the under runners the upper stone is stationary and the lower stone revolves, the upper stone having a central circular opening through which the substance is fed, as shown in Fig. 231, the under stone being connected with the shaft. In the upper runners the lower stone is stationary, the upper stone being perforated as in the under runners. In both, the moving stones revolve horizontally. The stone used must be very hard. The best buhrmill stone is obtained from the old and celebrated quarries of La Fertésous-Jouarre, in France. The surfaces of the millstones are crossed with "furrows", which pass from the center to the circumference, as shown in Fig. 232. The object of the furrows is to provide a means for the passage of the ground particles to the outer circumference and to the trough. This is accomplished through the centrifugal force and current of air

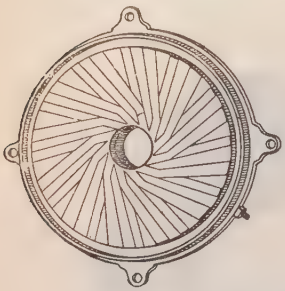
FIG. 231



Munson's under runner buhrstone mill

caused by the rapid revolution of the stone in motion. The fineness of the powder is regulated by raising or lowering one of the stones, this of course increases or decreases the space between them; the character of the powder is also influenced by the dressing of the stone. Fig. 231 illustrates one of the best of the buhrstone mills,—Munson's under runner. The ground drug coming from a buhrstone mill requires bolting or sifting to separate the coarse particles which are then returned to the mill for regrinding.

Fig. 232

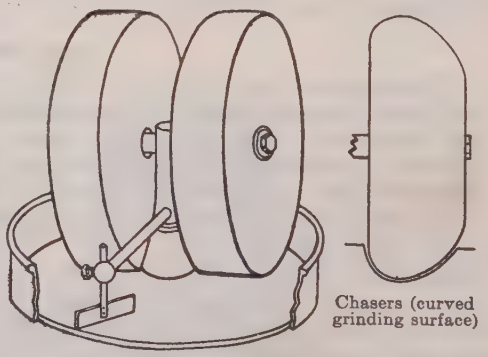


Buhrstone

The Bogardus mill is constructed on a very ingenious principle. The grinding surfaces are two horizontal chilled iron plates, the lower one revolving, the upper one stationary; both have corrugations with sharp edges, arranged concentrically. The peculiarity of this mill is that the centers of the grinding plates are not directly over each other as in buhrstone mills, but the center of the lower plate is placed a few inches to one side; by this arrangement the substance to be ground is caught by the ring edges of the revolving plate and dashed against the cutting edges of the stationary upper plate at an angle, the effect being to incise it as if cut with scissors and crush it at the same time.

Chaser mills are so called because two heavy granite stones, mounted vertically like wheels and connected by a short horizontal shaft, are made to revolve or *chase* each other upon a granite base (see Fig. 233). The stones are discoid, and the grinding surfaces are the circumferential edges of the stones and the surface of the granite base; an iron cylinder, called a "curb", surrounds the circular base, and a "scraper", made of iron and adjusted at an angle, is connected with the shaft. It is evident that if the substance to be powdered is delivered upon the granite base in the path of the rapidly revolving stones it must speedily be reduced to powder, not only on account of the crushing weight of the heavy stones, but also because of the attrition caused by the outer edge of the stone travelling through a longer distance than the inner edge. In some mills the stones having flat, grinding surfaces have been replaced by stones having curved surfaces, and the flat base by a circular gutter curved to correspond with that of the surface of stone. In this way the grinding surfaces have been greatly increased and rapid pulverization facilitated. Fig. 233 also shows the stones of this form. In practice the chasers are enclosed in a tight box or small room, closed with air-tight doors, and the substance to be powdered is fed in from the top by an elongated funnel, the spout of which delivers the material immediately upon the path of the stones. The height of the curb is increased by pasting heavy paper around it, and the fineness of the powder is influenced by the height of the curb. The revolution of the chasers produces an upward current of air; this carries over the lighter particles, which fall outside the curb and are subsequently col-

Fig. 233



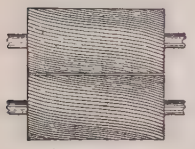
Chasers

lected as a fine powder; those particles which are larger are of course heavier and cannot rise to the height of the curb, but fall back under the stones to be reground. In this way refractory substances can be reduced to very fine powder. Such powder is termed *air-sifted*. Chasers are more largely employed in making " dusted " or very fine powders than any other form of pulverizing apparatus.

Chaser mills are also used extensively in grinding cacao beans to form the paste which is commercially known as "chocolate liquor".

Roller mills operate by crushing, or crushing and cutting, the substance. In its simplest form this mill consists of two iron rollers revolving in the same direction at different rates of speed. The distance between the rollers may be regulated by adjusting screws. This principle has been developed and improved in modern milling, so that for grinding certain drugs this type of mill gives excellent results. The rollers are made of steel, chilled iron, or porcelain, and are corrugated or ribbed to suit special purposes. Fig. 234 shows the position of the grooved rollers, and Fig. 235

FIG. 234

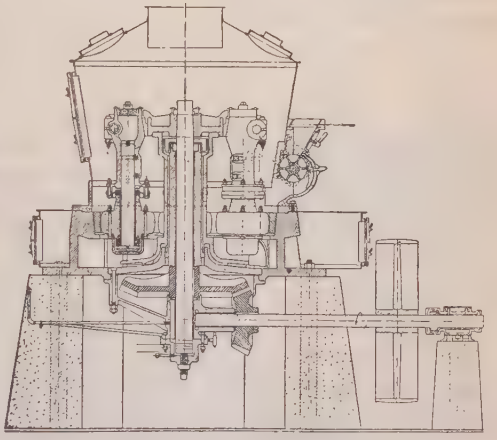


Grooved rollers

FIG. 235

Grooved roller (cross section)

FIG. 236



Raymond roller mill (cross section)

shows a sectional view. The roller mill is the type used in grinding wheat flour on an immense scale. The term roller mill is also applied to a more modern type of mill in which the rollers are hardened steel disks revolving horizontally within closely set rings also of hardened steel. The Raymond Roller Mills are of this class (see Figs. 236 and 248).

Hand Mills

It is difficult to construct a drug mill for the general use of the pharmacist. The drug miller has the choice of a buhrstone mill, chaser, disintegrator, iron mill, etc., which he can adjust to suit the character of the substance he desires to grind. The pharmacist's drug mill, on the other hand, is expected to do all kinds of work rapidly and well. It must, therefore, be capable of ready adjustment, possess durability, and have cutting surfaces not quickly dulled, and working parts not liable to get out of order.

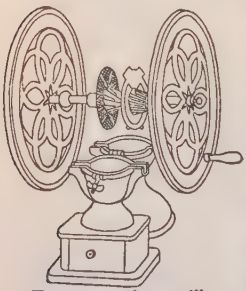
It is not easy to realize that every medicinal substance has an individuality of its own, but he who neglects the study of the physical characters of the substances of the materia medica can never expect to overcome successfully the obstacles which stand in the way of disintegration. Hand drug mills may be divided into three classes: 1. Those having vertical grinding surfaces. 2. Those having horizontal grinding surfaces. 3. Those having conical grinding surfaces. They have the following points in common: iron is the principal

material of construction, the grinding surfaces are of hardened iron or steel and consist of teeth arranged in concentric rows, and the regulation of the fineness of the powder is controlled by adjusting screws by which the plates are made to approach or recede from each other.

1. Hand Drug Mills with Vertical Grinding Surfaces

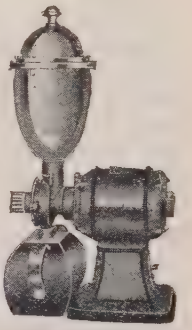
Swift's Mill—This hand mill has been in use longer than any other in the American market. Its introduction marked an era in the history of small scale drug grinding, and, although superseded now by greatly improved mills, it is still remembered with grateful feelings by those, who had been previously accustomed to laborious mortar practice. In this mill there are two vertical grinding plates, one of which is stationary, while the other is connected with the horizontal revolving shaft; a conical breaker is also attached to the shaft, and when in position it is immediately below the lower opening of the hopper; a fly wheel with a handle is bolted to the outer end of the horizontal shaft, and furnishes the power required. The teeth are of iron and arranged in concentric rows, and the plates are made to approach each other or to separate by an adjusting screw.

Fig. 237



Enterprise drug mill

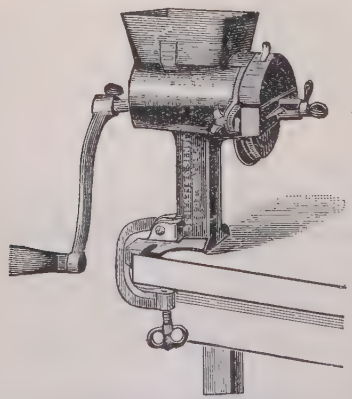
Fig. 238



Electrically driven mill

The Enterprise Mill—This mill embodies the principle of supporting the grinding plates upon a horizontal shaft, to the extremities of which heavy fly wheels are attached. It also provides facilities for lifting all the working parts out of the interior to facilitate their cleaning. Fig. 237 thoroughly illustrates this mill. The left hand grinding plate revolves, being geared to the shaft, while the one on the right hand is stationary. When in position for grinding they are nearly in contact. The opening of the interior is effected by simply turning the thumb screw in front. Practically all modern mills of this type are driven by an electric motor. (See Fig. 238.)

Fig. 239



Quaker City F. No. 4 mill

Plates and crushers

The Quaker City F. No. 4 Mill (Fig. 239) in its general appearance looks

much like a meat grinder. It is equipped with a worm crusher and feeder which forces the drug between the two grooved grinding plates at the end of the worm shaft. The plate with the larger opening is attached to the body of the mill and is stationary while the second plate is attached to the feeder shaft and is rotated. This same type of mill is manufactured in a larger style when it is power driven. These mills are made by the A. W. Straub Company, of Philadelphia.

2. Hand Drug Mills having Horizontal Grinding Surfaces

Swift's B Mill—In this mill the grinding plates are horizontal, the lower one revolving, while the upper one is stationary and forms the lower part of the hopper. It has two fly wheels, but the receptacle for the powder is an open one. A valuable feature of the Enterprise mill is present here,—*i. e.*, that of opening horizontally in the center. The fineness of the powder is regulated by raising or lowering the lower plate by the thumb screw.

3. Hand Drug Mills having Conical Grinding Surfaces

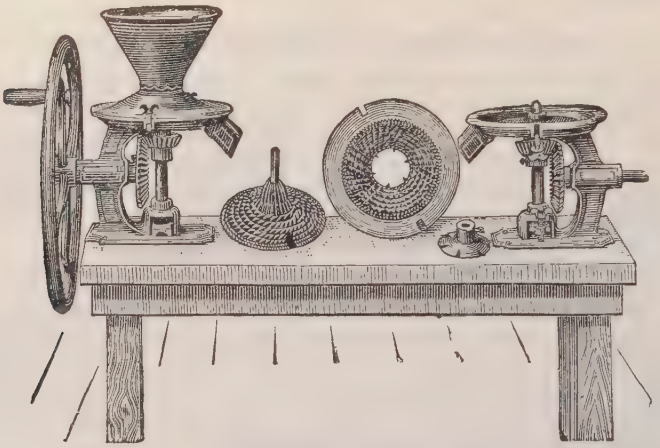
The principle of construction in these mills is probably the best, because it avoids the fault of those constructed on the vertical plate principle, that of permitting particles to drop into the receptacle before they are finely ground, and also the fault of the horizontal plate mills, which may hold the ground particles too long, often until clogging results. The conical plate mill, if properly constructed, leaves little to be desired.

Hance's Mill is made on this principle. Formerly, the objection to this mill was the loss of time and labor consumed in getting it apart. This has been obviated by the introduction of the principle of opening it horizontally with the same kind of thumb screw and hinge that is used in the Enterprise mill. The Hance mill is better adapted for heavy work than any other of the hand drug mills, and, if desired, a belt and pulley can be attached for steam power, or it may be operated by an electric motor. The lower plate is conical in shape, the summit being elongated into a breaker; the teeth are arranged in consecutive rows, a scraper being attached to the under surface of the lower plate; the upper grinding surface is situated upon the lower surface of the hopper, and corresponds in shape and in the arrangement, number, and size of teeth with the surface of the lower plate. The revolving plate is attached to the upright shaft by a simple key; this permits the easy removal of the plate when the mill is to be cleaned, yet holds it securely when in operation. Power is communicated by means of two shafts at right angles, geared with bevel cog wheels. The fineness of the powder is regulated by a thumb screw at the base, which elevates the revolving plate. The support to the mill is a strong iron frame, which is cast in one piece, and, although the mill has but a single fly wheel, this is partially compensated for by the length of the bearing for the horizontal shaft. Figs. 240 and 243 show the form which is designed to be bolted to the working table or counter. Fig. 242 shows the upper grinding plate and Fig. 241 the lower plate; a feeder is shown lying upon the counter, which is fastened to the upper portion of the lower plate by its set screw, so that seeds and similar drugs may be automatically fed to the mill.

General Rules for Operating Hand Mills—Much of the dissatisfaction experienced in operating hand mills has arisen from improper methods of using them, or from failure to measure accurately the degree of resistance to disintegration possessed by the substance to be ground. One of the first requisites, as before mentioned, is to dry the substance as perfectly as its physical char-

acter will permit without injuring it. If coarse, bulky, fibrous roots, barks, or similar substances are to be ground, they must first be cut or bruised. Most substances are ground with less labor if they are first passed through the mill with the coarse adjustment, returning the portion which is sifted out, for regrinding, after setting the plates more closely together. This plan is repeated

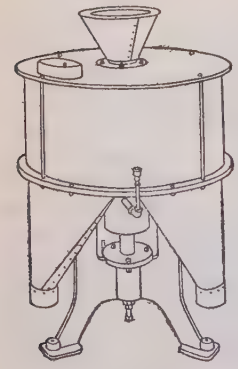
Fig. 240 Fig. 241 Fig. 242 Fig. 243



Hance mill Lower plate Upper plate Base

until the whole is ground. Care should be taken not to feed the substance into the hopper faster than it can be ground. The desire to get through quickly is the most frequent cause of clogging the mill, and when this occurs much time is lost, and the operator is strongly reminded of the well worn proverb about undue haste. If a considerable quantity is to be ground, two persons can operate the mill to better advantage than one,—one feeding the mill carefully, the other supplying the physical labor, and after the expiration of a given time, exchanging places. Good judgment is necessary in determining the rapidity with which substances can be fed into the hopper. Resinous or oily drugs, or substances which soften by heat, require very careful treatment and cannot be fed rapidly; dry ligneous barks or roots, on the other hand, can be fed as rapidly as the extent of grinding surface of the mill and the muscle of the operator will permit. The mill should be thoroughly cleaned after each operation, particular attention being given to the grinding plates. In the case of substances which form hard lumps by heating or clogging up the plates, the quickest way is to use boiling water to soften or dissolve the lumps; the plates should then be quickly dried, to prevent rusting. By running sawdust, bran, or rice chaff through a mill, after an odorous drug has been ground, it may be speedily cleaned and freed from odor.

Fig. 244



Max mill

High Speed Mills

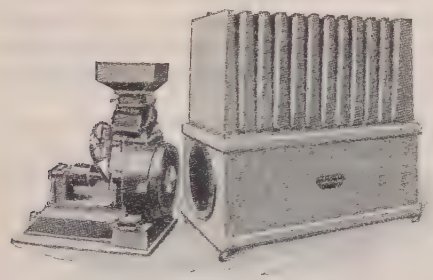
These mills differ from those thus far considered in the principle of construction, in the character of the grinding surfaces, and in the method of operation.

The *Max Mill* is an illustration of this type (see Fig. 244). It is made by

the Abbé Engineering Company, and acts on the principle of *percussion* at a high rate of speed. Power is conveyed by a vertical shaft, to which is attached a carrier provided with hard steel beaters, and as the substance is fed into the mill it is thrown by centrifugal force against a corrugated hard iron plate, the particles at the same time being thrown into violent contact with each other. Coarse or fine powders can be made at will.

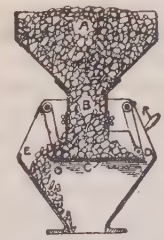
The Limited Pulverizer (Fig. 245), which is built by the Schutz O'Neill Co., also works on the principle of percussion at a high rate of speed. The mill is equipped with either a Vibrator or a Breaker Feeder. The *vibrator feeder* (Fig. 246), is used only for material which has first been broken down to corn size. The amount of feeding is controlled by a hand lever which may vary from ten to several thousand pounds per hour. It is fitted with a magnet to prevent metal from entering the mill as it passes over the vibrating plate. The *breaker feeder* (Fig. 247) will handle lumps up to six inch cubes, gradually reducing

Fig. 245



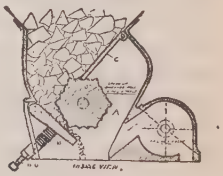
The limited pulverizer and receiver

Fig. 246



Vibrator feeder

Fig. 247



Breaker feeder

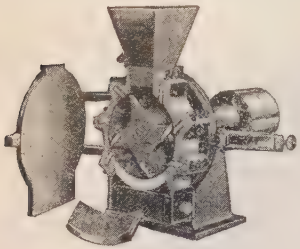
them into bits and finally feeding them into the grinding chamber. Its capacity is about equal to that of the Vibrator Feeder. The drug is broken by a hexagonal roll which revolves over the breaker plate that is made to rise and fall.

As the drug enters the grinding chamber it is beaten from side to side by beaters or lugs which are attached to a steel plate which whirls at a very rapid gait. The outer edge of the grinding chamber consists either of a corrugated shell or a perforated steel shell, the latter being preferable for pulverizing fibrous stock. The back of the grinding chamber consists either of a smooth plate or it may be fitted with an outer corrugated circle which greatly increases the efficiency of the mill for tough stock like nux vomica or licorice root. The discharge section of the mill is fitted with a cone and cone plate with whizzers. The cone plate is perforated with half-inch holes and has almost complete control of the air current passing through the mill as well as the fineness of the powder. Setting the plate inward toward the cone increases the quantity of air; this carries out larger particles with it; setting the plate flush with the end of the cone decreases the amount of air passing through, thereby carrying out only a finer degree of powder. The material which is too coarse to be carried out by the air current, is automatically returned to the tailings valve and by means of a rotating paddle, fed into the grinding chamber again.

Fig. 253 illustrates a new mill designed by Dr. Samuel W. Wiley, of Wiley & Co., Inc., Baltimore, especially for the proper preparation for chemical analysis of commercial products such as drugs, fertilizers and feed stuffs without loss of moisture from heating during the preparation of the sample. This is now offered by the A. H. Thomas Company.

Four knives on a revolving shaft work with a shearing action against six which are set in the frame. The screen is dovetailed into this frame so that none of the material comes out of the grinding chamber until it is fine enough to pass through the mesh. Three sieves with screen of ½ mm., 1 mm., and 2 mm. mesh, respectively, are furnished with each mill. A hinged front permits easy cleaning. The mill is 21 inches high and occupies a floor space about 14 x 20 inches. The grinding chamber is 8 inches inside diameter, with knives 3 inches wide. The mill should be operated at from 400 to 800 revolutions per minute.

Fig. 248

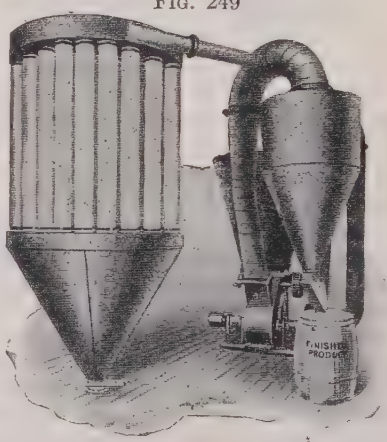


The Wiley mill

Receivers for high speed mills—In the high speed mills the intake of air is so great that special forms of receivers for the finished product must be provided to prevent loss. The receiving boxes are equipped with air strainers of strong fabric which keep the pulverized material from escaping and allow the air to pass through. These air strainers are of different shapes. A plain balloon form is sometimes used but the zigzag or accordion form, or the tubular style are most commonly used (see Figs. 245 and 249).

In *Mead's Disintegrator* high speed mills, the grinding is effected by hardened steel beaters riveted to a steel disk, which revolves vertically between corrugated rings; the beaters are placed on the side of the disk nearest to the feeding trough, and catch the material as it enters the mill, beating it with great force against the corrugated rings until it is fine enough to pass between the disk and the face of the rings; as soon as it passes here, it is on the side of the mill from whence it is discharged, and all that is fine enough is immediately driven out by the beaters on the back of the disk. That portion of the substance which is not fine enough is caught by the beaters and beaten against the screens until sufficiently fine to pass through. The screens are two inches in width, and extend around three-fourths of the diameter of the mill. They are made of square steel bars, and present a grinding surface to the beaters, but there is sufficient space between them to permit the passage of fine particles. A new type of screen—the cross cut blank screen (Fig. 250), and the cross cut perforated screen (Fig. 251) have been designed for use in the Mead mill to afford a means of producing finer grindings and pulverizations. The screens are made of steel with a cross cut surface presenting hundreds of sharp cutting edges to the material to be ground. The perforated screen contains a perforation at the apex of each pyramid. By combining the cross cut blank screen, the cross cut perforated screen, and the bar screens, it is possible for the miller to grind the drug to any degree of fineness. The substance, as it is ground, falls into a receiving box below the mill, or is discharged through the floor into a room below. One prime requisite in running this mill is high speed. The disk must make three thousand revolutions a minute. The disintegrator is capable of grinding one

Fig. 249



Raymond roller mill (receiver and air strainer)

hundred and fifty pounds of ignatia bean, one thousand pounds of jalap or six hundred pounds of wild cherry bark, in one hour. Fig. 252 gives an illustration

Fig. 250

Cross cut blank screen

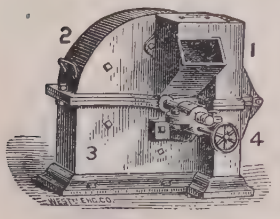
Fig. 251

Cross cut perforated screen

of the mill, while Fig. 253 shows an enlarged view of the revolving disk and a section of the bar screens immediately above.

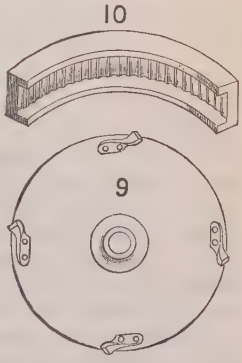
Sifting is the process of passing a powdered substance through the meshes of perforated material with the object of separating the coarser from the finer particles. Sieves are employed in this process. The frames of hand sieves are usually round, although sometimes they are oval, square, or rectangular. The ordinary sieve is usually made by stretching wire gauze over a flat wooden ring, and keeping it in its place by slipping over it a narrow wooden ring of slightly greater diameter, which is tacked securely. Covered sieves, or drum sieves, have tight covers for the top and bottom. The simplest pharmaceutical sieves for general use are obtained by making five rectangular frames, each four inches deep, ten inches wide, and sixteen inches long. These should be light but strong, and the bottoms covered with brass wire gauze of different degrees of fineness. A box, ten inches deep, twelve inches wide, and twenty-two inches long, with a tight cover, is provided to hold the sieves and prevent dust from escaping. Two cleats are nailed horizontally upon the sides of the box, five inches from the top, for the sieve to slide upon, and a hole is cut in the front of the box in order to permit a handle, with a hook at the end, to pass through and be attached to a screw eye in the front side of the sieve; two large corks are screwed to the back of the sieve at either end to act as buffers. The powdered substance is introduced into the proper sieve, which is placed upon the cleats, and the handle passed through the hole and hooked to the sieve; the cover is then placed in position, and the sieve pushed backward and forward, touching the back lightly.

Fig. 252



Mead's disintegrator

Fig. 253



Revolving disk and screens

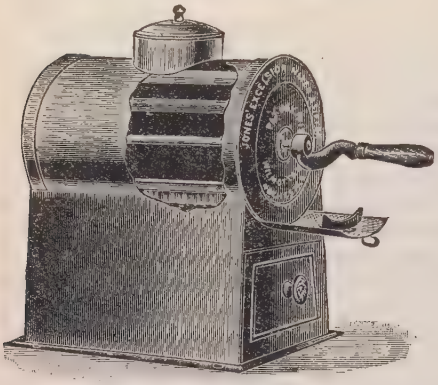
A very important point, which must not be overlooked after sifting substances, is the thorough mixing of all portions of the sifted powder, in order that each part of the finished powder may have a uniform composition. The starchy portions of a drug will be powdered more quickly than the ligneous portions, and will usually pass through the sieve first; hence the sifted powder must always be thoroughly mixed. Upon the small scale this may be easily effected with a spatula or mortar and pestle; upon a larger scale special apparatus is needed.

Jones' Mixer and Sifter (Fig. 254) is well adapted for smaller operations; the principle is that of using revolving mixers and brushes. A perforated metal

plate forms the bottom of the sifter, and, when mixing, an unperforated plate is pushed over the perforated plate, so that when the powder is thoroughly mixed this plate can be pulled out, and the powder then sifts through the perforated plate into the drawer below.

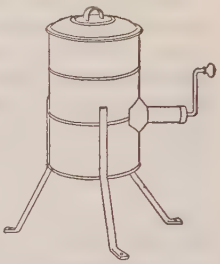
In Fig. 255 is seen an enclosed sifter well adapted for many purposes, while Fig. 256 shows a sectional view of the same kind of sifter for smaller operations. The sieve is hemispherical in shape, and is contained in a tinned iron scoop. (See Fig. 257, which shows the end view.) Two circles of stout wire are soldered to a central axis at right angles to each other, and the axis passes through the tin handle and terminates in a crank. When a powder is placed in the scoop, and the wire rings are made to revolve by turning the axis with the hand, the particles of powder are rapidly forced through the meshes of the sieve. This apparatus is especially useful in breaking up moistened lumps in powders which are about to be percolated. These forms of sifters are manufactured for household use and are obtainable at stores selling kitchen supplies.

Fig. 254



Jones' mixer and sifter

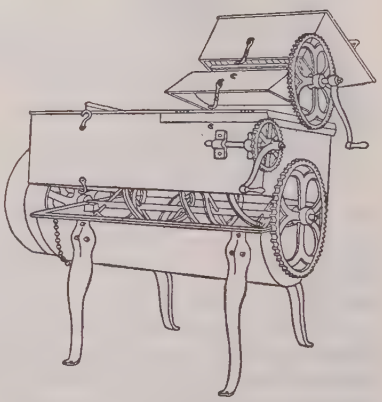
Fig. 255



Enclosed sifter

Hunter's sifter is one of the most effective large machines; it is shown in Fig. 258. In this the powder is sifted in the cylindrical sieve, and adhering particles or small lumps are brushed through by the revolving brushes; the revolving spiral mixers in the large box cause the particles to be thoroughly mingled. The illustration shows the method of operating so well that further description is unnecessary.

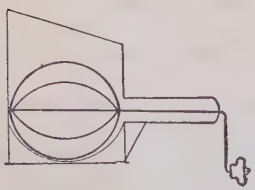
Fig. 258



Hunter's mixer and sifter

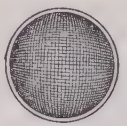
The gyrating type of sifter is extensively used at the present time for the sifting of powdered drugs. The *Rotex Sifter* (Fig. 259) is a good example of this type. This sifter which has a gyratory hand sieve motion has a double screen in its sifting frame; the screen on the under side of the sifting frame is of a very coarse mesh and supports a number of rubber balls, which in their motion keep the sieve-pores open by coming in contact with the screening surface of

Fig. 256



Scoop sifter

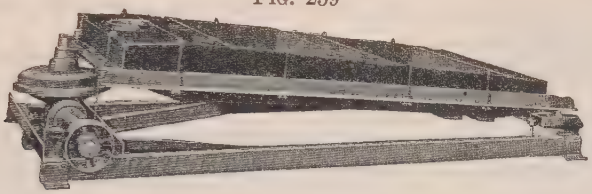
Fig. 257



Scoop sifter (end view)

the sieve cloth which is fastened to the upper side of the sifting frame. The frame is equipped with a number of bevelled cross bars which tend to deflect the ball upward, tapping the sifting cloth. This action may be likened to that of tapping the fingers against the under side of a sieve, but at the rate of

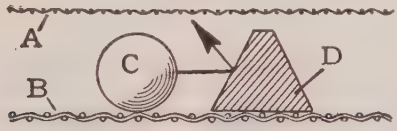
FIG. 259



Rotex sifter

300 taps per minute. Fig. 259*a* illustrates the principle upon which it operates. The inclined sifting box which encloses the sifting frame is equipped with three spouts, one as a feeder, one for the purpose of carrying off the sifted powder, and the third for carrying off the tailings.

FIG. 259*a*



A—The Sifting Cloth.
B—The Coarser Ball Support Screen
C—The Ball, of Solid Rubber
D—The Inclined Surface for Deflecting the Ball Upward

DIAGRAMMATIC REPRESENTATION OF THE ROTEX CLOTH CLEANING SYSTEM.

In some milling establishments, sifters of this type are connected with the Receiving Box of the drug mills and as the tailings are sifted off they are carried back to the grinding spout by means of an elevator carrier. This insures uniformity in powder, as the tailings are being continuously reground and added evenly to the powdered drug instead of regrinding the entire amount of tailings after sifting has been completed and then mixing this with the the previously sifted portion.

The *Ro-Tap Sifter* is a handy mechanical device for making sieving tests. The sieves which fit into a frame are given a rotating effect, and a small mallet at the top of the frame automatically taps it, helping to keep the sieve pores open. These Ro-Tap sifters are equipped with a variable time control.

U. S. P. DESCRIPTION AND STANDARDS

Fineness of Powder—The fineness of powder is expressed, in the Pharmacopœia, by descriptive words which correspond to numbers indicating the number of meshes to a linear inch of the sieve through which the powder will pass. The number of openings to the linear inch, however, is not an indication of the size of the openings in the sieve due to the variation in the diameter of the wire used in various sieve cloths.

For this reason the Bureau of Standards has established specifications for *standard sieves*, as given below.

These specifications also establish tolerances for the evenness of weaving as irregularities from careless weaving might permit much larger particles to pass the sieve than would be indicated.

A Special Committee of the U. S. P. X., under the Chairmanship of Prof. E. L. Newcomb, made a special study of drug powders and reported that

commercial milling methods made it impracticable to specify too narrow a limit for powdered drugs. In any unmanipulated sample there would necessarily be a considerable proportion which would be finer than the specified size. The U. S. P. X therefore established the following specifications:

"A *coarse powder* (No. 20) is one in which all of the particles will pass through a No. 20 standard mesh sieve and not more than 40 per cent through a No. 60 standard mesh sieve.

"A *moderately coarse powder* (No. 40) is one in which all of the particles will pass through a No. 40 standard mesh sieve and not more than 40 per cent through a No. 80 standard mesh sieve.

"A *fine powder* (No. 60) is one in which all of the particles will pass through a No. 60 standard mesh sieve and not more than 40 per cent through a No. 100 standard mesh sieve.

"A *very fine powder* (No. 80) is one in which all of the particles will pass through a No. 80 standard mesh sieve".

For determining uniformity of degree of fineness of a powdered vegetable drug, the standard testing sieves which meet the requirements of the Bureau of Standards, U. S. Dept. of Commerce shall be used. These specifications for standard sieves are:

Specifications for Standard Sieves

Sieve No.	Sieve opening in millimeters	Wire diameter millimeters	Tolerance in average opening
10	2.000	0.760	±3%
20	0.840	0.420	±5%
40	0.420	0.250	±5%
60	0.250	0.162	±6%
80	0.177	0.119	±6%
100	0.149	0.102.	±6%

For very fine powders, bolting cloth is often used for the sifting medium, although sieve cloth No. 300 size or even smaller is now available. When acid substances are to be sifted, horsehair sieves are used.

Gruffs and Tailings—In powdering drugs there is frequently a small portion which is not easily reduced to powder; with reference to this, the Pharmacopœia directs the following procedure: " In the preparation of ground or powdered drugs, no portion of the drug shall be rejected during milling or sifting unless specifically permitted under the official description of the drug. It is permissible, however, to withhold *final tailings* not exceeding 5 per cent of the drug being powdered, which may be added in no greater percentage to other lots of the same drug in subsequent millings".

CHAPTER XIII

SOLUTION

Solution—In pharmacy this term is applied to the process whereby any substance, sometimes called a *solute*, is liquefied or made to disappear when brought in contact with a liquid. The particles of the substance, being uniformly diffused through the liquid, do not separate upon standing. The liquid used to effect this change is called a *solvent*, and, the combination with the dissolved substance, a *solution;* if the liquid has exercised its powers as a solvent to its utmost extent, and is incapable of retaining any more of the dissolved substance, it is termed a *saturated solution*. A substance which is not acted on by a solvent is said to be *insoluble*. This term is often used in a relative sense to indicate a negligible degree of solubility.

All substances are not soluble to the same degree nor do all solvents have the same effect upon a given substance. Solubility is usually expressed in mathematical terms, although for the sake of convenience certain arbitrary terms have come into use in pharmacy and medicine to indicate the degree of solubility of a substance in water (see page 175). Unless otherwise stated, water is assumed to be the solvent when no other liquid is mentioned.

The expressions "*soluble in*" and "*dissolved by*" are not exactly synonymous as correctly used in scientific descriptions. "*Soluble in*" implies solution without chemical decomposition. "*Dissolved by*" implies that chemical reaction has taken place. Thus it is correct to say that sugar is soluble in water, but it is not correct to say that zinc is soluble in hydrochloric acid. The correct statement here would be: zinc is dissolved by hydrochloric acid.

When a solution is perfectly homogeneous and when the dissolved substance is found by physical and chemical tests to be dispersed in the molecular condition, the solution is said to present a *single phase* and is known as a *true, simple,* or *molecular solution*. It is this type of solution that will be discussed in the pages immediately following. In a simple solution the solid suffers no change in its identity on being dissolved, and if the reverse operation of evaporation is applied, the solid substance is recovered with its identity unchanged. The making of solution of potassium hydroxide, and of solution of boric acid are examples of simple solution.

Another form of solution is known as a *chemical solution*. Here the identity of the dissolved body is changed by the action of the solvent or of other ingredients in the solution, and the simple process of evaporation does not yield the original substance or substances. The making of solution of ammonium acetate or of solution of magnesium citrate are examples of chemical solution.

There is still another type of solution which is known as *colloidal*. This type will be discussed later under the heading, *Colloids* (see page 184).

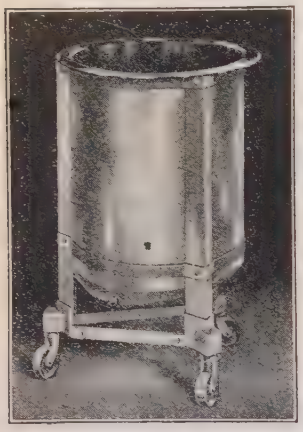
Solution of Solids—This operation is frequently performed by the pharmacist. In this place only the methods of effecting the solution of solid bodies which can be entirely dissolved in the solvent will be considered. This excludes the operations of infusion, decoction, percolation, maceration, etc., which will be considered at length in subsequent chapters.

Effects of Pulverization and Agitation—The solution of a solid may be facilitated by pulverizing it and also by agitating it in contact with the solvent. This increases the extent of surface exposed to the solvent and promotes the

frequent contact of the surface with fresh portions of the solvent. This is easily illustrated, as already noted in the chapter on comminution, by placing half an ounce of lump alum and half an ounce of powdered alum each in a separate pint of water at the same time. A few vigorous stirs will soon cause the latter to dissolve, while the former will require a much longer time even if continuously agitated.

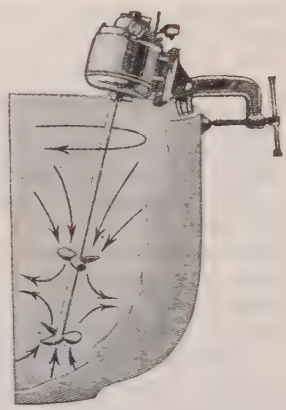
Fig. 260 illustrates a portable, glass-lined tank, made by the Pfaudler Chemical Company, for preparing solutions and Fig. 261 a portable agitator sold by the Alsop Engineering Company. Such an equipment greatly facilitates the making of solutions on a large scale.

Fig. 260



Portable glass-lined tank

Fig. 261



Portable agitator

Effect of Heat—The application of heat generally increases the degree of solubility, for nearly all substances are more soluble in hot solvents than in cold ones. In addition to this, the convection currents in the liquid caused by heat hasten solution by constantly bringing fresh surfaces into contact with the liquid.

Density of Solutions—The effect of dissolving a solid body, specifically heavier than the solvent, is always to increase the density of the liquid in which the solid is dissolved. The specific gravity of water is 1.000. If 5 per cent of sucrose or sugar, which has a specific gravity of about 1.60, is dissolved in it, the specific gravity of the resulting solution is 1.021; if 10 per cent, 1.070; if 20 per cent, 1.088, etc. This increase of density is capable of optical proof, for if any very soluble substance is suspended near the surface of some water in a transparent glass vessel, the downward currents of the solution can readily be noticed if the experiment is viewed by transmitted light.

Solubility of Substances in Saturated Solutions—While a saturated solution is one which is incapable of dissolving any more of the substance which was dissolved in the liquid, it must not be assumed that the saturated solution will not dissolve other solids. In fact, saturated solutions of some substances are better solvents for certain other substances than the plain solvent would be. A saturated solution of potassium iodide for example, is an excellent solvent for iodine, which by itself is scarcely soluble at all in water.

Reduction in Temperature Caused by Rapid Solution—When a solid dissolves rapidly in a liquid without chemical action, a reduction in temperature always takes place, and cold is produced, in accordance with the law governing the conversion of solids into liquids, whereby sensible heat is converted into latent heat. This is a frequently observed phenomenon at the prescription counter when a saturated solution of potassium iodide or of some other soluble salt is made. The so-called *freezing mixtures* are produced by utilizing this principle. Thus, if 5 parts of potassium sulphocyanide are quickly mixed with 4 parts of cold water, the temperature of the solution falls to −20° C. (−4° F.); 32 parts of sodium chloride, if mixed

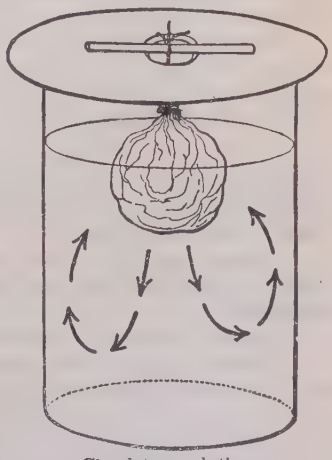
with 100 parts of finely chopped ice, will produce a brine having a temperature of −23° C. (−9.4° F.). Equal parts of crystallized calcium chloride and finely chopped ice, when well mixed, will have a temperature as low as −45° C. (−49° F.).

Elevation of Temperature Produced by Solution Accompanied by Chemical Action—If chemical action or hydration takes place while solution is progressing, the opposite effect, or elevation of temperature, is frequently produced, as when some oxides are dissolved in aqueous solutions of acids and in dissolving certain anhydrous salts in water. Sodium iodide, although chemically analogous to potassium iodide, liberates heat when it dissolves in water. This is due to the fact that there is but one form of potassium iodide, the anhydrous form. Sodium iodide however, exists not only in the anhydrous form but in the form of a compound containing two molecules of water of crystallization and it is in the transformation of the anhydrous to the hydrated form that the heat is produced.

Modes of Effecting Solutions of Solids—The method usually employed by the pharmacist when a chemical salt is to be dissolved in water in compounding a prescription is one which requires the use of the solution mortar and pestle (see Fig. 213). The ordinary practice is to crush the substance into fragments in the mortar with the pestle, and then pour the solvent upon it, meanwhile stirring with the pestle until solution is effected. If definite quantities are used, and the whole of the solvent is required to dissolve the given weight of the salt, a portion only of the solvent should be added at first, and when this is saturated the solution is poured off and a fresh portion of solvent added. This operation is repeated until the solid is entirely dissolved; the solutions are then mixed. Other methods of effecting solution are to shake the solid with the liquid in a bottle or flask, or to apply heat to the substances in a suitable vessel.

With hygroscopic compounds like pepsin, scaled iron salts, argyrol, and some others, the best method of effecting solution in water is to pour the substance directly upon the surface of the water in which solution is to be effected and then stir vigorously with a glass rod. If the ordinary procedure, such as using a mortar and pestle, is employed with these substances, gummy lumps are formed which are exceedingly difficult to dissolve.

Fig. 262



Circulatory solution

The *solubility* of chemicals and the *miscibility* of liquids are important physical factors for the pharmacist to know as they often have a bearing upon the intelligent and proper filling of prescriptions. Mainly for the information of the pharmacist the U. S. P. gives figures to indicate the degree of solubility or miscibility of the various official substances.

Circulatory Solution—A very satisfactory method of dissolving substances, is to suspend the solid near the top of the liquid upon a porous diaphragm or a suitable retaining device, or to tie it in a gauze bag if its nature will permit of this treatment. The substance immediately in contact with the solvent is dissolved, and the solution descends, its place being supplied by fresh portions of the solvent. A circulation is thus created and solution facilitated (see Fig. 262).

Solvents Used in Pharmacy—*Water.* The most useful of all solvents is water. It has a more extensive range of solvent action than any other liquid, and the aqueous solutions are among the most important preparations of pharmacy. They are especially treated in later chapters, under the heads of Liquores, Aquæ, Syrupi, etc. Water is also the best solvent known for most inorganic salts. As a diluting medium for other solvents with which it is miscible, as alcohol, glycerin, etc., water is indispensable in many preparations.

Alcohol, as a solvent, is next in importance to water. It has an important advantage over water in the fact that preparations made with it keep almost indefinitely, while most aqueous solutions of organic substances soon decompose or become worthless. Resins, volatile oils, alkaloids, glucosides, etc., are dissolved by alcohol, while many inert principles, like gum, albumin, and starch, are insoluble in it, so that it has also great usefulness in its negative character. Mixtures of water and alcohol, in proportions varying to suit specific cases, are exceedingly common. They are often referred to as *hydroalcoholic* solvents or *menstrua.*

Glycerin is an excellent solvent, although its range is not so extensive as either of the preceding. It has in its concentrated state preservative qualities of a high order, but has not the valuable negative qualities of alcohol. It dissolves the fixed alkalies, a large number of neutral salts, and vegetable acids, pepsin, tannin, and some other active principles of plants, etc., but it also dissolves gum, soluble carbohydrates, starch, etc., and thus its solutions are generally loaded with inert constituents. It is also of special value as a simple solvent as in glycerite of phenol, or where the major portion of the glycerin is simply added as a preservative and stabilizer of solutions that have been prepared with other solvents. (See Glycerites and Fluidglycerates.)

A certain group of solvents which do not mix with water are known as *immiscible solvents.* The more important of these are ether, petroleum benzin, chloroform, carbon disulphide, benzene, and carbon tetrachloride.

Ether is a good solvent for special purposes. Oils, fats, resins, and some of the alkaloids and neutral principles are dissolved by it. It is one of the solvents used in making prepared oleoresins.

Petroleum Benzin is very similar in its solvent properties to ether. It is frequently used in pharmacy to remove inert and objectionable fatty and waxy constituents from such drugs as opium, digitalis, strophanthus, lactucarium, etc., prior to extracting the active principles with a hydroalcoholic menstruum.

Chloroform resembles ether and petroleum benzin as a solvent. It has an advantage over both, however, in not being inflammable. It is used in preparing solution of gutta percha and several N. F. solutions of resinous substances (see page 342).

Carbon Disulphide is an excellent solvent for rubber, phosphorus, etc. Its range is limited, however, and its odor and inflammability detract from its usefulness.

Carbon Tetrachloride is a valuable non-inflammable solvent for fats, oils, etc.

Coal-tar Benzene has solvent properties similar to those of the majority of the other immiscible solvents.

Acetone is not an immiscible solvent but stands midway between alcohol and ether in its solvent action. It was used officially as a solvent for extracting the prepared oleoresins but has been replaced by ether for this purpose for economic reasons.

Acid and *alkaline* solutions are sometimes used as solvents for special cases.

Oils are also used as solvents in liniments, etc.

New Solvents—In consequence of the stimulation of organic chemical research brought about by the World War, and the coincident rise in price of tax-paid alcohol due to the passage of the Prohibition Amendment, many new solvents have made their appearance and most of these are now available in large quantities and in prices below that of tax-paid alcohol. For special technical uses unconnected with the preparation of official medicinal preparations many of these are finding a place, and inasmuch as the fields of research connected with the use of these solvents is bound to grow in the near future it is considered advisable to include a list of these solvents, classified in order of their volatility.

Solvents boiling below 100°C.: Acetone, benzene, ethyl acetate, ethyl alcohol (anhydrous), ethyl propionyl, isopropyl alcohol, methyl acetate. Solvents boiling at about 125° C.: Amyl acetate, amyl alcohol, butyl acetate, butyl alcohol, diethylcarbonate, ethyl butyrate, toluene. Solvents boiling between 150° and 200° C.: Benzyl alcohol, diacetone alcohol, diethyl oxalate, ethyl acetoacetate, ethyl benzoate, ethyl lactate, xylene. Solvents boiling at about 300° C.: Diamylphthalate, dibutylphthalate, dibutyltartrate, diethylphthalate, diethyltartrate, triacetin, tricresylphosphate, triphenylphosphate.

Solubility as a Test—The solubility of a substance in various solvents constitutes a factor whereby its identity and purity can, in some degree, be determined, but the U. S. P. X has recognized the fact that the degree of solubility of the various official substances is primarily valuable as information required by physicians and pharmacists in connection with the preparation and dispensing of medicines. The U. S. P. makes the following statement concerning solubility as a physical factor.

"The following points must be observed in the accurate determination of solubilities: 1. Purity of both the dissolved substance and the solvent is essential, since impurities in either effect the solubility to a greater or less extent. 2. Constancy of temperature must be accurately maintained during the course of the determination. 3. Complete saturation must be secured. 4. Accurate analysis of the saturated solution and correct expression of the results are imperative. In connection with the above named essential features of a correct solubility determination, attention should be called to the varying rates of solution of different compounds, and to the marked effect of the degree of fineness of the particles upon the time required for the saturation of the solution. In general, it may be said that an equipment comprising a thermoregulator and a constant agitation device is indispensable for accurate solubility determinations.

"The solubility data given throughout this volume have for the most part been determined under the above described conditions, and will, therefore, frequently show a somewhat greater solubility than would be found in the daily experience of most pharmacists.

"When in Pharmacopœial texts it has not been possible, or in some instances not desirable to indicate exact solubility, a descriptive term has been used. The following table indicates the meaning of such terms:

	Amount of solvent in one part of solute
Very soluble	Less than 1 part.
Freely soluble	From 1 to 10 parts.
Soluble	From 10 to 30 parts.
Sparingly soluble	From 30 to 100 parts.
Slightly soluble	From 100 to 1000 parts.
Very slightly soluble	From 1000 to 10,000 parts.
Practically insoluble	More than 10,000 parts.

TABLE OF THE SOLUBILITY OF OFFICIAL SUBSTANCES

Terms used and their relative values

Abbreviations

	Solvent
v. s. = Very soluble	Less than 1 part.
fr. sol. = Freely soluble	From 1 to 10 parts.
sol. = Soluble	From 10 to 30 parts.
sp. sol. = Sparingly soluble	From 30 to 100 parts.
sl. sol. = Slightly soluble	From 100 to 1000 parts.
v. sl. sol. = Very slightly soluble	From 1000 to 10,000 parts.
pract. ins. = Practically insoluble	More than 10,000 parts.

Other abbreviations:
alm. ins. = Almost insoluble.
dec. = Decomposed.
inc. sol. = Incompletely soluble.
ins. = Insoluble.
m. r. sol. = More readily soluble.
m. sol. = More soluble.
n. ins. = Nearly insoluble.
p. sol. = Partially soluble.
r. sol. = Readily soluble.

One Gm. dissolves	In cc. of water		In cc. of alcohol		In cc. of Glycerin	In cc. of Chloroform	In cc. of Ether	In cc. of Petroleum Benzin	In cc. of Benzene	Other solvents.
	At 25° C.	Boiling	At 25° C.	Boiling	At 25° C.	At 25° C.	At 25° C.	At 25° C.	At 25° C.	
Acetanilidum	190	20	3.4	0.6	5	3.7	17	sl. sol.	47	Acetone—4.
Acetphenetidinum	1310	82	15	2.8	—	14	130	—	—	—
Acidum Acetylsalicylicum	300	—	5	—	—	17	10–15	—	—	Ethyl acetate—aqueous solutions of sodium borate and sodium phosphate.
Acetyltannicum	sl. sol.	—	sl. sol.	—	—	—	—	—	—	Carbon disulphide—30.
Benzoicum	275	18	2.3	1.5	—	4.5	3	sp. sol.	10	Oil of turpentine—23.
Boricum	18	4	18	6	4	—	—	—	—	Volatile oils.
Citricum	0.5	0.5	1.8	—	—	—	30	—	—	
Salicylicum	460	15	2.7	—	—	42	3	—	135	Turpentine—52. Acetone—3.
Stearicum	alm. ins.	—	21	—	—	2	3	—	—	
Tannicum	v. sol.	v. sol.	v. sol.	v. sol.	1	alm. ins.	alm. ins.	alm. ins.	alm. ins.	Acetone—v. sol. Diluted alcohol—fr. sol Dehydrated alcohol—sl. sol.
Tartaricum	0.75	—	3	—	—	alm. ins.	sl. sol.	—	—	
Trichloraceticum	0.1	—	v. sol.	—	—	—	v. sol.	—	—	
Aconitina	v. sl. sol.	—	28	—	—	—	65	alm. ins.	7	
Æthylis Aminobenzoas	2500	—	5	—	—	2	4	—	—	Olive Oil—30–50 Dilute acids.
Chloridum	sl. sol.	—	fr. sol.	—	—	—	fr. sol.	—	—	
Æthylmorphinæ Hydrochloridum	8	—	22	—	—	sl. sol.	sl. sol.	—	—	
Albumini Tannas	alm. ins.	—	alm. ins.	—	—	alm. ins.	alm. ins.	—	—	
Aloinum	sol.	—	sol.	—	—	—	sl. sol.	—	—	Acetone.
Alumen (Potassium)	7.2	0.3	ins.	—	fr. sol.	—	—	—	—	
Ammonium	5.2	0.3	ins.	—	fr. sol.	—	—	—	—	
Exsiccatum	20 inc.	1.5	ins.	—	—	—	—	—	—	
Amidopyrina	18	—	1.5	—	—	1	13	—	12	
Ammonii Benzoas	10	—	35.5	—	8	—	—	—	—	
Bromidum	1.3	0.9	12	1.2	—	—	—	—	—	

TABLE OF THE SOLUBILITY OF OFFICIAL SUBSTANCES—*Continued*

One Gm. dissolves	In cc. of water		In cc. of alcohol		In cc. of Glycerin	In cc. of Chloroform	In cc. of Ether	In cc. of Petroleum Benzin	In cc. of Benzene	Other solvents
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling	At 25° C.	At 25° C.	At 25° C.	At 25° C.	At 25° C.	
Ammonii Carbonas	4	dec.	—	—	—	—	—	—	—	
Chloridum	2.6	1.4	100	—	8	—	—	—	—	
Salicylas	1	—	3	—	—	—	—	—	—	
Antimonii et Potassii Tartras	12	3	ins.	—	15	—	—	—	—	
Antipyrina	1	—	1.3	—	—	1	43	—	—	
Apomorphinæ Hydrochloridum	50	17 (80° C.)	50	—	—	v. sl. sol.	v. sl. sol.	—	—	
Argenti Nitras	0.4	0.1+	30	6.5	—	—	sl. sol.	—	—	
Nitras Fusus (5% AgCl ins.)	0.4	0.1+	30	6.5	—	—	—	—	—	
Argento-Proteinum Fortius	fr. sol.	—	alm. ins.	—	—	alm. ins.	alm. ins.	—	—	
Mite	fr. sol.	—	alm. ins.	—	—	alm. ins.	alm. ins.	—	—	
Arseni Iodidum	1 12	—	sol.	—	—	sol.	sol.	—	—	Carbon disulphide.
Trioxidum	slowly sol.	—	sl. sol.	—	fr. sol.	—	sl. sol.	—	—	
Arsphenamina	sol.	—	sol.	—	sol.	v. sl. sol.	v. sl. sol.	—	—	
Atropina	455	90 (80° C.)	2	1.2 (60° C.)	27	1	25	—	—	
Atropinæ Sulphas	0.4	—	5	2.5	2.5	420	3000	—	—	
Barbitali Sodium	5	2.5	sl. sol.	—	—	—	ins.	—	—	
Barbitalum	130	13	14	—	—	75	35	—	—	Acetone. Ethyl acetate.
Barii Sulphas	ins.	—	—	—	—	—	—	—	—	
Betanaphthol	1000	80	0.8	—	sol.	17	1.3	—	—	Olive oil.
Bismuthi Subcarbonas	ins.	—	ins.	—	—	—	—	—	—	
Subgallas	pract. ins.	—	pract. ins.	—	—	—	pract. ins.	—	—	
Subnitras	pract. ins.	—	ins.	—	—	—	—	—	—	
Subsalicylas	pract. ins.	—	—	—	—	—	—	—	—	
Caffeina	46	5.5 (80° C.)	66	22 (60° C.)	—	5.5	530	—	100	Acetone—50.
Caffeina Citrata	4	—	—	—	—	—	—	—	—	
Caffeinæ Sodio-Benzoas	1.1	—	30	—	—	p. sol.	—	—	—	
Calcii Bromidum	0.7	0.4	1.3	—	—	ins.	ins.	—	—	
Carbonas Præcipitatus	pract. ins.	—	ins.	—	—	—	—	—	—	
Chloridum	1.2	0.7	10	2	—	—	—	—	—	
Glycerophosphas	50	—	ins.	—	—	—	—	—	—	More soluble in water below 25° C. Solubility increased by nitric acid.
Iodobehenas	ins.	—	v. sl. sol.	—	—	fr. sol. (warm)	v. sl. sol.	—	—	
Lactas	20	—	pract. ins.	—	—	—	—	—	—	
Calx	840	1740	ins.	—	sol.	—	—	—	—	Sol.—Syrup.
Chlorinata	p. sol.	—	p. sol.	—	—	—	—	—	—	
Camphora	800	—	1	—	—	0.5	1	fr. sol.	—	fr. sol.—carbon disulphide. fr. sol.—fixed and volatile oils.
Carbromalum	3000	—	18	v. sol.	—	—	14	—	—	
Chloral Hydras	0.25	—	1.3	—	—	2	1.5	—	—	v. sol.—Olive oil. fr. sol.—Oil of turpentine.

TABLE OF THE SOLUBILITY OF OFFICIAL SUBSTANCES—*Continued*

One Gm. dissolves	In cc. of water		In cc. of alcohol		In cc. of Glycerin	In cc. of Chloroform	In cc. of Ether	In cc. of Petroleum Benzin	In cc. of Benzene	Other solvents
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling	At 25° C.	At 25° C.	At 25° C.	At 25° C.	At 25° C.	
Chloramina	7	2	dec.	—	—	ins.	ins.	—	ins.	
Chromii Trioxidum	0.6	0.5	violent dec.	—	—	—	—	—	—	
Chrysarobinum	v. sl. sol.	—	385	—	—	13	160	—	30	Carbon disulphide—180
Cinchonidinæ Sulphas	65	22 (80° C.)	90	41 (60° C.)	—	620	n. ins.	—	—	
Cinchophenum	alm. ins. (cold)	—	120	m. v. sol.	—	400	100	—	—	
Cocaina	600	270 (80° C.)	6.5	v. sol.	—	0.7	3.5	—	—	Olive oil—12. Liquid petrolatum.
Cocainæ Hydrochloridum	0.4	—	3.2	2 (60° C.)	sol.	12.5	ins.	—	—	
Codeina	120	—	2	1.2 (60° C.)	—	0.5	18	—	1	
Codeinæ Phosphas	2.3	0.5 (80° C.)	325	125	—	4500	1875	—	—	
Codeinæ Sulphas	30	6.5 (80° C.)	1280	440 (60° C.)	—	ins.	ins.	—	—	
Colchicina	22	—	fr. sol.	—	—	fr. sol.	220	ins.	100	
Cotarninæ Chloridum	v. sol.	—	v. sol.	—	—	—	—	—	—	
Cupri Sulphas	2.5	0.5	500	—	2.8	—	—	—	—	
Dextrosum	1	m. sol.	59	m. sol.	—	—	—	—	—	
Dichloramina	alm. ins.	—	dec.	—	—	1	—	—	1	Eucalyptol. Chlorinated paraffin hydrocarbons. Carbon tetrachloride—2.5.
Elaterinum	ins.	—	325	100	—	15.5	450	—	310	
Emetinæ Hydrochloridum	fr. sol.	—	fr. sol.	—	—	—	—	—	—	
Epinephrina	v. sl. sol.	—	v. sl. sol.	—	—	ins.	ins.	—	—	Acetone—ins. Fixed and volatile oils—ins.
Eucainæ Hydrochloridum	30	m. sol.	35	m. sol.	—	6	—	—	—	
Ferri Carbonas Saccharatus	p. sol.	—	—	—	—	—	—	—	—	
Chloridum	0.2	—	fr. sol.	—	sol.	—	sol.	—	—	
et Ammonii Citras	r. sol.	—	ins.	—	—	—	—	—	—	
Phosphas Solubilis	fr. sol.	—	ins.	—	—	—	—	—	—	
Sulphas	1.4	0.4	ins.	—	—	—	—	—	—	
Sulphas Exsiccatus	slowly sol.	—	—	—	—	—	—	—	—	
Sulphas Granulatus	slowly sol.	—	—	—	—	—	—	—	—	
Ferrum Reductum	ins.	—	ins.	—	—	—	—	—	—	
Glucosum	v. sol.	—	sp. sol.	—	—	—	—	—	—	
Glusidum	290	25	31	—	—	sl. sol.	sl. sol.	—	—	
Glusidum Solubile	1.2	—	50	—	—	—	—	—	—	
Guaiacol Carbonas	ins.	—	60	fr. sol.	sl. sol.	1	18	—	fr. sol. (Boiling)	sl. sol.—Fixed oils.
Homatropinæ Hydrobromidum	6	—	40	12 (60° C.)	—	420	ins.	—	—	
Hydrargyri Chloridum Corrosivum	13.5	2.1	3.8	1.6	12	—	22	—	—	
Chloridum Mite	ins.	—	ins.	—	—	—	ins.	—	—	
Iodidum Flavum	pract. ins.	—	ins.	—	—	—	ins.	—	—	

TABLE OF THE SOLUBILITY OF OFFICIAL SUBSTANCES—*Continued*

One Gm. dissolves	In cc. of water		In cc. of alcohol		In cc. of Glycerin	In cc. of Chloroform	In cc. of Ether	In cc. of Petroleum Benzin	In cc. of Benzene	Other solvents
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling	At 25° C.	At 25° C.	At 25° C.	At 25° C.	At 25° C.	
Hydrargyri Iodidum Rubrum	pract. ins.	—	115	20	—	910	120	—	—	Solutions of soluble iodides. Mercuric chloride. Sodium thiosulphate. Hot solutions of alkali chlorides.
Oxidum Flavum	pract. ins.	—	ins.	—	—	—	—	—	—	
Salicylas	pract. ins.	—	pract. ins.	—	—	—	—	—	—	
Hydrargyrum Ammoniatum	ins.	—	ins.	—	—	—	—	—	—	
Hyoscyaminæ Hydrobromidum	v. sol.	—	2.5	—	—	1.7	2260	—	—	Olive oil—34.
Iodoformum	pract. ins	—	60	16	80	10	7.5	—	—	Carbon disulphide—2.8
Iodum	2950	—	12.5	—	80	fr. sol.	fr. sol.	—	—	Carbon disulphide—4. fr. sol.—Carbon tetrachloride. sol.—Aqueous solutions of iodides.
Lactosum	4.9	2.6	v. sl. sol.	—	—	ins.	ins.	—	—	
Magnesii Carbonas	pract. ins.	—	ins.	—	—	—	—	—	—	
Oxidum	pract. ins.	—	ins.	—	—	—	—	—	—	
Sulphas	1.3	0.2	sp. sol.	—	1.1	—	—	—	—	
Menthol	sl. sol.	—	v. sol.	—	—	v. sol.	v. sol.	v. sol.	—	Liquid petrolatum—fr. sol. Fixed and volatile oils—fr. sol. Glacial acetic acid—fr. sol.
Methenamina	1.5	—	12.5	—	—	10	—	—	—	
Methylthioninæ Chloridum	fr. sol.	—	fr. sol.	—	—	sol.	—	—	—	
Morphinæ Hydrochloridum	17.5	0.5	52	46 (60° C.)	sol.	ins.	ins.	—	—	
Morphinæ Sulphas	15.5	0.7 (80° C.)	565	240 (60° C.)	—	ins.	ins.	—	—	
Neoarsphenamina	v. s.	—	sl. sol.	—	sol.	alm. ins.	alm. ins.	—	—	Acetone—alm. ins.
Nitrogenii Monoxidum	1 vol. water at 25° C. dissolves 1.3 vol. N_2O			—	—	—	—	—	—	
Pancreatinum	slowly and inc. sol.	—	ins.	—	—	—	—	—	—	
Paraformaldehydum	v. slowly sol.	m. r. sol.	ins.	—	—	—	ins.	—	—	
Pelletierinæ Tannas	250	—	sol.	—	—	ins.	sl. sol.	—	—	
Pepsinum	fr. sol.	—	n. ins.	—	—	n. ins.	n. ins.	—	—	
Phenobarbitalum	1000	—	8	—	—	40	13	—	700	
Phenol	15	—	v. sol.	—	v. sol.	v. sol.	v. sol.	—	—	Carbon disulphide—v. sol. Fixed and volatile oils v. sol.
Phenolphthaleinum	alm. ins.	—	13	—	—	—	70	—	—	
Phenolsulphonphthaleinum	1300	—	350	—	—	alm. ins.	alm. ins.	—	—	Acetone—500.

TABLE OF THE SOLUBILITY OF OFFICIAL SUBSTANCES—*Continued*

One Gm. Dissolves	In cc. of water		In cc. of alcohol		In cc. of Glycerin	In cc. of Chloroform	In cc. of Ether	In cc. of Petroleum Benzin	In cc. of Benzene	Other solvents
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling	At 25° C.	At 25° C.	At 25° C.	At 25° C.	At 25° C.	
Phenylis Salicylas	6670	—	6	—	—	v. sol.	v. sol.	—	—	Fixed and volatile oils v. sol.
Phosphorus	pract. ins.	—	400 (dehydrated)	—	—	40	102 (Absolute)	—	31.5	Carbon disulphide—0.9 Fixed and volatile oils —sp. sol.
Physostigminæ Salicylas	75	16 (80° C.)	16	5	—	6	250	—	—	
Pilocarpinæ Hydrochloridum	0.3	—	3	1.5 (60° C.)	—	366	ins.	—	—	
Nitras	4	—	75	21 (60° C.)	—	ins.	ins.	—	—	
Plumbi Acetas	1.4	0.5	38	—	fr. sol.	—	—	—	—	
Oxidum	alm. ins.	—	ins.	—	—	—	—	—	—	
Potassa Sulphurata	v. sol.	—	—	—	—	—	—	—	—	
Potassii Acetas	0.5	0.2	2.9	—	—	—	—	—	—	
Bicarbonas	2.8	2 (50° C.)	alm. ins.	—	—	—	—	—	—	
Bitartras	155	16	8820	—	—	—	—	—	—	
Bromidum	1.5	1	250	21	4.6	—	—	—	—	
Carbonas	0.9	0.7	ins.	—	—	—	—	—	—	
Chloras	16.5	1.8	alm. ins.	—	sol.	—	—	—	—	
Citras	0.6	—	alm. ins.	—	fr. sol.	—	—	—	—	
et Sodii Tartras	0.9	—	pract. ins.	—	—	—	—	—	—	
Hydroxidum	0.9	0.6	3	v. sol.	2.5	—	—	—	—	
Iodidum	0.7	0.5	22	8	2	—	—	—	—	
Nitras	2.8	0.5	620	—	sol.	—	—	—	—	
Permanganas	13.5	3.5	dec.	dec.	—	—	—	—	—	
Procainæ Hydrochloridum	0.6	—	30	—	—	sl. sol.	alm. ins.	—	—	
Pyrogallol	1.7	v. sol.	1.3	v. sol.	—	—	—	—	—	
Quinidinæ Sulphas	90	15	10	—	—	sol.	alm. ins.	—	—	
Quinina	1560	800	0.8	—	—	1.1	1.9	—	—	
Quininæ Æthylcarbonas	sl. sol.	—	2	—	—	1	10	—	—	r. sol.—Dilute acids.
Bisulphas	9	0.7	23	0.7 (60° C.)	15	625	2500	—	—	
Dihydrochloridum	0.6	—	12	—	—	sl. sol.	v. sl. sol.	—	—	
et Ureæ Hydrochloridum	0.9	—	2.4	—	—	—	—	—	—	
Hydrobromidum	40	3.2 (80° C.)	1	—	7	0.6	23	—	—	
Hydrochloridum	16	0.5 (80° C.)	0.8	—	7	0.7	340	—	—	
Sulphas	725	47 (80° C.)	107	12 (60° C.)	30	sl. sol.	sl. sol.	—	—	
Quininæ Tannas	sl. sol.	—	m. sol.	—	—	sl. sol.	sl. sol.	—	—	
Resorcinol	0.9	0.2 (80° C.)	0.9	—	fr. sol.	sl. sol.	fr. sol.	—	—	
Salicinum	23.5	3.3 (80° C.)	88.5	30 (60° C.)	—	ins.	ins.	—	—	
Santoninum	alm. ins.	sl. sol.	43	6.5	—	1.7	110	—	—	
Scopolaminæ Hydrobromidum	1.5	—	20	—	—	sl. sol.	ins.	—	—	
Sodii Acetas	0.8	—	19	—	—	—	—	—	—	
Benzoas	1.8	1.4	61	—	—	—	—	—	—	
Bicarbonas	10	—	ins.	—	—	—	—	—	—	
Biphosphas	fr. sol.	—	pract. ins.	—	—	pract. ins.	pract. ins.	—	—	
Boras	15	0.6	ins.	—	1	—	—	—	—	
Bromidum	1.1	—	16	—	—	—	—	—	—	
Cacodylas	0.5	—	2.5	—	—	—	—	—	—	

TABLE OF THE SOLUBILITY OF OFFICIAL SUBSTANCES—*Continued*

One Gm. dissolves	In cc. of water		In cc. of alcohol		In cc. of Glycerin	In cc. of Chloroform	In cc. of Ether	In cc. of Petroleum Benzin	In cc. of Benzene	Other solvents
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling	At 25° C.	At 25° C.	At 25° C.	At 25° C.	At 25° C.	
Sodii Carbonas Monohydratus	3	1.8	ins.	—	7	—	—	—	—	
Chloridum	2.8	2.7	sl. sol.	—	—	—	—	—	—	
Citras	1.3	0.6	ins.	—	—	—	—	—	—	
Hydroxidum	0.9	0.3	v. sol.	—	—	—	—	—	—	
Indigotindisulphonas	sp. sol.	—	alm. ins.	—	—	—	—	—	—	
Iodidum	0.5	0.4	2	—	1	—	—	—	—	
Nitris	1.5	v. sol.	sp. sol.	—	—	—	—	—	—	
Phosphas	2.7	—	v. sl. sol.	—	—	—	—	—	—	
Phosphas Exsiccatus	8.1	1.1	ins.	—	—	—	—	—	—	
Salicylas	0.9	v. sol.	9.2	v. sol.	sol., 4 parts	—	—	—	—	
Sulphas	1	—	ins.	—	sol.	—	—	—	—	
Thiosulphas	0.5	—	ins.	—	—	—	—	—	—	
Strontii Salicylas	19	3.7	61	14	—	—	—	—	—	
Strophanthinum	sol.	—	—	—	—	n. ins.	n. ins.	—	n. ins.	sol.—Diluted alcohol.
Strychninæ Nitras	45	10	150	80 (60° C.)	50	105	ins.	—	—	
Sulphas	35	7	81	26 (60° C.)	fr. sol.	220	ins.	—	—	
Sucrosum	0.5	0.2	170	—	—	ins.	ins.	—	—	
Sulphonethylmethanum	200	m. sol.	sol.	—	—	—	sol.	—	—	
Sulphonmethanum	365	16	60	3	—	—	ins.	—	—	
Terpini Hydras	200	34	13	3	—	135	140	—	—	
Theobrominæ Sodio-Salicylas	1	—	sl. sol.	—	—	—	—	—	—	
Theophyllina	120	m. r. sol.	80	—	—	—	sp. sol.	—	—	
Thymol	1000	—	1	—	ins.	0.7	1.5	—	—	Olive oil—1.7. sol.—Fixed and volatile oils. r. sol.—Fixed and volatile oils—Collodion.
Thymolis Iodidum	ins.	—	sl. sol.	—	—	—	—	—	—	
Thyroxinum	ins.	—	pract. ins.	—	—	—	—	—	—	
Trinitrophenol	78	15	12	—	—	35	65	—	10	
Vanillinum	100	16 (80° C.)	fr. sol.	—	20	fr. sol.	fr. sol.	—	—	
Zinci Acetas	2.3	1.6	30	1	—	—	—	—	—	
Chloridum	0.25	—	1.3	—	sol.—2 parts	—	—	—	—	
Oxidum	ins.	—	ins.	—	—	—	—	—	—	
Stearas	ins.	—	ins.	—	—	—	ins.	—	—	
Sulphas	0.6	—	ins.	—	2.5	—	—	—	—	

"*Method for Determining Solubilities.*—In brief, this consists in preparing a saturated solution of the given substance and ascertaining, by analysis, the amount present in a definite quantity of the solution. Complete saturation can be attained most readily by constant stirring or agitation by means of a suitable mechanical contrivance. A simple apparatus for this purpose consists of a test tube of medium size fastened upright in a water bath maintained at constant temperature. The solvent and excess of solids are placed in the tube and stirred by means of a motor-driven rotating glass spiral. After a given period of stirring, a definite weight of the clear solution is analyzed and the stirring continued for an additional period of several hours. If analysis shows no increase of dissolved substance after the second period of stirring, the result is to be taken as the solubility at the particular temperature. Minute details of methods for determining solubilities are described in Bulletin No. 67 of the Hygienic Laboratory, U. S. Public Health Service".

The U. S. Pharmacopœia indicates the degree of solubility of a chemical substance by stating the number of cc. of solvent which will be required to dissolve 1 Gm. of the substance. The temperature at which solution is to be effected is frequently given.

Solution of Gases in Liquids

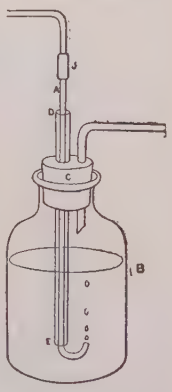
When gases dissolve in liquids, they sometimes do so to form simple solutions as in the case of chlorine water and hydrochloric acid. The majority of such solutions, however, are chemical solutions. These may be divided into two classes, *i. e.*, those in which the original gas is recovered on heating, as in carbonic acid water ("soda water"), solution of sulphurous acid and of ammonia water, and those in which the original gas is not recoverable by simple heating, as in nitric acid and in sulphuric acid. Some gases dissolve to form solutions having a specific gravity less than 1.000, for example, ammonia gas; others form solutions which are heavier than water, as hydrochloric acid.

The methods employed to effect the solution of gases in liquids differ essentially from ordinary processes of solution, and depend upon the solubility of the gas in the liquid, the relative specific gravity, and the strength of the solution desired. It is usually sufficient to conduct the gas into the liquid by a suitable tube, reaching nearly to the bottom, when more or less of the gas is absorbed by the liquid. This operation should always be conducted in a fume chamber or in some location where escaping gases will not be offensive or dangerous. For a continuous operation, as in making hydrochloric, nitric, and hydrobromic acids, and similar liquids, the well-known Woulff's or three-necked bottles, see Fig. 263, are employed advantageously, the gas which escapes solution in one bottle passing over into the next. The washing bottle shown in Fig. 264 is easily made, and well adapted for purifying gases prior to final absorption. *B* is an ordinary wide-mouthed bottle, closed with a perforated rubber stopper, *C*; a wide tube, *DE*, passes nearly to the bottom, and a narrow tube, *A*, is joined by a short piece of rubber tubing, *J*, to the tube leading from the generating flask, and at the other extremity is curved upward so as properly to deliver the gas into the water placed in the bottle

Fig. 263

Woulff's bottle

Fig. 264

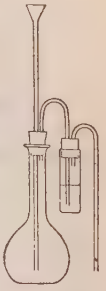


Wash bottle for gases

to wash it. It escapes by the bent tube, T, which is continued until it dips into the liquid in which the gas is to be dissolved. The space between the tube A and the wide tube DE acts as a safety valve. If the pressure accumulates through the too rapid generation of the gas, or if a stoppage occurs in the delivery tube, the liquid in the bottle is first blown out through this space, and the pressure is thus relieved.

Fig. 265 shows a very convenient apparatus for generating and washing small quantities of gases, for applying emergency tests, or for other purposes. As the apparatus suitable for each operation must be especially selected, general observations on the solution of gases will not be so useful in this chapter as a detailed process in connection with each preparation where it is described in the subsequent pages. One general rule should be noted, however,—*i. e.* that gases are always more rapidly and thoroughly absorbed by cold rather than by hot liquids. Hence the receiving bottle should be kept surrounded by ice or otherwise refrigerated.

Fig. 265



Gas generator

Solutions of gases are almost always potentially dangerous when exposed to warm temperatures on account of the liberation and expansion of the dissolved gas which may cause explosion or accident through the bursting of the container. Bottles containing such solutions should be cooled before opening if practicable, and the stopper should be covered with a cloth before attempting its removal.

CHAPTER XIV

COLLOIDS AND DIALYSIS

The term *colloid* was first used in 1861 by J. Graham to describe certain jelly-like substances which were incapable of passing through moist parchment under certain specified conditions. The opposite of the term colloid, as used by Graham was *crystalloid*, and the colloids and crystalloids were discussed for many years in pharmaceutical and chemical literature, in connection with the operation known as dialysis, in which a diaphragm of parchment, or some similar membranous film or sheet was employed for the separation of these two classes of substances. The term *osmosis* came to be used by biologists to describe the diffusion through membranes, which takes place in natural tissues of plants and animals, as well as in laboratory experiments; the term *exosmosis* meaning outward-diffusion and *endosmosis* meaning inward diffusion.

About 1905 the increasing attention given to physical chemistry led to the invention by Zsigmondy and Siedentopf of what is known as the ultra-microscope, which enables objects too minute to be seen by the most powerful magnification under direct illumination, to be rendered indirectly visible by illumination at right angles to the field of vision. The employment of this instrument in studying suspensions and solutions gave an impetus to the subject of *colloidal chemistry* as it has now come to be called.

It is now recognized that colloids do not exist as a distinct class of substances, but that the term colloid is correctly applied to a state of matter in which, by infinite subdivision and dispersion, some remarkable properties are developed.

Collodial chemistry may be defined as the chemistry which deals with matter in a finely subdivided state, in which, however, the particles are larger than molecules.

The smallest particle which can be seen under the highest magnification of the ordinary microscope by direct illumination is about 0.5μ (the μ is called the micron, and is $\frac{1}{1000}$ of a millimeter). The ultra-microscope renders visible particles which are fifty times smaller than the foregoing figure or $10\mu\,\mu$ (a $\mu\,\mu$, called *micro-micron*, is $\frac{1}{1000}$ of a micron). The largest molecules are smaller than $1\,\mu\,\mu$, and up to the present have never been seen by any power of magnification. Fig. 266 illustrates a comparison of the sizes of molecules of several common substances, with the sizes of particles of colloidal gold and the sizes of particles that may be taken as indicative of those in a mixture where there is no colloidal suspension. These comparisons are taken from "The Chemistry of Colloids" by Zsigmondy.

In a true or molecular solution there is perfect homogeneity throughout. In what is known as a colloidal solution there is a suspension or *dispersion* of one substance in another.

The substance that is so subdivided is known as the *disperse phase;* the substance that gives bulk and continuity is known as the *dispersion* medium. Some authorities refer to these two factors as the *dispersed phase* and the *continuous phase*, respectively.

Solutions differ from mixtures in that, by filtration the suspended substance is removed from the latter.

Colloidal solutions resemble true or molecular solutions in that filtration removes nothing from them.

We may have a continuous gradation from mixtures to true solutions. This is illustrated by the following diagram:

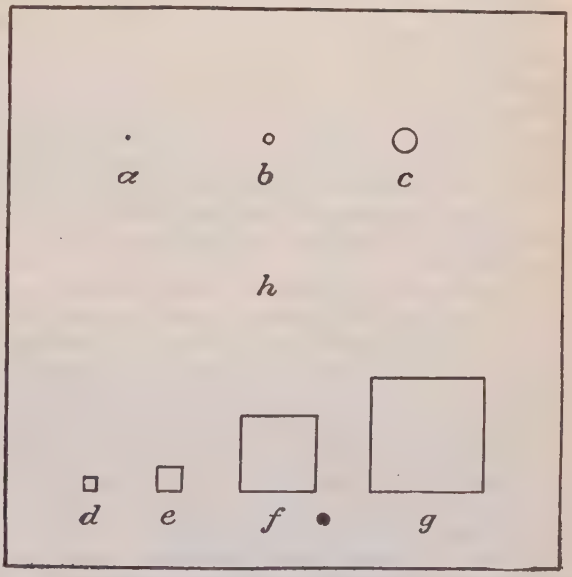
Mixtures	Colloidal solutions	Molecular solutions
Particles greater than 0.1μ; do not pass through filter paper; can be seen by direct illumination with the microscope; not dialyzable.	Particles ranging in size from 0.1 to $1\mu\mu$; easily pass through filter paper; can only be seen by use of ultramicroscope; not dialyzable.	Particles smaller than $1\mu\mu$; easily pass through filter paper; cannot be seen with microscope; are dialyzable.

One of the phenomena by which colloidal solutions may usually be distinguished from true or molecular solutions, without the aid of a microscope is due to the fact that colloidal solutions show an apparent condition of turbidity or cloudiness when viewed by reflected light, while by transmitted light they are perfectly transparent.

A simple and interesting experiment, by which both a colloidal solution and a molecular or true solution may be prepared, using the same ingredients but varying the temperature, may be carried out as follows:

In each of two 500 cc. flasks place 490 cc. of water. Heat one of these until the water begins to boil, allowing the other to remain at room temperature. Add to each of the flasks 10 cc. of official solution of ferric chloride. Observe the difference. In the flask containing the cold water, the ferric chloride will produce a molecular solution, very pale yellow in color and perfectly transparent in all lights. In the flask which contained the boiling water, the solution will be found to be deep red in color by transmitted light, with a pronounced appearance of turbidity when viewed by reflected light.

FIG. 266



Comparison in size of colloidal particles and molecules
Scale 1: 1,000,000
a. Hydrogen molecules.
b. Chloroform molecules.
c. Hemoglobin molecules.
d, e, f, g. Particles in colloidal gold.
The enclosing square indicates the comparative size of particles in a mixture in which there is no colloidal suspension

The effect of minute subdivision in changing physical properties is remarkable. A cubic inch of gold has a surface area of 6 square inches. By subdividing it to the point where its particles are of colloidal dimensions it is found by calculation that the surface area has increased to over one square mile, and that the particles are no longer subject to the law of gravitation, but form a colloidal suspension, or solution, deep red by transmitted light and showing apparent turbidity by reflected light, in which the particles remain suspended indefinitely and cannot be removed by the finest filtering mediums.

The colloidal state of matter occurs in a great variety of combinations. These may be tabulated as follows, stating first, the dispersion medium and second, the dispersed phase, and giving examples of each:

1. Gaseous—liquid	Mists—Fogs.
2. Gaseous—solid	Smokes—cosmic dust.
3. Liquid—gaseous	Foams.
4. Liquid—liquid	Emulsions.
5. Liquid—solid	Suspensions (ordinary colloidal solutions).
6. Solid—gaseous	Solid foams.
7. Solid—liquid	Solid emulsions.
8. Solid—solid	Solid suspensions.

Some of these classes are of scientific interest only, but classes four and five are of great importance in pharmacy. Emulsions will be considered later in Part XI, under The Prescription Pharmacist.

One of the interesting facts in connection with colloidal solutions is the constant vibratory motion of the suspended particles. This phenomenon was observed in 1827 by an English botanist named Brown, in the case of fine powders suspended in water, and is known to microscopists and physicists as the "*Brownian movement*". The ultra-microscope reveals the particles in a colloidal solution in a similar state of vibratory oscillation or motion and the fact may account for the indefinite suspension of the particles.

Colloidal solutions in water are called "*hydrosols*". In some rare instances other dispersion mediums are used and are called by appropriate names as "*alcosol*", etc.

A noteworthy property of many colloidal solutions is to leave a jelly-like residue upon concentration. These are frequently called *hydrogels*. In some cases the gelatinous or even dry residue possesses the property of resuming the colloidal state of dispersion when the lost water is replaced. These are called "*reversible sols*" or "*reversible gels*" as the case may be. If the dried residue does not reproduce a colloidal suspension, it is called *irreversible*.

Coagulation, *flocculation*, or *precipitation* sometimes takes place in colloidal preparations, in which the colloidal character is entirely lost. This is always an irreversible change, and is frequently produced by the addition of an electrolyte or ionizable salt to the preparation.

Under favorable conditions some solid or gelatinous residues undergo changes in the presence of water and other constituents, whereby they are transformed into colloidal dispersions. This phenomenon is called *peptization*.

The term *suspensoid* is sometimes applied to the solid disperse phase, while the corresponding term *emulsoid* is applied to the liquid disperse phase in a colloidal suspension.

Some colloidal substances are inherently so, and we know of them in no other form. Many of this class possess the property of communicating the colloidal property to compounds or substances not normally possessing it. These are known as *protective colloids*.

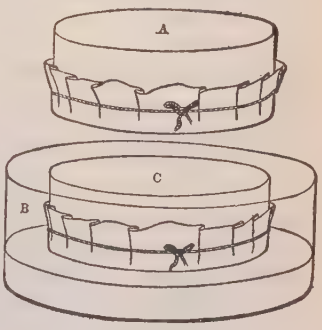
From the foregoing fundamental facts it will be appreciated that the colloidal state of matter is very common, and that it has a widespread range of possibilities. The color of gems and of ruby glass, the iridescence of the butterfly's wings, are a few instances of the effects produced by the colloidal state. The industries of rubber, of tanning, of clays, soils, and cements are but a few of the practical possibilities in connection with the study of colloids, for all of these industries have been benefited by the application of scientific principles based upon the study of colloids.

One of the phenomena connected indirectly with colloidal chemistry is that

of adsorption. Adsorption differs from absorption in that, in the latter case, a substance is simply taken into a porous medium and the degree of absorbability is simply one of volume, while in adsorption there is a manifestation of surface energy, and dissolved solids or gases are concentrated on the surface of the adsorbing agent. Adsorption plays an important part in decolorization (see page 213).

A very practical application of colloidal chemistry, as this branch of study is called, is concerned with the separation of colloids from substances which are not colloidal by placing a liquid in which both are present upon a suitable diaphragm which has its under surface in contact with water.

Fig. 267

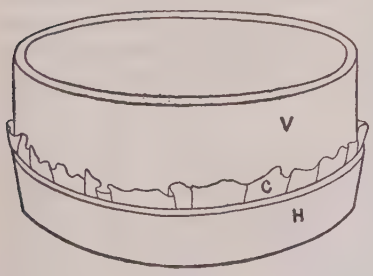


Dialyzer

A thin layer of gelatin interposed between two liquids offers no obstacle to the passage of the crystalloids from one to the other, while it completely prevents the passage of the colloids. This property belongs not only to gelatin, but to other substances, as bladder, parchment, parchment paper, and collodion film.

Upon the principles stated above Professor Graham contrived a very simple apparatus which he called the dialyzer (see Fig. 267). It consists of two parts, one a circular glass recipient *B*, about a foot in diameter and six inches deep, the other *A* a similar circular vessel, from six to ten inches in diameter and about two inches deep, made of hard rubber, celluloid, glass, or some similar substance, and the bottom covered with a circular piece of the material selected for the dialyzing diaphragm or septum, the edges of which are brought over the lower rim of the inner vessel nearly to the top and fastened securely outside of it by a string. The outer part, or circular basin, should contain distilled water in an amount from five to ten times the quantity of the liquid that may be introduced into the smaller vessel. The latter is to float upon the surface of the water in the former, and is to receive the liquid to be submitted to dialysis, which should not be more than half an inch deep. It is important that the diaphragm employed should have no defects, and should be brought well up and secured on the outside of the inner vessel to prevent the escape of liquid. If any liquid containing a mixture of colloidal and crystalloidal matter be placed in the floating vessel, after some hours it will be found that a portion of the latter has passed through the parchment paper, and is held in solution by the distilled water of the larger vessel, while the colloidal matter remains in the inner vessel and is called the *dialyzate*. The solution in the outer vessel is called the *diffusate*. The process is applicable to the dialysis of substances held in aqueous solution only, and will not answer for alcoholic or ethereal liquids. The hard rubber sieve, which has already been described (see Fig. 268), makes an excellent dialyzer if floated upon pure water in an evaporating dish or beaker. Fig. 269 shows another form in which the glass dialyzer has its upper edge expanded into a flat shoulder which rests upon the upper edge of the round dish, sometimes called the

Fig. 268



Dialyzer

"exarysator", containing the water. This has the advantage of keeping the diffusate covered while the dialysis is progressing. It is obvious that very different arrangements might be made to accomplish the same ends. Thus, a thoroughly clean bladder three-fourths filled with a mixture, suspended in a jar of distilled water, would yield similar results. Graham's apparatus is preferable to others only for its convenience. Collodion films have been largely used in laboratory experimental work.

The following applications of the process of dialysis have been made: 1. It facilitates in many instances to a considerable extent the separation of the active matter of any artificial or natural mixture from the inert and useless, the former being very often crystalline and the latter colloidal. In effecting the purification of organic chemicals, one of the most embarrassing problems is to get rid of contaminating impurities, and the process of dialysis may here often be brought to the aid of the operator. 2. In searching for poisons in organic mixtures, as in stomach contents, in which the application of tests is hindered by the colloidal matter present, the problem of the presence of the poison may sometimes be solved by submitting the suspected matter to dialysis. The poison, if diffusable, will be found in the diffusate separated from the other matters, and may then be detected by the application of appropriate tests, after concentration. 3. An application was formerly made of the process in the restoration of salted meat to a comparatively fresh state. If some salt beef with its brine is enclosed in a bag of material suitable for dialysis, as of untanned leather, and the bag immersed in sea water, in the course of some days the beef will have been rendered sufficiently fresh for use, the salt having passed out into the sea water. A number of extensively used forms of medicine are colloidal in character. *Colloidal silver, colloidal iron, colloidal bismuth, calomel, gold, copper, iodine,* etc., are all known and used. Such of these as are of importance will be discussed under their appropriate headings.

FIG. 269

Dialyzer (glass)

Dialyzed iron, or *Ferrum Dialysatum,* is a colloidal preparation made by placing a mixture of basic ferric chloride and ammonium chloride upon a dialyzing septum. The crystalloids (ammonium chloride and ferric chloride), with any free acid, pass into the diffusate, leaving the neutral colloidal liquid upon the septum. The resulting preparation is a colloidal form of ferric hydroxide and was at one time extensively used, but its instability led to its discontinuance.

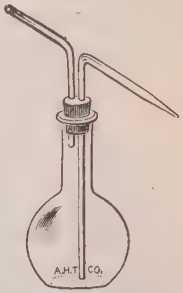
CHAPTER XV

SEPARATION OF FLUIDS FROM SOLIDS

THE operations considered under this head are among those which are most frequently used in pharmacy,—*i. e.*, Lotion, Decantation, Colation, Filtration, Clarification, Expression, Percolation, etc.,—and the principles which govern the successful performance of these practical processes should be well understood. They are almost exclusively mechanical processes.

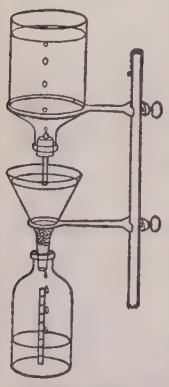
Lotion, or Displacement Washing is the process of separating soluble matter from a solid by pouring a liquid upon it which will dissolve and wash out the soluble portion. The separation of the fluid from the solid is generally effected by placing an obstruction in a funnel or cylindrical vessel, such as a pledget of cotton, notched cork, filter paper, etc., and then, having introduced the solid into the funnel and arranged a suitable vessel beneath, the liquid is poured upon it. (See Percolation.) Precipitates are frequently freed from contaminating soluble matter in this way. A very convenient method of applying the liquid is by the use of the spritz bottle (see Fig. 270). This is usually made from a flask, but a round shouldered pint bottle of the diameter most easily grasped by the hand is very satisfactory. Two glass tubes, one bent at an acute angle and the other at an obtuse angle, are used; one end of the former is drawn out to a capillary orifice, and the other extends nearly to the bottom of the bottle. The obtuse angled tube merely enters the bottle below the stopper; the upper portion of this tube should be held in the gas flame, so as to fuse the edges of the glass and thus prevent cutting the lips when it is used. By filling the bottle with liquid, and blowing with the mouth through the tube, a stream of liquid is ejected from the capillary orifice which can be directed to any portion of a solid substance that is to be washed. It is often desirable, in order to save time, to use the liquid hot. For that purpose, in an active laboratory, the spritz bottle may be kept on the water bath. The neck of the hot water spritz flask should be covered with some insulating material such as wicker, to prevent burning the fingers during its handling.

FIG. 270



Spritz bottle

FIG. 271

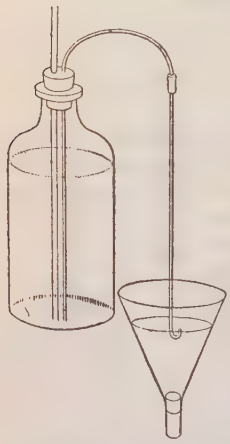


Continuous washing

Continuous Washing—The use of the spritz bottle for small operations is convenient. A simple method of automatically supplying the wash liquid in larger quantities is shown in Fig. 271. This requires no attention from the operator except at the beginning of the operation. The bottle is furnished with a perforated stopper and a short glass tube. All that is necessary is to fill the bottle and adjust it over the funnel so that the end of the tube shall be at the height desired for the liquid. On tilting the bottle slightly (if the tube selected is not too narrow in diameter) the liquid will run out into the funnel until it rises to the orifice of the tube, when the flow will cease. As the liquid gradually passes through the solid substance in the funnel, the level falls, and bubbles of air pass through the tube into the bottle, the liquid once more flows, and the

operation continues until the upper bottle is empty. Many elaborate methods of continuous washing have been suggested, but if care is taken in the simple apparatus just described to have the tube of proper diameter, at least so wide that the force of capillary attraction shall not be strong enough to prevent the ingress of air, it is the most satisfactory of all. Bottles having narrow mouths may often be used in the same way, and the cork and tube dispensed with. A little practice will enable the operator to make an apparatus in which the parts are adjusted to a nicety. On the larger scale, two carboys may be used,—one above and inverted, containing the liquid, supported by a box having a circular hole cut in its side, and the other inside the box, containing the funnel and filter.

Fig. 272

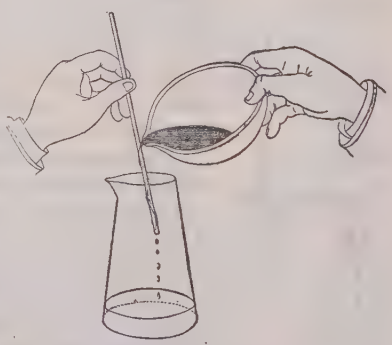


Continuous washing apparatus

A modification of Gay Lussac's apparatus is one of the most successful and practical for continuous washing (see Fig. 272). The bottle containing the wash liquid is furnished with a doubly perforated stopper and two glass tubes. One is bent as shown in the cut, and its lower extremity curved upward so that the outlet of both ends of the syphon tube are on the same level. By blowing a current of air through the other tube the syphon tube is filled, and the extremity may then be adjusted to such a height in the funnel as is desired. When the level of the liquid in the funnel falls below the orifice of the tube, bubbles of air will enter the bottle through the air tube, and the liquid will run out until it rises in the funnel to the level of the ends of the tubes, when it will cease. It will be found a practical convenience to cut the syphon tube just below the bend, so that a piece of rubber tubing may be used to form a flexible joint.

Decantation—The process of separating a fluid from a solid by decantation is very simple, and consists usually of allowing the solid to deposit at the bottom of the vessel, and then carefully pouring off the liquid by inclining the vessel. The effectiveness of decantation as a washing device, may be illustrated by the following example. If 360 grains of mercuric chloride dissolved in 50 fluidounces of water are mixed with 220 grains of potassium iodide dissolved in 50 fluidounces of water, double decomposition takes place, an insoluble precipitate of mercuric iodide subsides, and 100 grains of potassium chloride remain dissolved in the 100 fluidounces of water. As it is desirable to free the mercuric iodide from the contamination of potassium chloride, the supernatant liquid is poured off; if 90 fluidounces are decanted, 90 grains, or $\frac{9}{10}$ of the whole quantity of potassium chloride, are thus disposed of, and 10 grains are left. If the vessel is filled with water to 100 fluidounces, and 90 fluidounces are again poured off, 9 grains are again removed, and only 1 grain is left; this by a third washing and decantation in a similar manner would be reduced to $\frac{1}{10}$ of a grain, and thus the purification is speedily effected. Some skill is required to decant liquids neatly from vessels of various shapes, particu-

Fig. 273

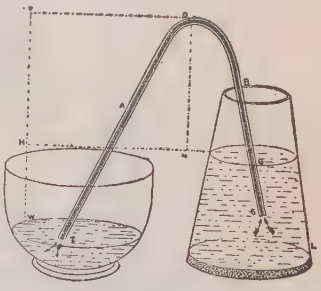


Use of the guiding rod

larly if they are not furnished with lips, or if filled nearly to the brim. The *guiding rod* may be used in many cases with effect. Indeed, it is a good practice to form the habit of using a stirrer or rod as a guide in decanting, as shown in Fig. 273, for it has a tendency to steady the hand of the operator. The practice recommended by some writers of greasing the rim of the vessel to facilitate decantation is a clumsy and usually unsuccessful expedient.

The Syphon (or Siphon)—It often happens in washing solid substances that decantation by pouring off the liquid cannot be successfully performed, either because the vessel is too full, or because, owing to the light character of the precipitate, the inclination of the vessel is sufficient to cause a disturbance in the powder, and an admixture of the liquid and solid. In such cases, and in many others, the useful instrument known as the syphon may be resorted to. This usually consists of a glass tube bent at a rather acute angle, and having one of the arms longer than the other. It is used by filling the syphon with liquid, and then inserting the short arm into the liquid that is to be drawn off, when a flow of liquid from the long arm is established, which need not cease until as much of the liquid is abstracted as is desired. After filling the syphon the liquid may be prevented from running out (if a tube of small diameter is used) by stopping up the end of the long arm with the forefinger of the right hand. If the liquid to be drawn off is not caustic or unpleasant to the taste, the short arm of the syphon may be placed in the vessel at the proper height, and suction applied by the mouth at the long end until the current is established. The principle of the action of the syphon is shown in Fig. 274. The combined lengths of the arms of the syphon are not equal to the length of the glass tube, *T O S*, but the real syphon is only the tube acting between the levels of the liquid in the vessels. In all operations with the syphon there must be a difference in the levels of the liquid.

Fig. 274



Syphon diagram

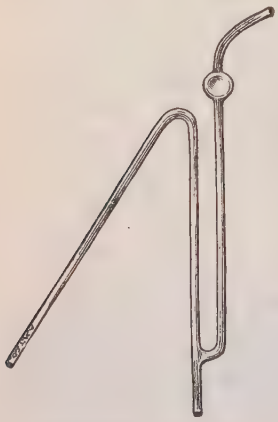
In Fig. 274, *O S* represents the liquid in the short arm, and *O T* the liquid in the long arm. It is apparent that, if a narrow tube syphon, with arms of equal length, is filled with liquid, and held level in liquid on the same plane, there can be no movement in the liquid; equilibrium is established, because the tubes are equal in length and in level liquid, and the pressure of the air is the same upon all parts of the liquid. But as the descending column of liquid in the long arm exceeds in weight that in the short arm, it follows on account of the excess of weight of liquid in this arm that if it is once set flowing through the longer arm it will continue until the levels of the liquid in the two vessels are the same. It will be observed that the custom of having one arm longer than the other is not a necessity, for if there is sufficient difference between the levels of the liquid the syphon will operate with the position of the arms reversed; but it is a convenience in a syphon of unequal arms always to immerse the short arm, as there is then the certainty that the other arm contains the longest column of liquid. The syphon, obviously, cannot be operated in a vacuum, or if the length of the upward column of water exceeds thirty-three feet.

Syphons for Special Purposes—In the larger laboratory operations the most convenient syphon is made from a six-, eight-, or ten-foot length of rubber hose. This syphon, on account of its flexibility, can be used in many operations where glass or metal would be inconvenient or inadmissible, while

its durability and simplicity of operation make it a necessity. Indeed, the utility of glass syphons is greatly increased by cutting the long arm just below the bend and joining it to the other by a piece of rubber tube.

The method, already referred to, of starting a syphon by applying suction with the mouth at the long end, or filling the syphon with liquid, is not always practicable, and various other expedients are in use. The *syphon with a bulbed lateral tube*, illustrated in Fig. 275, is used where caustic liquids are to be decanted. The finger is placed over the end of the long arm, and suction applied at the small tube until the downward current is started.

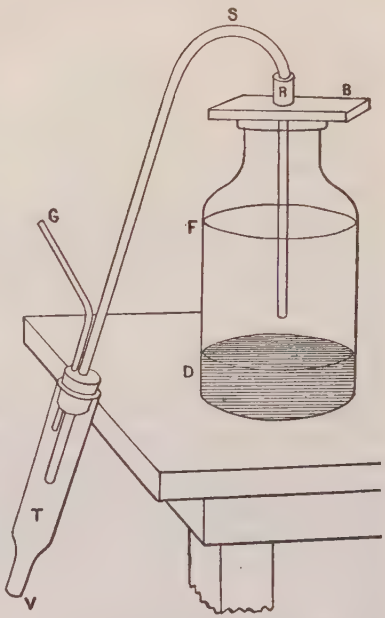
Fig. 275



Syphon with lateral tube

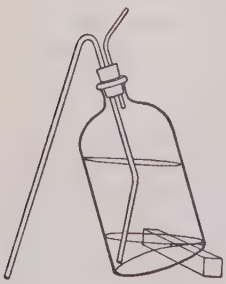
Negretti's syphon has a glass syringe attachment upon the lower part of the long arm to accomplish the same purpose. Fig. 276 represents a modification of Mohr's syphon which may be readily assembled extemporaneously. It is started like the syphon with a lateral tube, the moistened forefinger closing the lower aperture, *V*, while suction is being used at *G* until the liquid has been started. A simple glass tube, with a short piece of rubber tube attached, is in practical hands an efficient substitute for an elaborate contrivance to start the flow in a syphon; even if the liquid is caustic or disagreeable, there is no risk in careful hands if the rubber tube is held between the thumb and finger so that it can be instantly pinched tightly to prevent the upward flow of the liquid into the mouth.

Fig. 276



Syphon with starter

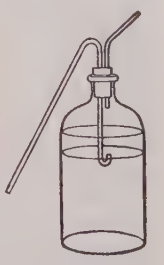
Fig. 277



Syphon in bottle

Fig. 277 represents a form of syphon for drawing off the liquid to almost the last drop in the bottle. The shorter arm of the syphon is bent, and the syphon is started by blowing through the shorter tube in the cork. Fig. 278 shows a syphon with the shorter arm "turned up". This form has the advantage of retarding the tendency to empty itself, and, in syphoning the liquid from precipitates, there is not so much danger of stirring up the particles on the bottom.

Fig. 278

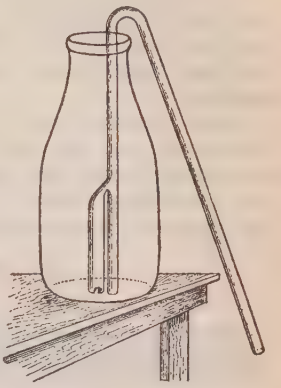


Syphon

Another form of glass tube syphon has the end sealed and a lateral opening just above the blunt sealed end. This also permits a liquid to be drawn off very closely without disturbing a sediment.

A self-starting syphon, known as a *siphonette* and made by D. R. Kasanof and Company, of New York City (see Fig. 279), admits bubbles of air to the short arm from a lateral bulb, the air lifting the liquid until the flow is established from the long arm. It is used especially for separating "top milk" but may be given general application. Other forms of self-starting syphons are on the market.

Fig. 279



Self-starting syphon

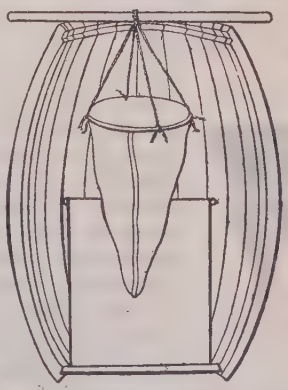
Colation, or Straining (*colare*, to strain), is the process of separating a solid from a fluid by pouring the mixture upon a cloth or porous substance which will permit the fluid to pass through, but will retain the solid. This operation is frequently resorted to for separating sediment or mechanical impurities of various kinds from liquids. Gauze, fine muslin, cotton, flannel, woolen, felt, and other fabrics are used. Strainers are employed where the solid particles to be removed are not in very fine particles, or where complete separation is not especially desired.

It is sometimes difficult to distinguish between colation and filtration for they imperceptibly grade into each other. Felt strainers usually effect a separation equivalent to filtration while even a coarsely woven fabric at times becomes a filter by the accumulation of material which fills up its pores and makes a "filter bed".

Felt strainers are usually made of felted, seamless, conical bags; the material is of wool or hair and quite thick. They form excellent strainers for melted fats, petrolatum, wax, oils, syrups, elixirs, etc., where a large quantity of substance is to be strained. Their expensiveness is, however, an objection to their use, and the difficulty of cleaning them, owing to the tenacity with which they retain odors, unfits them for general use by the pharmacists, but for special purposes in a manufacturing laboratory they are very useful.

Woolen strainers made of twilled woolen cloth, flannel blanket material, etc., are more economical, because they can be cut to any size desired, and the material costs less, and if the seams are closely sewed or overseamed they will last a long time. The form known as Hippocrates' sleeve (see Fig. 280) is that generally used. Fig. 281 shows the shape and dimensions before being sewed. A wooden hoop or brass ring is required to keep the opening extended. This should be arranged so that it can be removed when the bag is to be washed. The most convenient support is a stick passed through the cords which are attached to the strainer, the whole suspended

Fig. 282



Use of strainer]

Fig. 280

Strainer, Hippocrates' sleeve

Fig. 281

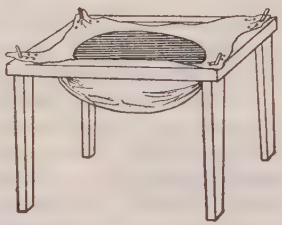
Pattern for Hippocrates' sleeve

in a barrel or tank arranged as shown in Fig. 282. The object of suspending it in the barrel is to avoid currents of air, which, in the case of many liquids, would cause evaporation from the surface and the formation of a crust, and thus impede the rapidity of colation. A tin or copper can of proper size may be placed in the barrel to collect the strained liquid.

Cotton flannel or Canton flannel strainers are cheaper than woolen, and if bleached they have the great advantage that they can be used for alkaline solutions. The unbleached cotton flannel is probably stronger, but the coloring matter naturally present, being soluble in alkalies, is apt to discolor the liquid.

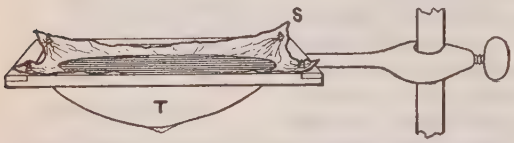
Cotton cloth or muslin strainers are generally suspended on a wooden frame, (*tenaculum*) see Fig. 283. The frame should be securely joined without glue, and at each corner there should be a strong, pointed nail projecting slightly outward. Fig. 284 shows the method of fastening the strainer to the frame.

Fig. 284



Strainer and frame (tenaculum)

Fig. 283



Cotton cloth strainer

It should be secured at each corner, first upon the permanent nails, and then two tacks at the side of each nail should be driven two-thirds of their length into the frame; this partial driving of the nail is sufficient to hold the cloth and permit of the easy removal of the tacks. A strainer hung in this way will hold more liquid and do much better work than one which is tacked all around the frame. This method of straining is particularly useful in collecting precipitates which require washing.

Colation in Smaller Operations—When solid particles are to be separated from liquids in the operations of the dispensing counter, several methods may be used. One of the most convenient is to insert a plug of absorbent cotton in the neck of a funnel and then pass the liquid through; a funnel with a circle of brass wire gauze soldered in it two-thirds of the way down is sometimes used, although not recommended, because of the difficulty of cleaning it. A very popular piece of apparatus for this purpose is shown in Fig. 285. It is a two piece funnel made of hard rubber. A piece of muslin can easily be placed between the two sections, forming a quick and convenient means of straining preparations at the prescription counter.

Fig. 285

Hard-rubber strainer

The cotton cloth used by the makers of cheese, called cheese cloth, is admirably adapted for many kinds of straining.

Fig. 286

Careless straining

In using a funnel for straining, care should be taken to see that the strainer, is not too large, for if the wet strainer projects over the edge of the funnel, a syphon action due to capillary attraction may be set up and more of the liquid delivered outside of the bottle than inside. Fig. 286 shows the action of such a strainer.

Fabrics of some kinds, particularly those of cotton, are usually treated or impregnated with a material called *sizing* to improve their appearance and quality for certain purposes. For use as a strainer this sizing material must be removed as it is always objectionable in that it fills up the pores and causes contamination. There is a wide range of substances used for sizing, some being soluble only in cold water, others only in hot water. The proper method for their removal, therefore, is first to soak the fabric for some hours in cold *distilled water*, then rinse thoroughly and cover with *distilled water* and boil for a few minutes, finally rinsing well in distilled water to carry out the last traces of the gelatin, albumin, glue, or starch which may have been present in the sizing.

CHAPTER XVI

FILTRATION

Filtration is the process of separating liquids from solids with the view of obtaining the liquids in a transparent condition. The intervention of a porous substance, called the *filter* or the *filtering medium*, to intercept the solid particles, is necessary in performing this process. The filter may be made of paper, paper pulp, sand, siliceous earth, asbestos, ground glass, charcoal, porous stone, etc. The liquid which has passed through the filter is called the *filtrate*.

Paper filters are the most useful of all filters for the pharmacist, and they are employed in all the finer operations requiring filtration. The solid particles are much more completely separated by filtration through good paper filters than through strainers, owing to the pores of the paper being smaller and more numerous. The paper used for this purpose is especially prepared, and is called *filter paper*. It is now made upon a large scale, and can be had of excellent quality. Unlike a strainer, it is rarely used more than once; its cost is so trifling, and it is so easily ruptured when wet, that it is not worth while to attempt to save filters for subsequent use. Filter paper is found in commerce in two forms,—in large, nearly square sheets, and in circular sheets. The former is used for large filters, and has some advantages, if the waste pieces can be put to use; but it is now almost universally the custom for the pharmacist to rely upon the circular sheets of different sizes. For pharmaceutical purposes the gray paper, which is made from a mixture of cotton, flax, wool, etc., answers sufficiently well for filtering drug preparations, as fluidextracts or tinctures, but, owing to the coloring matter it contains, it should never be used for any colorless or light colored chemical solutions.

It is well to form the habit of using white filter paper for all liquids that are intended to be colorless when filtered; of course, for analytical work a special quality of paper should be employed. Satisfactory filter papers are now made in this country although many pharmacists yet prefer to use French filter paper of the "Prat Dumas" brand. A high grade of white filter paper made in Sweden, by Munktell, is preferred for the process of ignition and analytical work; it yields the smallest amount of ash, and is practically free from soluble salts and impurities. The Durieux filter paper, of French manufacture, has gained great favor with careful pharmacists and chemists. It is credited with not only high quality but also unusual toughness.

The Whatman English filter papers, first produced in 1915 under difficult circumstances incident to war conditions, from the mills of W. and R. Balston, Ltd., makers of the famous Whatman drawing and other hand-made papers, successfully met a great need for quantitative filter papers during the period when other European papers were unavailable. Since that time constant improvements have been effected and maintained in all grades, and they are now very popular, particularly in the analytical laboratory.

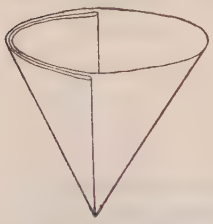
Another high grade filter paper is that produced by the firm of Carl Schleicher and Schüll, Germany. This firm also markets a serviceable filter hat of vertical shape made into a seamless cone with an angle of 60°.

Methods of Folding Filtering Paper—Two kinds of paper filters are used, the *plain* and the *plaited*.

1. *The Plain Filter*—This filter is used habitually by the analytical chemist, and is preferred by the pharmacist where precipitates are to be

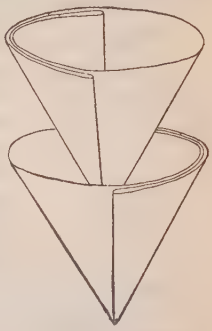
collected, and in some other operations (see Fig. 287); it is made by exactly doubling a circular sheet of filtering paper upon itself, and then folding this directly in the middle, so that, when opened, four equal divisions or sectors appear; the filter is used by separating one of the sectors from the other three, and placing the cone formed into a funnel; the liquid is then poured upon the filter, and the process of separating the solid from the liquid commences. The advantages of the plain filter are, 1, simplicity and rapidity in folding, no skill being required; 2, in collecting precipitates, but one-half of the surface of the filter (two sectors) is in contact with the moist precipitate, which is often closely adherent, and therefore but one-half of the surface has to be cleaned. In some cases there may be a disadvantage in the use of the plain filter, owing to the unequal rate of flow,—the tendency of the three folds being to attract the liquid to the side of the funnel upon which they rest, and thus the precipitate may be unequally washed. A stronger and more rapid filter may be made by placing one plain filter inside of another, so that the three sides of the upper one shall be in contact with one side of the lower one, and *vice versa* (see Fig. 288). If the sides of the funnel have an angle of 60°, the plain filter made as described will fit the funnel properly; but it frequently happens that the angles of funnels vary, and if an ordinary plain filter is placed in a funnel not having an angle of 60°, a portion of the filter is left unsupported, and the weight of the liquid is apt to rupture the moist paper. This difficulty may be overcome by making a fresh crease in the outside fold of the plain filter; if this is made to the right of the original crease of the 60° filter, and the inside fold pushed around a corresponding distance, a filter having a smaller angle is produced, while if the fresh crease is made to the left of the original crease, a larger angled filter may be made. Rother's method of making a plain filter has the advantage of furnishing two filters from the same sheet that is usually required for one filter. To make it, the circular disk of filtering paper is cut through in the line of its diameter, and half of the disk is folded into two equal parts; the double edge of the cut sides is turned down and folded over on itself narrowly several times (see Fig. 289), and with the blade of a spatula the fold is compressed so that it will retain its shape (see Fig. 290). This filter may be used in collecting precipitates.

Fig. 287



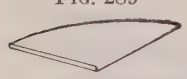
Plain filter

Fig. 288



Double plain filter

Fig. 289



Rother's filter (first step)

Fig. 290

Rother's filter

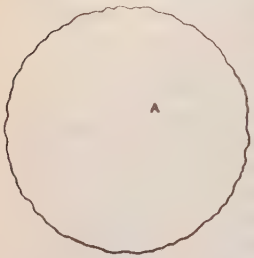
2. *The Plaited Filter* may well be called the "pharmacist's filter", for it is the form largely used in ordinary filtering operations. Figs. 291 to 301 show the progressive steps in the folding of a plaited filter. It is made by folding a circular sheet of filtering paper twice, as in making a plain filter.[1] The edge *B D*, Fig. 294, is then laid upon *E D*, and the crease *F D* is formed; in like manner *C D* is laid upon *E D*, and *H D* is formed. Then *D B* is laid upon *F D*, and *I D* is formed, and by rolling over the fold in the same direction once more until *F E* is laid upon *E D*, the crease *K D* is made (see Fig. 296). Now

[1] It will be observed that in the first folding of French filters, "Prat Dumas", the disks are not perfect circles. This causes one edge to project (see Fig. 292), and facilitates the opening of the filter.

in the same way *C D* is laid upon *H D* and *H D* upon *E D*, and it will be noticed that the folded semicircle has been creased into eight equal spaces, and that the direction of each crease is the same, so that if the paper is lifted it will appear as shown in Fig. 298.

The next step is to fold each one of these spaces *back on itself* (Fig. 296). *B D* is laid upon *F D*, and then *B D* is turned upward and back until it is laid upon *I D*. This makes the crease *Q D*, which is the first fold in the opposite direction. Taking both folds between the forefingers and thumbs of both hands, the edges *B D* and *I D* are folded upward and back upon

Fig. 291

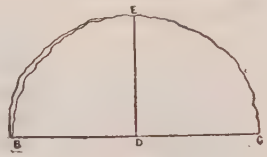


Filter

Fig. 292

Folding plaited filter

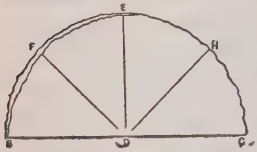
Fig. 293



Folding plaited filter

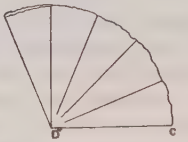
F D, and the crease *P D* is formed; then these three edges, *B D*, *I D*, and *F D*, are taken all together and folded back upon *K D*, and the crease *O D* is formed, and so on, each space in turn being folded back in the opposite direction, until the last one is reached. The folded filter is then held at the

Fig. 294



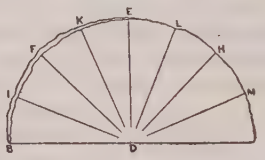
Folding plaited filter

Fig. 295



Folding plaited filter

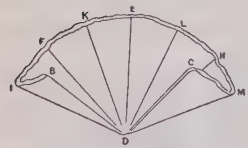
Fig. 296



Folding plaited filter

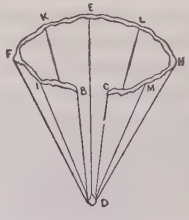
apex with the left hand upon a table or flat counter, and pressed and smoothed out with the right hand in order to emphasize the folds. It should then be placed in the funnel, while still unopened, to see whether it needs trimming; if the rough edges of the filter project above the top of the funnel, the filter

Fig. 297



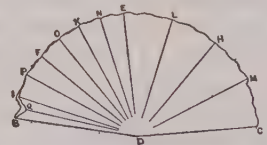
Folding plaited filter

Fig. 298



Folding plaited filter

Fig. 299



Folding plaited filter

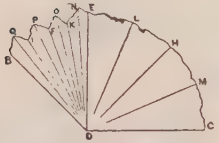
must be removed, and they must be cut off neatly with a sharp knife or a pair of scissors so that the whole of the filter may be placed inside of the funnel.

Another method of folding a plaited filter is illustrated in Figs. 302 and 303. A plain filter is folded as in Fig. 287, and the quadrant, consisting of four thicknesses of paper, beginning at the left hand side, is folded at once into

narrow parallel plaits backward and forward. Fig. 302 represents the filter after being opened, and Fig. 303 shows the inside of the filter. It will be observed that the creases do not converge to a point as in the plaited filter (see Fig. 301), and hence the apex is less likely to be weakened.

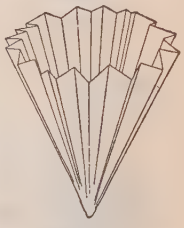
Maxims—1. In folding a filter, care should be observed not to extend the creases entirely to the apex, but to end them at a distance of about half an inch from it, because the point at which all the creases converge would be thereby so weakened that the weight of the liquid would rupture the filter. When the filter has been accurately plaited and the creases emphasized by pressure, it is then carefully opened, placed in a dry funnel, and with the open hand pressed firmly into place so that the point enters the throat of the funnel. This serves to support the apex of the filter upon which must rest the weight of the liquid above and also forms channels through which the filtrate may flow. The speed of filtration is markedly increased if this precaution is carefully observed. When a filter is carelessly placed in the funnel, it forms a bag at the apex, which readily breaks, or clings to the sides of the funnel, and retards the flow of the filtrate from above.

Fig. 300



Folding plaited filter

Fig. 301

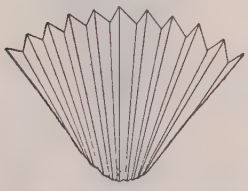


Plaited filter

2. The filter in the funnel should be moistened with the liquid to be filtered or with a liquid corresponding to the solvent employed. This promotes rapid filtration, and washes the filter besides.

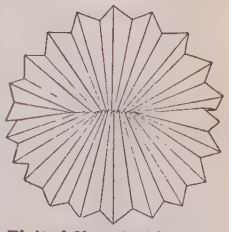
3. If the liquid to be filtered contains free acid or alkali, or a very fine precipitate, or is very dense or hot, a double filter should be used. In the case of plain filters, they should be arranged as in Fig. 288. If plaited, two sheets of paper should be taken and folded as if they were single. A filter may be also strengthened by placing a small capping filter or plain filter, a piece of well washed linen or muslin folded like a plain filter, or a plug of absorbent cotton, into the funnel before introducing the filter. In analytical operations the apex of the filter is usually supported by means of a small cone made of perforated sheet platinum. The apex is always the weakest, the most exposed, and yet the most important part of the filter.

Fig. 302



Plaited filter, parallel folds

Fig. 303



Plaited filter, inside view

4. In pouring the liquid into the filter, the stream should never be delivered directly upon the apex, but upon one of the sides, so that the force of the fall will be broken before the weakest point is reached.

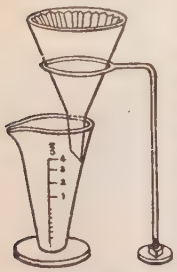
5. The filter should be entirely within the funnel. If the edges of the paper project above the funnel, waste from evaporation of volatile liquids, also from the increased and unnecessary absorption due to the excess of filtering paper, ensues, and in addition an untidy and careless habit is encouraged.

6. If the receiving vessel is small, the end of the funnel should touch its side, so that the filtrate will trickle down its inside edge. By this expedient splashing will be avoided (see Fig. 304).

7. In filtering into a bottle, care should be taken to leave sufficient space between the neck of the funnel and the mouth of the bottle for the escape of

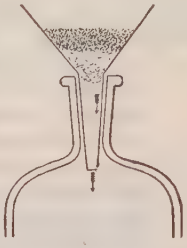
air, otherwise filtration will be retarded or prevented; a piece of twine placed between the two surfaces generally serves the purpose. *The end of the funnel should project below the lowest part of the neck of the bottle* (see Fig. 305). If the diameter of the end of the funnel is too large to admit of this, or if it is only half inserted, the filtrate will be very apt to fill the intervening space and flow over the outside of the bottle, as shown by the arrows in Fig. 306.

Fig. 304



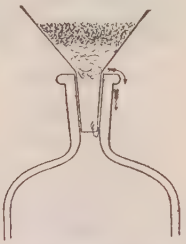
Arrangement of funnel in filtration

Fig. 305



Filtering into a bottle (proper method)

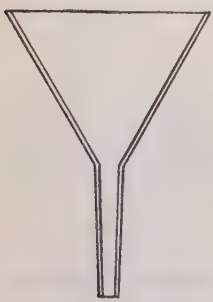
Fig. 306



Filtering into a bottle (improper method)

Funnels, sometimes called *tunnels*, are conical shaped utensils intended to facilitate the pouring of liquids into narrow mouthed vessels, and, they have also an important service to perform for the pharmacist in supporting filters, as just described. Funnels are made of tinned copper, tinned iron, hard rubber, porcelain, queensware, granite or agateware, earthenware, or glass. Metallic funnels have an advantage in point of durability over porcelain and glass, but a disadvantage in being acted upon chemically by liquids and in being more difficult to clean. The triangle formed by the sides of a funnel, and the line joining them, should be equilateral (see Fig. 307). The angles being each 60°, a funnel having this shape will accurately support a plain filter made in the usual way. Funnels are frequently fluted, grooved, or ribbed on the inside for the purpose of facilitating the downward flow of the filtrate (see Fig. 308), or wire frames, either fixed or folding, are arranged in a funnel with the same object. These aids are of doubtful utility, however, while the tendency of the raised ribs is to form a lodgement for foreign substances. *A well made plaited filter* in a plain funnel will perform as much work in the same time, and if the habit is once formed of always carefully and skilfully folding a filter, its importance in saving time and labor will be appreciated ever afterwards. Some of the glass funnels in the market have an improvement in the neck, which, instead of being round, is triangular or grooved. The necks of some copper funnels are similarly grooved. A copper funnel made by H. Sherman, of Philadelphia (see Fig. 309) has a square shaped outlet and is specially efficient. These devices permit the free escape of air from the interior of the bottle, and are superior to the indistinct groove often made on the neck of some glass and porcelain funnels. Plain *glass funnels* are more generally useful to the pharmacist than any other kind. They are readily cleaned, and dirt upon them may be easily seen. They are very useful as percolators, and the whole process of filtration or percolation may be observed

Fig. 307



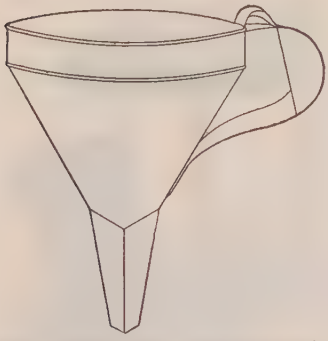
Plain funnel

Fig. 308

Ribbed funnel

without trouble. Their chief disadvantage is the ease with which they are broken. The next in value from the standpoint of usefulness is the tinned-copper funnel. *Copper funnels* are far superior to those made from tinned iron, and the difference in cost is greatly in favor of tinned copper, if true economy is considered (see Fig. 310). They must never be used for acid or alkaline liquids, however, and they really have a very limited use except for transferring hydro-alcoholic solutions of vegetable drugs from one container to another. *Hard*

Fig. 309



Tinned copper funnel with square neck

Fig. 310

Tinned copper funnel

Fig. 311

Hard rubber funnel

rubber funnels are light in weight, and are not very easily broken, for they may be even dropped upon the floor without injury (see Fig. 311). They are not acted upon by chemical substances, and with ordinary care will last a lifetime. They lack one advantage of those made from glass, however, in the absence of transparency. A hard rubber funnel divided to hold a strainer may be used at the dispensing counter (see Fig. 305). Porcelain, or queensware, funnels are of course, not transparent, and they have the disadvantage, at least in the larger sizes, of being heavy. They are, however, not affected by liquids, but their advantages over glass are so slight (being somewhat less fragile) that they are not often employed. Earthenware funnels, if well glazed, are very useful in filtering *hot liquids*. Enameled funnels, called granite or agateware, etc., are made from sheet iron having the surface entirely covered with a glazed composition which resists the action of most chemical substances. If carefully used, they serve many purposes. Their greatest objection arises from the brittleness of the enamel, which is apt to chip off if the funnel is dropped upon the floor or subjected to a blow, and at the point where the neck of the funnel is joined to the body, the enamel coating is so thin that by constant use it is soon chipped off, the exposed iron quickly rusts, and the neck breaks off. Tinned iron funnels which are frequently used, are popular because of their cheapness; but it is quite possible for a pharmacist to ruin in one operation a preparation worth ten times the cost of the funnel by filtering it through a tinned iron funnel and allowing it to come in contact with the iron exposed by the wearing off of the tinned surface.

Fig. 312

Funnel stand

Fig. 312 shows a funnel stand useful for small filtering operations in the

laboratory or at the prescription counter; the two long-stemmed funnels are of the type used in chemical work. This type permits more rapid filtration by the increase of weight of the liquid in the longer stem. Retort stands (see Figs. 184 and 186) are frequently used as funnel stands.

Fig. 313 shows a funnel designed for filling bottles, in which the flow of the liquid is controlled by the valve operated by the thumb. This is convenient when filling bottles arranged in rows, and if carefully used the bottles need not be soiled on the outside through overrunning, and the quantity in each bottle may be accurately adjusted.

Fig. 313

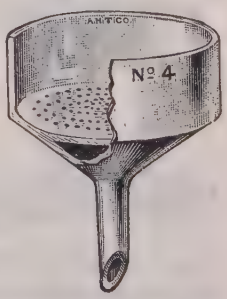
Valve funnel

Fig. 314

Kiefer glass tray filter

When funnels are used as supports for the filtering paper in the process of filtration, only a small portion of the paper, mostly the apex of the folded filter, is in action at one time. Figure 314 shows Kiefer's glass tray filter consisting of a square, shallow glass dish with flat perforated bottom, resting in a slightly larger tray, but supported in such a position as to allow space between the two vessels. A square, unfolded filter paper is placed upon the perforated bottom and moistened, after which the liquid to be filtered is poured into the dish, or, admitted from an inverted bottle containing the liquid. In this way a constant level of liquid is maintained over the filter bed, and no decrease either in pressure or in available filtering area occurs, as when a funnel is employed. A drawback to this form of filter, however, lies in the added space required for its operation. It is important to use the ground-glass cover to avoid excessive evaporation.

Fig. 315



Buchner funnel

The *Buchner* type of funnel (see Fig. 315), is largely used today in pharmaceutical laboratories. A piece of round filter paper is laid on the perforated porcelain diaphram and filtration may be conducted either with air pressure applied to the surface of the liquid on the filter or through application of a vacuum to the receiving vessel.

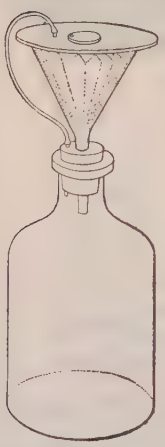
Continuous Filtration—Most of the expedients used in continuous washing (see page 189) are applicable to continuous filtration.

Filtration of Volatile Liquids—It is evident that the ordinary methods of filtering liquids will not be practicable for very volatile liquids, because of the loss through evaporation, and the liability to explosion, in the case of inflammable volatile liquids, if brought in contact with a flame. Funnels must be covered, and provision made for the escape of the confined air in the receiving

vessel. The following method is preferred to the elaborate expedients usually recommended. A bent glass tube is arranged in a glass or metallic funnel, so that the tube will lie close to the side of the funnel and allow one end to project above the filter, but not above the edge of the funnel. It may be held in its place by a ring of absorbent cotton gently thrust into the throat of the funnel, or a rubber cover perforated to admit a tube is placed on top, and connection between the bottle and funnel effected as shown in Fig. 316.

Among many other devices to obviate the use of open funnels, from which much evaporation is liable to occur, especially in the filtration of alcoholic liquids, the type of filter known as the monopad filter, and manufactured by the Karl Kiefer Machine Co., Cincinnati, is recommended (see Fig. 317). It requires but a moment to renew the filtering sheets. There are no rubber gaskets or wire screens, just a top and bottom plate which are easily cleaned and any grade of filter paper can be used. It is substantial, compact, easily handled, and may be carried from place to place.

Fig. 316



Filtration of volatile liquids

A quart, a gallon or hundreds of gallons can be filtered through this filter. All parts of the filter that are in contact with the liquid are made of bronze and when so desired may be heavily silver-plated.

Fig. 317

Monopad filter

Other Filtering Media—Many devices have been advanced to replace filter paper, which, it must be admitted, has many disadvantages, particularly for use on the large scale. In the modern pharmaceutical laboratory one may see a great many variations of filtering processes, each designed to fit the needs of special cases. The filter press, the centrifugal filter, the vacuum filter, the sand bed filter, the charcoal filter, paper-pulp filter, porous porcelain filter, all may be seen, each applied to its special purpose. Each one of these possesses some advantageous quality, and it is the working experience of the laboratory operators that guides them in their selection of appropriate filtering devices. Reference is made later in the text to many of these special large scale filters.

However, it will not be inappropriate here to refer briefly to special filtering devices which may be useful in the small laboratory or at the prescription counter.

Cotton Filters—A small pledget of absorbent cotton, loosely inserted in the neck of a funnel serves well to remove large particles of extraneous material from a clear liquid. Although this might be properly termed colation, the cotton can also be used to serve as a most efficient filter. It is sometimes necessary to return the liquid a number of times to secure perfect transparency. This should be remembered in filtering eye lotions through cotton, when small detached filaments are carried through at first.

Asbestos and Glass Wool Filter—Where strongly active chemical solutions such as acids or alkalies are to be filtered, filter paper cannot be used. In its place either asbestos or glass wool may be used as one uses absorbent cotton for filtering. These two substances are resistant to ordinary chemical action

and when properly packed into the neck of a funnel constitute very effective filtering media.

Stoneware Filters—For small and large scale filtrations there are available many patent varieties of porous stoneware filters. These are peculiarly effective for some purposes, their special advantage being derived from the fact that they may be cleaned by igniting them to red heat, thus destroying organic matter, or by treatment with strong acids, to which they are highly resistant. Special porous filters are used for removing bacteria from liquids. They are usually made of diatomaceous earth and answer the most exacting requirements of filtration, removing even the most minute bacteria (see Fig. 318).

Fig. 318

Candle filter, Berkefeld type

Alundum Filter—This kind of filter is made of an aluminum silicate in the form of dishes or crucibles and replaces the Gooch crucible for collecting the finest precipitates, no asbestos being necessary. (See Fig. 319.) It is patented.

Fig. 319

Alundum filter

Sand Filters—This type of filter is used on a large scale only, such as in the municipal purification of drinking water. A large bed of properly proportioned layers of sand, stone, and gravel constitutes the filter through which the great bulk of water passes on its road to purification. These filters are materially aided in their water-purifying efficiency by the action of bacteria in the filter bed.

Aids to Filtration—It has long been known that the addition of an insoluble absorbent powder or other material to a liquid prior to its filtration greatly increases the efficiency of the process. Purified talc, siliceous earth (or kieselguhr), clays, charcoal, paper pulp, chalk, magnesium carbonate, etc., have been used for this purpose. There are also proprietary compounds, such as *"filter-cel"* and *silica gel* which are so used.

It must not be overlooked, however, that powdered substances employed for such purposes must be insoluble and inert and not all of the foregoing list of substances are applicable for general filtration purposes.

Talc is non-adsorbent and is a safe medium for filtering any liquid without fear of depreciating its value, if it has been purified for this special purpose and provided it is not the impalpably fine variety which will pass through the filter paper. The U. S. P. directs that, as a filtering medium, purified talc should not be finer than the powder which passes through a No. 80 sieve but is retained by a No. 100 sieve.

Kieselguhr is almost pure silica (SiO_2). It is as generally applicable as talc for general filtration purposes, with no danger of removing active constituents by adsorption.

Siliceous earths of the type of *clays*, such as fuller's earth or kaolin when in the hydrated form, which always occurs when they are brought into contact with aqueous liquids, are safe for general use only in filtering fixed oils. Liquids containing coloring matter or alkaloidal principles must not be filtered through these media, for adsorption of both color and alkaloids occur and the liquid is depreciated in value.

Wood charcoal is a decolorant and deodorant, and *animal charcoal* possesses adsorptive properties, not only toward alkaloids but toward some glucosides

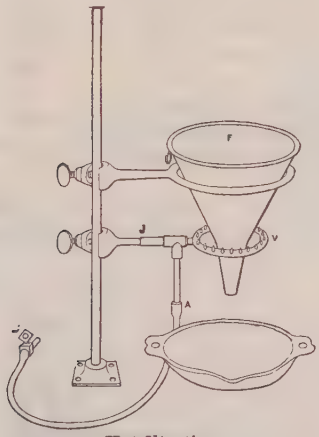
and bitter principles as well. It should never be used as a filtering medium unless the removal of such constituents is desirable.

Chalk and *magnesium carbonate* are readily attacked by acids and are slightly dissolved by aqueous liquids with the production of alkalinity in the filtrate. This is particularly true of magnesium carbonate, in which the degree of alkalinity communicated to the filtrate is sufficiently great to cause precipitation of alkaloids. Either of these media, when added to an alkaloidal preparation prior to filtration, will precipitate and remove all of the alkaloidal constituents. Neither of these media is suitable for general use.

A study of the foregoing facts makes it apparent why care should be exercised in the selection of a filtering medium where the choice is left to the pharmacist.

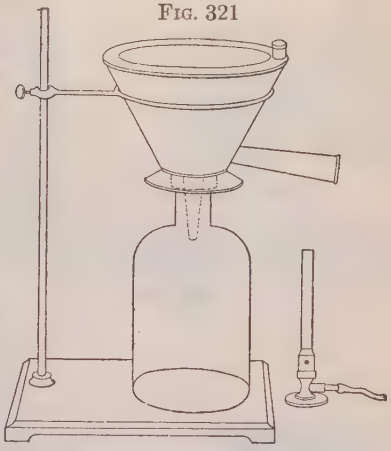
Hot Filtration—This process is not resorted to as frequently as it might be with advantage, because of the difficulties which are asserted to attend it.

FIG. 320



Hot filtration

FIG. 321

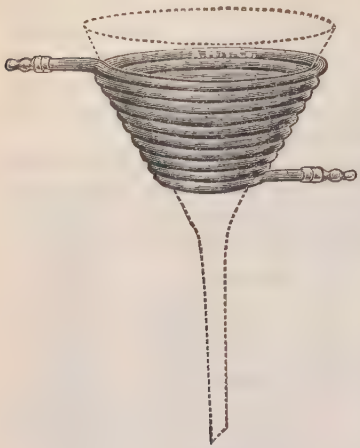


Jacketed hot water funnel

These have been greatly overestimated, for by the use of simple, properly contrived apparatus many preparations which heretofore have been dispensed, bearing an unsightly cloudy appearance, can be greatly improved. Yellow wax is frequently full of mechanical impurities; ordinary straining will not remove these, but by the application of heat it may be filtered through paper and thoroughly purified. Jellies, benzoinated lard, petrolatum, cerates, ointments, etc., may thus be filtered. One of the simplest and most easily managed forms of apparatus (see Fig. 320) is made by filing off the ring from one of the ring supports of a retort stand, *J*, and slipping on to the arm a brass circular jet, *V*, attached to a tee carrying the gas supply pipe, *A*. A tinned copper or tinned iron funnel is supported by an appropriate ring at a suitable distance above the jet. The filter is placed in the funnel, a receiving vessel adjusted below, and the hot liquid poured into the filter. It is plain that the liquid can be heated to almost any degree, and the filtration conducted at a much higher temperature (if need be) than by the jacketed hot water funnel (see Fig. 321), and, on the other hand, the heat may be regulated so that it will be very moderate. The hot water funnel is an old device, and consists simply of a jacketed funnel having a wide tube soldered at the lowest point, and an opening in the upper edge for the water supply. A burner or lamp flame will heat the water contained in the jacket, and a regulated heat not exceeding that of boiling water is obtained.

Fig. 322 shows another form of funnel to be used for hot filtration; the coil of pipe may be used for steam or hot water, by connecting it with a suitable supply.

Fig. 322



Funnel in coil

Rapid Filtering Apparatus—Much attention has been given to methods for increasing the rapidity of filtration. This may be accomplished by introducing pressure upon the filter or by creating a vacuum in the receiving vessel.

Vacuum Filtration — One of the first practical efforts made to create a vacuum to aid filtration was by means of the Bunsen pump. The action depends upon the principle that a column of water descending through a tube from a height is capable of sucking with it the air contained in a lateral tube, if the latter is properly placed. This form of aspirator is only practicable where water pressure is available.

Fig. 323

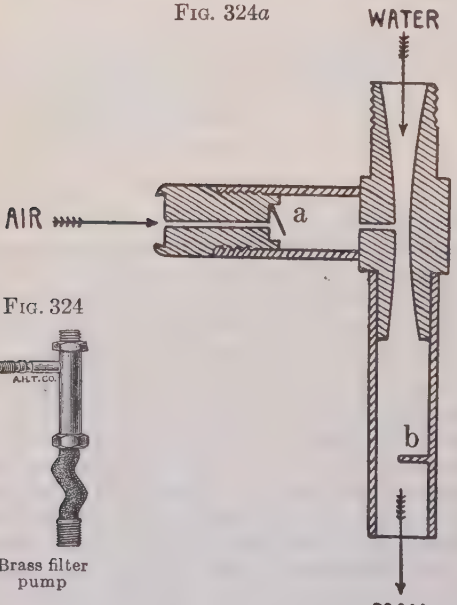
Glass filter pump

Water Pumps Acting by Pressure—The varieties of aspirator or vacuum pump which operate under the influence of water pressure are all based upon

Fig. 324

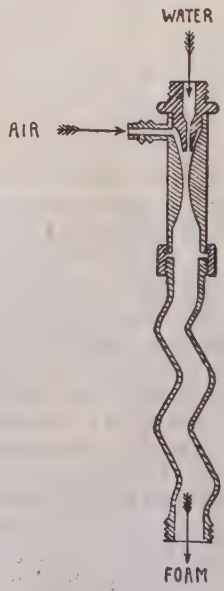
Brass filter pump

Fig. 324*a*



Chapman's pump

Fig. 325

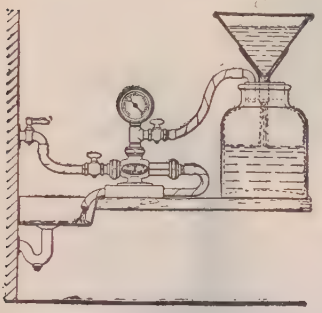


Richard's pump

the same principle. The following are selected from the great variety in use as being good illustrations. Fig. 323 shows a filter pump of glass, although the glass variety is not recommended because of its extreme liability to break-

age. Fig. 324*a* shows Chapman's vacuum pump. The valve at "*a*" prevents the water from flowing into the bottle which carries the filter when the pressure of water ceases or is reduced. Figs. 324 and 325 illustrate Richard's pump, largely used in analytical laboratories for hastening filtration. The zigzag form of the tube serves the same purpose as the projection in the lower portion of the outlet tube of the Chapman pump, *i. e.*, to break the direction of the solid stream of flowing water and assist in drawing the air from the bottle.

Fig. 326



Method of using filter pump

Fig. 326 shows a very efficient form of filter pump capable of exhausting a one gallon vessel, to produce a twenty-nine and one-half inch vacuum in ten minutes with a ten pound water pressure.

Fig. 327

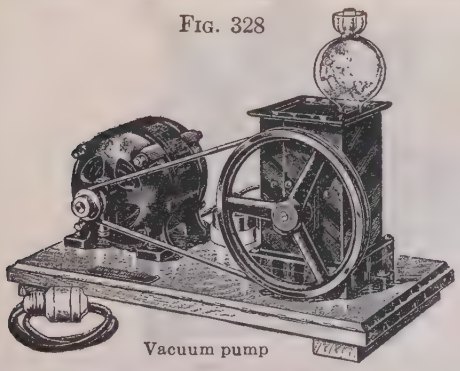
Vaccu-filter

The vacuum filter (see Fig. 327) obtainable from the Alsop Engineering Company, provides an inexpensive and rapid form of vacuum filter, in which filter paper or felt may be used. It has the added advantage of preventing evaporation and of being made of nickel-plated brass, and is non-corrosive. The filter may easily be taken apart and cleaned.

On a larger scale the vacuum for filtration is produced by one of the many forms of vacuum pumps now available. An excellent form for laboratory use is made by the Central Scientific Company. (See Fig. 328.)

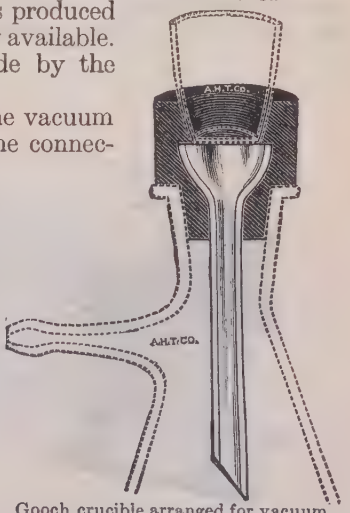
In assembling a filtering apparatus, using the vacuum principle, it is necessary to have no leaks in the connections from the filter to the aspirator. If filter paper is used in connection therewith, a plainly folded paper must be used and its tip must be protected against breakage by reinforcing it with a filter paper support or some other device, or a Buchner filter may be used employing a specially strong filter paper.

Fig. 328



Vacuum pump

Fig. 328*a*

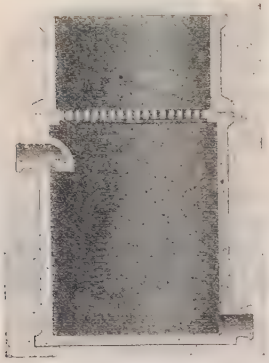


Gooch crucible arranged for vacuum

In analytical work it is customary to use the Gooch crucible and flask (see Fig. 328*a*) for rapid filtration. The flask, of especially thick glass, is provided with a side tube which is to be connected with the vacuum pump

The perforated crucible bottom is converted into a filter bed of extreme fineness by means of a layer of asbestos fibers prepared by pouring upon the porcelain base a suspension of these fibers in water. It is to be noted that in analytical work the residue left upon this filter bed is generally of more importance than the filtrate.

Fig. 329



Stone crock for filtration

Fig. 330

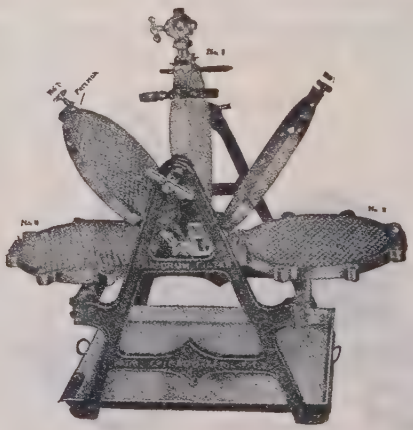
International filter

The principle of vacuum filtration is also applied on the large scale through the use of a perforated diaphragm arranged in a barrel or crock. Paper pulp which has been thoroughly steamed is packed on the porous diaphragm and forms a very efficient filter bed for many pharmaceuticals. The filter may

Fig. 331

Monocell filter

Fig. 332



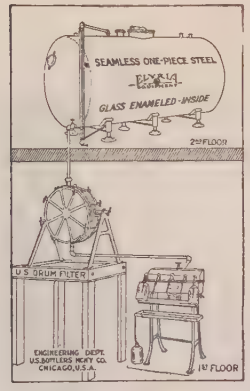
U. S. Drum filter

also be formed from plates of porous stoneware and "chinked" with asbestos fiber when corrosive liquids are to be filtered. This is especially rapid if a vacuum is applied. The stone crock made by Maurice A. Knight, of East Akron, Ohio, provides an excellent apparatus (see Fig. 329).

Filtration Under Pressure—Fig. 330 illustrates a form of laboratory filter for use when a large quantity of the same liquid is to be filtered. It is made by

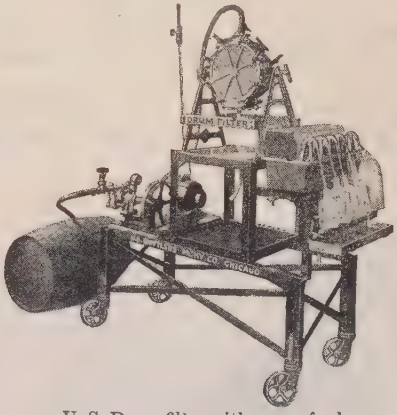
the International Filter Co., of Chicago. A sheet of filter paper is placed between the upper and lower porous disks, which are then clamped together, and the liquid to be filtered is forced upward, through the filter. Pressure from gravity or a pump is applied to increase the rapidity of filtration.

FIG. 333



U. S. Drum filter with gravity feed

FIG. 334

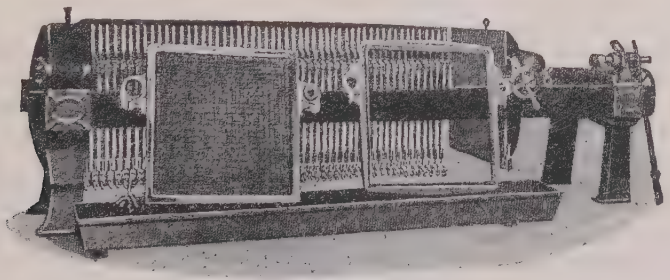


U. S. Drum filter with pump feed

A similar filter known as the monocell filter is illustrated in Fig. 331 and is made by the Karl Kiefer Company. This filter employs a paper sheet or cloth pad and may be used with from two to fifty pounds pressure.

The U. S. Drum Multiple Disc Filter, sold by the Illinois Glass Company, is illustrated in Fig. 332. Cloth filter disks or paper filters may be used and it is readily opened and cleaned. Fig. 333 illustrates a gravity feed arrangement with bottle filler, and Fig. 334 the same Drum filter and a bottle filler fitted with a pump feed.

FIG. 335



Filter press

Another type of pressure filter designed for large scale filtration is shown in Fig. 335. This filter is made by T. Shriver and Company, Harrison, N. J., and serves as an example of the filter press which finds use in the large manufacturing establishments. It may also be procured in small experimental size and made of various materials, such as wood, iron, bronze, tin, aluminum, monel metal, etc., to suit all needs.

The Vallez rotary filter is another form mostly employed upon the large scale, although small outfits suitable for a pharmaceutical laboratory are

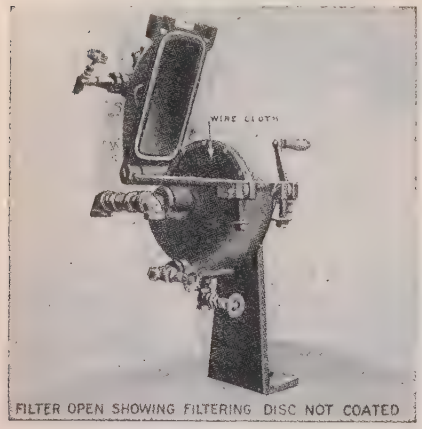
available. The filter plate may be covered with monel metal, nickel, or phosphor bronze sieves. The filtering medium, paper pulp or kieselguhr, covers the sieve to increase the efficiency of the filter. (See Fig. 336.)

The Karl Kiefer Machine Company, of Cincinnati, also manufacture a pulp filter which may be operated with from one to ten filtering plates. This very efficient filter (Fig. 337) requires cotton pulp as the filtering medium and is especially suited for clarifying fruit juices, syrups, perfumes, etc. Smaller forms may be procured.

Centrifugal Filtration—This principle has been applied to the filtration of pharmaceutical products where large quantities of liquids require clarification. In the rotating bowl of the Sharples Laboratory Super-Centrifuge, made by the Sharples Specialty Company, of Philadelphia (see Fig. 338), which revolves at the rate of 40,000 revolutions per minute, a separating force of approximately 40,000 times the force of gravity is applied to the liquid under treatment. The suspended solid particles from the cloudy liquid collect on the inside surface of the bowl and the resulting clear filtrate is continuously discharged through the spout. It is necessary to remove the sediment from the bowl of the machine from time to time.

Centrifugal filters are also manufactured by the DeLaval Separator Company, of New York, and other companies.

Fig. 336

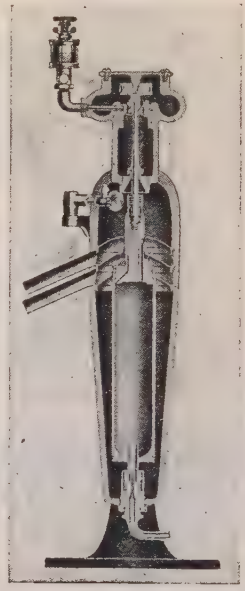


Vallez rotary filter

Fig. 337

Multiple pulp filter

Fig. 338



Sharples centrifugal filter

CHAPTER XVII

CLARIFICATION AND DECOLORATION

CLARIFICATION is the process of separating from liquids, *without the use of filters or strainers,* solid substances which interfere with their transparency. The processes of clarification and decoloration from a pharmaceutical point of view and on the small scale have declined in importance of late years, owing to the fact that chemical and other substances requiring the processes are supplied in a purified condition so cheaply that it is impossible for the pharmacist to compete with the manufacturer who operates on the large scale and uses apparatus and methods which are thorough and economical. This is particularly true of sugar and of the alkaloids. Formerly the apothecary bought raw sugar and clarified the syrup; now the difference in price between raw sugar and pure sugar is so slight that official syrup is never made from raw sugar. The decoloration of alkaloidal solutions and the manufacture of alkaloids cannot be attempted on the small scale by the pharmacist because of economic conditions. It is, nevertheless, very important to comprehend thoroughly the principles underlying both processes, as emergencies may arise when such information would be of great value.

Clarification may be effected in several ways:

1. By the application of heat or by otherwise increasing the fluidity of the liquid. 2. By the use of albumen. 3. By the use of gelatin. 4. By the use of milk. 5. By the use of paper pulp. 6. By fermentation. 7. By subsidence through long standing.

1. *By the Application of Heat*—When a viscid liquid is heated its specific gravity is diminished, and usually particles which are suspended in it, and interfere with the transparency of the liquid, will separate, the heavier ones falling to the bottom, and the lighter ones rising; in the latter case, ebullition facilitates the separation, the minute bubbles of steam becoming enveloped in the viscid particles rise through their buoyancy, and a scum is formed which may be readily separated. The process formerly official for the clarification of honey (Mel Depuratum) is a good illustration of the use of heat in this connection.

Clarification may also be effected by *increasing the fluidity of the liquid* in other ways. The specific gravity of the liquid may be decreased by the addition of water, alcohol, or other liquid lighter specifically than the one to which it is added; this causes the suspended particles to deposit, and the clear liquid may then be decanted.

2. *The Action of Albumen*—The property possessed by albumen of undergoing solution at ordinary temperatures and becoming coagulated by heat renders it one of the most useful substances that can be employed in the process of clarification. Its action is mechanical, and where albuminous principles exist naturally in the liquid, as in many fruit and vegetable juices, the simple heating of the liquid suffices to coagulate the albumin, which envelops the particles that render the liquid cloudy, and these rise to the top and are skimmed off. Albumen, or white of egg, is frequently added to liquids to clarify them; in such cases it should always be added before the liquid is heated. This is best accomplished by adding about an equal bulk of the liquid to the albumen, then pouring the mixture onto a muslin strainer and squeezing

it through the meshes of the cloth by gathering up the corners and spirally twisting the strainer, when the structure of the albumen is destroyed, and a smooth mixture results; the strained solution is then added to the liquid to be clarified, and the whole heated gradually (usually until it boils), without stirring, until coagulation is effected. In most cases the white of one egg is sufficient for a gallon of liquid. The error most frequently made by operators is the use of an excess of albumen. Care must be exercised in the employment of albumen as a clarifying agent where the active principle of a liquid forms a precipitate by combining with it, as would be the case with phenols, heavy metals, etc.

3. *The Use of Gelatin*—Gelatin is used when tannin is present, whether or not it is the cause of the cloudiness which it is desired to remove. Its action depends upon the fact that gelatin forms with tannin an insoluble compound which is the basis of leather. Isinglass or fish glue, as it is sometimes called, one of the purest forms of gelatin, is preferred by some users of the method. Gelatin is used by adding a weak solution of it in hot water, about 1 or 2 per cent, to the liquid and then allowing it to stand. After a short time a flocculent precipitate forms which gathers together the particles causing the turbidity. The insoluble compound formed must always be strained or filtered out. An ounce of gelatin will suffice for clarifying a barrel of wine and it is the preferred medium for this purpose. The operation is called "*fining*".

4. *The Use of Milk*—The presence of casein in milk, and the fact that acids precipitate it in the form of a curdy precipitate, are taken advantage of in the use of milk as a clarifying agent. It is employed particularly for the clarification of wine, but should not be used in excess. A half pint of milk suffices to clarify a barrel of wine. Milk is also applicable where tannin is present and in such cases forms an insoluble precipitate, as does gelatin.

5. *The use of paper pulp* does not depend upon chemical combination, its action is purely mechanical. Paper pulp for filtering is best prepared by placing unsized paper, such as white blotting paper or white filter paper, into a mortar or other suitable vessel, and pouring enough solution of sodium or potassium hydroxide on it to saturate it, then stirring it with the pestle until it is reduced to a pulp. This should then be washed by placing a loose plug of absorbent cotton in a funnel and pouring in the mixture. When it has drained, hot water should be poured upon it until all traces of alkalinity are removed; the dried purified pulp may then be placed in stoppered wide-mouthed bottles until needed. Paper pulp for filtering may also be purchased ready for use. It is preferable to soften it by heating with a jet of live steam. It is used as a clarifying agent by adding a portion to the cloudy liquid, agitating the mixture and allowing the whole to stand quietly until the liquid is clear.

6. *By Fermentation*—The changes in the composition of juices during fermentation usually lead to the deposition of those substances which previously interfered with their transparency. The generation of alcohol through fermentation produces a liquid in which the substances causing turbidity are insoluble, hence the formation of the deposit. The preparation of syrup of raspberry (N.F.V.) affords a good illustration of the principle of clarifying juices by fermentation, while in the manufacture of wines the principle has been known and practiced for centuries.

7. *By Subsidence through Long Standing*—This method involves the least possible amount of labor and expense, and is resorted to very frequently (particularly upon the large scale) when haste is unnecessary, and whenever the liquid readily withstands the tendency to spoil during the time necessary to effect complete separation. The deposit formed is usually called a *sediment*. In some industries it is termed a "*sludge*". These terms are

not synonymous with *precipitate. A sediment is solid matter separated merely by the action of gravity from a liquid in which it has been suspended. A precipitate, on the other hand, is solid matter separated from a previously clear solution by physical or chemical change.* The fixed oils are usually clarified by subsidence; in the vegetable oils the sediment consists principally of albuminous and gummy substances, cellular tissue, and water which have been separated with the oil during the process of expression.

Decoloration or *decolorization*, as it is sometimes called, is *the process of depriving solutions of color by the use of an appropriate medium. Animal charcoal* is the most widely used decolorizing medium, while *kaolin, fuller's earth, and other clays are employed for special purposes.* Decoloration is used in the abstraction of coloring matter from fats, oils, petrolatum, syrups, etc. Animal charcoal, or bone black, which is produced by heating bones in closed vessels out of contact with air, and then grinding the resulting charred mass, is generally preferred in decolorizing operations. Wood charcoal possesses much less decolorizing power. The selective removal of color from liquids passed over or through them, by certain charcoals and clays, is an *adsorption* phenomenon and will be found extensively discussed in books on colloidal chemistry. Animal charcoal varies greatly in its decolorizing power. Purified animal charcoal is not so powerful as a decolorizer as the crude animal charcoal from which it was made (see filtering media, page 204). The inorganic matter (calcium salts) present in crude animal charcoal is capable of causing contamination of some kinds of solutions, particularly those which are acid, and it is sometimes necessary to use purified animal charcoal even though it possesses a lower degree of efficiency. The animal charcoal which possesses the greatest efficiency as a decolorizer is produced by carbonizing dried blood. For other information about the properties of charcoal, see *Carbo Animalis* and *Carbo Animalis Purificatus,* U. S. Dispensatory, 21st edition. For most decolorizing operations of the pharmacist on the small scale, the solutions, melted fats, oils, etc., can be poured directly upon the animal charcoal, which is placed in a funnel and prevented from passing through by the insertion of a plug of absorbent cotton, or it may be arranged in an ordinary percolator, and the cold liquid percolated through the charcoal. It is not satisfactory simply to shake the charcoal with the liquid and subsequently filter, as is done with clays which are used as decolorizing media. The deeper the layer of charcoal through which the liquid must pass, the greater the efficiency of the operation.

Clays are used as decolorizing agents by mixing them intimately with the liquid to be decolorized and, after allowing them to stand for a time, filtering to remove the clay. The removal of the color by the clay is also due to adsorption (see Colloids). It is very important to remember that both charcoal and clay absorb a number of valuable principles used in medicine,—*e.g., bitter substances,* like gentiopicrin, aloin; *astringents,* like tannin; *alkaloids,* like quinine morphine, strychnine, etc. (see Filtration, page 204). Charcoal has even been used as an antidote for poisoning with the alkaloids. It should always be used, in decoloration, with discrimination and judgment, for it may be found that in striving to improve or restore the appearance of a preparation by lessening the color its value has been sacrificed. John Uri Lloyd has demonstrated that aluminum silicates in the form of kaolin, fuller's earth, or especially prepared hydrous aluminum silicate, even when simply shaken with solutions of alkaloids, completely remove them from solution. These substances should therefore never be used as filtering or clarifying agents for alkaloidal preparations. This action of aluminum silicate is now applied to the commercial separation and preparation of alkaloids.

CHAPTER XVIII

SEPARATION OF IMMISCIBLE LIQUIDS

The separation of liquids which are mutually soluble is usually effected by distillation, if one or both of the liquids are volatile (see page 131); but the separation of liquids which do not mix with each other is generally a simpler process, and the object of this chapter is to show the methods at present in use.

Separations of this kind are necessary in—1. Alkaloidal assaying. 2. Manufacturing operations. 3. Distillation of volatile oils. 4. Accidental contaminations and admixtures.

The Pipette—This instrument, which is usually employed for accurately measuring small volumes of liquids, has other uses as well. It consists of a narrow tube with its lower end drawn out to a capillary orifice. To increase its

Fig. 339 Graduated pipette

Fig. 340 Measuring pipette

Fig. 341 Pipette (sheet rubber top)

Fig. 342 Glass syringe

Fig. 343 Open separatory funnel

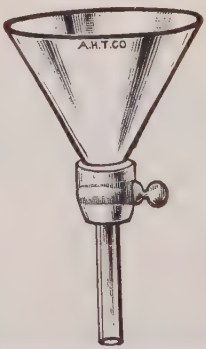


Fig. 344 Pear shaped separator

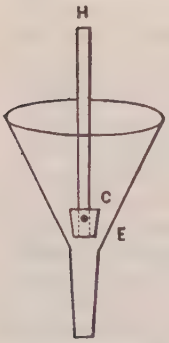
capacity the diameter of the middle portion is often increased, or a bulb, either globular or elongated, is blown in it near the top. Small amounts of liquids floating upon the surface of other liquids may usually be separated by the careful use of a pipette. The lower orifice is dipped into the liquid that is to be separated and suction applied with the mouth at the upper end; the liquid rises, fills the bulb, and if the end of the moistened forefinger is applied to the top, the liquid may be transferred to a more appropriate receptacle. Figs. 339 and 340 show two forms of the instrument. A useful kind of pipette may be made of a thistle tube with a piece of sheet rubber tied over the top (Fig. 341). If pressure is applied to the rubber, the air is partially expelled; if the point of the pipette is then applied to the liquid and the pressure relaxed, the liquid will rise, and it may be transferred to another vessel. In a modification of this, a rubber bulb is attached to the pipette and used in a similar manner. A medicine dropper may be used for very small quantities.

A glass syringe (see Fig. 342) is very useful in collecting a small quantity of oil floating on top of a liquid contained in a beaker or open vessel. The piston of the syringe should be well soaked in warm water before attempting

this simple but delicate operation. A soft rubber ear syringe or infants' rectal syringe is also useful in some cases.

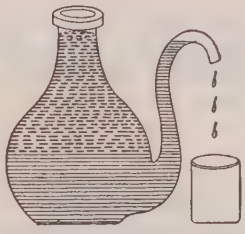
A separatory funnel, as indicated by its name, is used to facilitate the separation of immiscible liquids. An open funnel having a glass stopcock in its neck is illustrated in Fig. 343. The mixed liquid is poured into the funnel, which is kept at rest until separation takes place, then the lower liquid is allowed to run off by opening the stopcock. With careful use, liquids can be separated with great accuracy in this way. Where the liquid is valuable or very volatile, as some of the oils, the closed separatory funnels, such as the pear shaped separator (Fig. 344), which can be securely stoppered and evaporation prevented, are preferred. In assay processes, when immiscible liquids are to be separated, this latter form is preferred, because of the narrowing of the lower portion and the line of demarcation between the liquids can be more accurately observed. Doctor Mitchell devised a cheap but efficient substitute for the separatory funnel for emergency uses (Fig. 345). A good, well pressed cork, *C*, is fitted into the throat of a funnel, *E*, and a wooden skewer, *H*, or other

Fig. 345



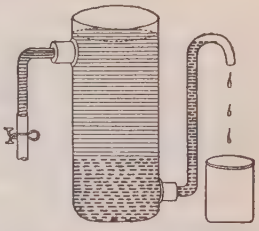
Mitchell's separator

Fig. 346



Florentine receiver

Fig. 347



Receiver for light and heavy oils

suitable wooden rod, is whittled to a flat wedge, and this forced tightly into the cork. The lower portion of the rod is notched, and the upper part of the cork is tied securely to it, or a wooden pin may be driven through it and the cork, to fasten it. It is used by forcing the cork *C* into the neck of the funnel, pouring in the liquids, and, when they have separated, lifting the handle *H* carefully until the lower liquid has entirely escaped, and then pushing it down to stop the flow.

Florentine Receiver—The separation of volatile oils from the water which usually accompanies them during distillation is a very important part of their process of manufacture. Where the volatile oil is lighter than water, the receiver shown in Fig. 346 is used. The mixed oil and water collect in the glass receiver during distillation, the oil floating on the top, while the water ascends the bent tube from the bottom; further addition of distillate causes an overflow, and the water from the bottom of the receiver is discharged through the tube into a suitable vessel, and this is continuous as long as the distillation proceeds. The reverse action can be produced in the receiver for light or heavy oils (Fig. 347) in which either a lighter or a heavier fraction may be continuously collected. The process of separation is continued automatically.

CHAPTER XIX

PRECIPITATION

Precipitation is the process of separating solid particles from a previously clear liquid by physical or chemical changes. The separated solid is termed a *precipitate;* the cause of precipitation, the *precipitant;* the liquid which remains in the vessel above the precipitate, the *supernatant liquid.*

The precipitate usually falls to the bottom of the vessel. It may, however, remain suspended or rise to the top.

The objects of precipitation in pharmacy are,—

1. As a convenient method of obtaining solid substances in the form of fine particles. Example, the precipitation of calcium carbonate.

2. To effect the purification of solids. Example, the preparing of precipitated calcium phosphate.

3. To observe by means of classified and carefully conducted tests the presence or absence of certain substances. Example, as in qualitative analysis.

One of the most important uses of precipitation is in testing, as it affords the most ready means of identifying chemical substances or of ascertaining their purity. A great many pharmacopœial tests are based upon this process. The color, quantity, and character of the precipitate are all taken into account. The terms *curdy, granular, flocculent, gelatinous, crystalline, bulky,* and others, which are sufficiently distinctive, are used to define the peculiar form which the precipitate assumes when thrown out of solution. A *magma* is a thick, precipitate left after the liquid is decanted. (See Magma Magnesiæ, Magma Bismuthi, etc.)

FIG. 348

Precipitating jar

Methods of Effecting Precipitation—Precipitation may be produced in many ways. The following are some of the causes of precipitation. If solutions containing albuminous matter are heated, a flocculent precipitate of coagulated albumin will be thrown down; while if solutions of the silver salts are exposed to the light, precipitation will take place. Precipitation will usually occur when a hot saturated solution of an amorphous substance is allowed to cool, as in the preparation of antimony oxysulphide, or when to a solution is added a liquid in which the dissolved substance is insoluble, as when strong alcohol is added to a small quantity of mucilage of acacia, or if water is added to an alcoholic solution of a resinous substance. Precipitation in the form of fine crystalline granules usually takes place when alcohol or alcoholic liquids are added to strong solutions of chemical salts.

Precipitation is generally caused by *chemical* reaction and some of the most interesting processes in pharmacy are the results of this method of producing it,

Vessels used in Precipitation—Precipitating vessels should be deep, comparatively narrow, and broader at the bottom than at the top (Fig. 348). This construction permits the precipitate to occupy less height in the vessel by causing it to spread out upon the bottom; thus the supernatant liquid can be more thoroughly decanted, the particles of the precipitate will lie in closer contact, and a better opportunity is given for the escape of imprisoned air or gas which frequently exercises a buoyant effect on the particles and prevents their subsiding rapidly and closely. Upon the large scale, cedar tanks, of the shape just described, may be used; these may have wooden spigots introduced, at

convenient distances apart, so that the supernatant liquid may be conveniently run off from different levels as the case may require. Large earthenware jars or glass-lined steel tanks are also used for the collection and washing of precipitates.

Manner of Conducting the Process—If two solutions are used, and it is known that they contain the exact molecular quantity of solid substance to react mutually without leaving an excess of one or the other, the rapidity with which the substances are mixed is immaterial though the physical character of the precipitate is sometimes affected by the speed of the reaction; but when this is not the case, and the precipitant is to be added until precipitation ceases, it is necessary to proceed with caution. The precipitant is then added gradually, and where acid or alkaline solutions are used and carbonates or bicarbonates are not present, litmus paper is useful in indicating the approach of an excess. In other cases the precipitate may be allowed to subside, and the precipitant slowly dropped into the clear liquid above until it is noticed that further addition is without effect. If the precipitate is too bulky to subside quickly, the whole may be vigorously stirred until thoroughly mixed, a small portion transferred to a small plain filter and the filtrate tested by a further addition of precipitant. If this small portion is weighed, or measured, or is a known proportion of the whole, a simple calculation will determine the quantity necessary to complete the precipitation. Ammonia water is one of the most useful of alkaline precipitants, because an excess is at once noticed by the odor. This is easily done by blowing the air from the surface of the liquid, thoroughly stirring up the mixture, and then noting whether it possesses an odor of ammonia.

The Production of Heavy and Light Precipitates—Hot, dense solutions usually produce heavy precipitates, and such precipitates are more readily washed from adherent contaminating salts than those which are light and bulky. An additional advantage is that they occupy less space, and consequently their dose is less bulky. A good example of this is found in the manufacture and use of the heavy and light magnesium carbonates. In many cases of precipitation the order of mixing the ingredients may be disregarded and either may be looked upon as the potential precipitant. This is not always the case, however, and it is particularly not true of precipitates caused by mixing solutions of iron salts with solutions of carbonates or hydroxides.

In this case the proper order is to pour the solution of the iron salt into the solution of the carbonate or hydroxide in order that the latter may be in excess at all stages of the operation, for, if the reverse is done, the first portions of the precipitate are partly composed of basic salts of iron which remain as a contamination.

When in doubt a safe rule to follow is to use as the precipitant the solution containing the electropositive element or group of the desired precipitate. Thus in precipitating lead sulphate pour the solution of the lead compound into the one containing the sulphate. In forming a precipitate which is a hydroxide always try to keep the hydroxide in excess to the end of the operation.

Collecting and Washing Precipitates—In small operations precipitates are collected upon plain filters or in a Buchner apparatus upon a flat filter. The special advantages of such filters have been already pointed out. (See page 202). Upon the large scale muslin strainers are generally used. These are suspended on frames, as shown in Figs. 283 and 284. In washing precipitates which are placed on strainers of this kind, care must be observed to close up the fissures which usually appear in the magma after it has been allowed to stand a short time, by stirring the precipitate thoroughly before adding more water. (See Lotion, Decantation, pages 189 and 190.)

CHAPTER XX

CRYSTALLIZATION, GRANULATION, AND EXSICCATION

Crystallization is the process whereby substances are caused to assume certain determinate forms termed *crystals*. These are distinctive and when perfect are bounded by geometrical surfaces. Crystallization is a molecular phenomenon and very frequently solids which have no external regularity of form or substances apparently in fine powder are in reality crystalline. Crystalline character is not always easily recognizable therefore, and sometimes requires the use of the microscope and polarizing apparatus to arrive at a definite decision. Those substances which are not in a crystallized condition are termed *amorphous*. The main object of crystallization is the purification of the substance. The descriptions of the crystalline forms assumed by bodies form the basis of the interesting science of *crystallography*. In a work of this kind it is impossible to more than briefly outline the basis for the classification of crystals, since the practical process of crystallization must receive the most attention. (See Bragg and Bragg's *X-Ray and Crystal Structure*, Walker's *Crystallography*, Mier's *Mineralogy*, and Rinne's *Crystals and the Fine Structure of Matter*, etc). Every crystallizable body invariably assumes its own characteristic form, or some form directly derived from it or related to it, and in order to classify them crystallographers recognize at the present time six systems, to one or the other of which every crystal is referred.

The plane surfaces bounding a crystal are termed *faces;* when two contiguous faces intersect, an *edge* is formed; an *angle* is formed when three or more faces intersect.

The faces, edges, or angles of a perfect crystal have equal faces, edges, or angles opposite to them, and if the middle points of the opposite faces or edges, or the opposite angles, be joined by straight lines, the point at which these lines intersect will be the centre of the crystal. The lines drawn through this point are called *axes* (the plural of the word axis).

When the same body crystallizes in two or more forms belonging to different systems, it is said to be *dimorphous, trimorphous, polymorphous,* etc. When different substances crystallize in the same form, they are said to be *isomorphous.*

Prismatic (or prism-like) crystals are those which are extended principally in the direction of their longest axis. *Tabular crystals* are those crystallizing in flat planes; *laminar,* those crystallizing in thin plates; *acicular,* those which are needle shaped, etc.

Other terms are used to describe the physical characters of crystals, which are readily understood and are not technical in their meaning.

The systems of classification are based upon the length and relative position of the axes of the crystal. Those in which the three axes intersect at right angles are termed *orthometric;* and when the angles caused by their intersection are oblique, they are called *clinometric.*

Systems in Crystallography

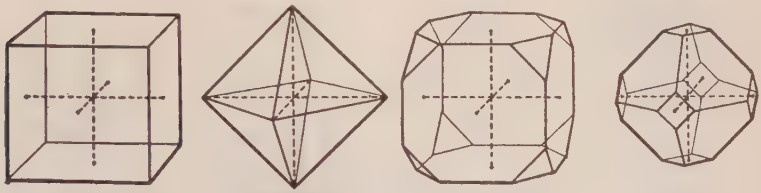
I. Monometric, Cubic, or Regular System—The crystals have three axes of *equal* length intersecting at right angles (see Figs. 349, 350, 351, and 352). Potassium and sodium bromides and iodides, sodium chloride, and the alums crystallize in the monometric system.

II. Dimetric, Tetragonal, or Quadratic System—The crystals have three axes, two of which are *equal,* the other *different* in length, all intersecting at right angles (see Figs. 353,

354, 355, and 356). Calomel, though rarely seen in crystalline form, belongs to this system of crystals.

III. Trimetric, or Rhombic System—The crystals have three axes of *unequal* length, all intersecting at right angles (see Figs. 357, 358, 359, and 360). The crystals of iodine, sulphur and zinc sulphate belong to the trimetric system.

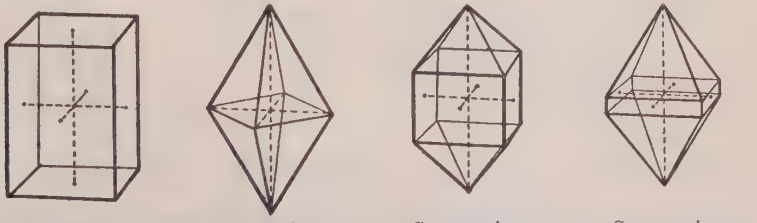
FIG. 349 FIG. 350 FIG. 351 FIG. 352



Cube Octahedron Truncated cube Truncated octahedron

IV. Hexagonal, or Rhombohedric System—The crystals have four axes, three of *equal* length, in the same plane, and inclined to one another at angles of 60°. The fourth axis is *different* in length, and intersects the plane of the three at right angles (see Figs. 361, 362, 363, and 365). Citric acid, silver nitrate, quartz, and calcium carbonate crystallize in the hexagonal system.

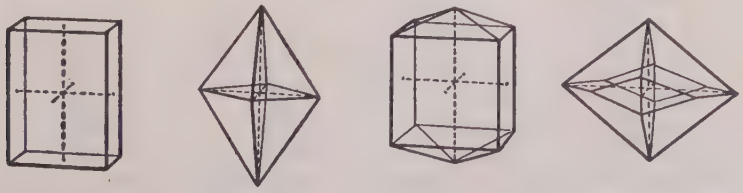
FIG. 353 FIG. 354 FIG. 355 FIG. 356



Right square or dimetric prism Dimetric octahedron Square prism, pyramidal summits Square prism, pyramidal summits

V. Monoclinic, or Oblique Prismatic System—The crystals have three axes of *unequal* length, two of which are obliquely inclined to each other, the other axis forming right angles with these two (see Figs. 365, 366, 367, and 368). Tartaric acid, lead acetate, potassium bicarbonate, sodium phosphate, sucrose, ferrous sulphate, and many other chemicals crystallize in this system.

FIG. 357 FIG. 358 FIG. 359 FIG. 360



Rhombic prism Rhombic octahedron Rhombic prism, pyramidal summits Rhombic octahedron (partially truncated)

VI. Triclinic, or Anorthic System—The crystals have three axes of *unequal* length, all obliquely inclined to one another (see Figs. 369, 370, 371, and 372). Boric acid, potassium dichromate, and copper sulphate are illustrations of the triclinic system.

Determination of Crystalline Form—The method of determining the position of a crystal in one or other of the systems above noted is to measure the inclination of the angles which the faces of the crystal make with one another. From the data obtained, the length and inclination of the axes are

calculated. A reflecting goniometer, such as Penfield's or of the Goldschmidt type, is used to measure the angles of larger crystals.

Most commercial crystals are not perfect examples of the system to which they belong, and are therefore difficult to classify. Methods of examining and

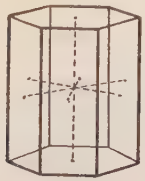


Fig. 361. Hexagonal prism

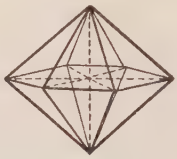


Fig. 362. Double hexagonal pyramid

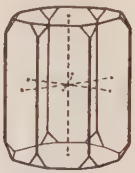


Fig. 363. Hexagonal prism (truncated)

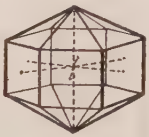


Fig. 364. Hexagonal prism, pyramidal summits

classifying crystals of microscopic size have been developed in recent years in the Bureau of Chemistry of the United States Department of Agriculture, by Edgar T. Wherry, who has made some remarkable and valuable discoveries in connection with this work.

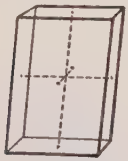


Fig. 365. Monoclinic prism

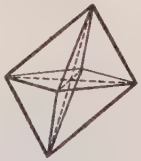


Fig. 366. Monoclinic octahedron

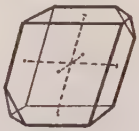


Fig. 367. Monoclinic prism (partly truncated)

Fig. 368. Monoclinic prism, pyramidal summits

In microscopic work the identification of plant tissues is frequently dependent upon the recognition of the crystals which are present. A special goniometer is attached to the microscope to obtain their measurements and characteristics.

Cleavage—If a crystal of potassium ferrocyanide or a piece of mica is broken and examined, it will be noticed that the cohesion of the particles is

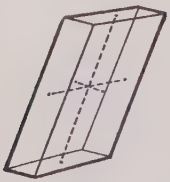


Fig. 369. Triclinic prism

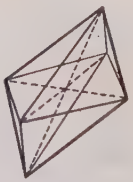


Fig. 370. Triclinic octahedron

Fig. 371. Triclinic prism (truncated)

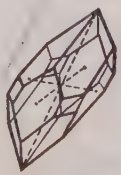


Fig. 372. Triclinic octahedron (partly truncated)

less in one direction than in any other, and if the blade of a knife is inserted in the proper place, the crystal may be easily split or cleft. Other crystals possess this property, but to a greatly varying extent. Perfect crystals may sometimes be formed by cleavage from larger crystals which are irregular.

The process of crystallization generally takes place when a body passes from a liquid or a gaseous condition into the solid state. A few instances are known where amorphous solids become crystalline upon long standing without becoming liquefied, as in iron or brass wire, sulphur, barley sugar.

Methods of Obtaining Crystals—1. By fusion and partial cooling. 2. By sublimation. 3. By deposition from supersaturated solutions as they cool. 4. By deposition from solutions during evaporation. 5. By deposition from solutions upon passing a galvanic current through them. 6. By precipitation. 7. By the addition of a substance having a strong affinity for water.

1. *By Fusion and Partial Cooling*—Substances which have low melting points, like sulphur, and some of the metals, like bismuth, antimony, etc., may be crystallized in this way. To obtain crystals of a substance like sulphur, it should be melted in a deep vessel and then allowed to cool, so that a crust will be formed; a hole is then made in the crust, and a smaller one on the opposite side; the vessel is now inclined toward the side having the larger hole, and the melted substance runs off; when the surfaces inside are examined, they will be found studded with crystals. If the quantity of material used is large, and the mass has been gradually cooled, the crystals will be large and distinct. The crust should be perforated as soon as it is fairly formed, and the fluid contents quickly removed.

2. *By Sublimation*—This is one of the most useful methods of obtaining crystals (see Sublimation, page 146).

3. *By Deposition from Supersaturated Solutions*—This is the method most frequently employed to obtain crystals. The solution of the substance is generally effected by the use of heat (see Solution, page 172). This solution should be filtered, and evaporated to the proper degree, the latter part of the operation being the most important in determining the size and beauty of the crystals. As a rule, substances which are very soluble in water and which make concentrated solutions produce small, ill defined crystals, while substances which are less soluble and which make comparatively dilute solutions, even when they are supersaturated, produce crystals of more perfect form. The proper strength of the solution must always depend upon the solubility of the substance.

Perfect rest for a solution designed for crystallization must be secured, if well defined crystals are desired, and the solution must not be cooled quickly. Sometimes crystals creep or travel up the sides of a crystallizing vessel, and even over its edge, if a small amount of mother liquor has been allowed to remain, or if they are of an intermittent deliquescent type that alternately becomes moist and dry with changes in atmospheric condition.

It has long been known that if a smooth glass rod having a single scratch upon it be placed in a solution ready to crystallize, crystals will first attach themselves to the scratched part, and the smooth part of the rod will frequently not have any separate crystals upon it. Rough surfaces, by offering more points of adhesion, attract the nuclei upon which the crystalline body is subsequently deposited. It is for this reason that rough stoneware vessels are frequently used for crystallization or that strips of wood, glass, or lead are suspended in liquids intended for crystallization, while in the manufacture of rock candy, threads are usually strung across the crystallizing tubs at regular intervals, columnar masses of fine crystals being thus produced. Sometimes crystallizing liquids are *seeded*, as it is called, by adding some small perfect crystals from a previous operation. These act as *nuclei* for the more rapid formation of crystals. Perfect geometrical crystals may be obtained by the practice of "nursing", which consists in selecting from the ordinary stock as perfect a crystal as can be found for the nucleus, and then suspending it by a horsehair or piece of sewing silk in a warm saturated solution of the salt.

Warm saturated solutions of various salts, particularly if contained in chemically clean vessels, protected from the dust, and left at absolute rest

until cooled, usually fail to crystallize. If the receptacle is shaken or jarred, or if a crystal from which the solution has been made, or any other solid substance is dropped into it, crystallization sometimes takes place in an instant, and considerable heat is evolved. This is particularly noticed with salts capable of crystallizing with more than one molecule of water, as sodium sulphate, sodium carbonate, sodium acetate, etc. This phenomenon is known by the name of *retarded crystallization.*

4. *By Deposition from Solutions During Evaporation*—This process is especially useful where the liquid is more volatile than water, as alcohol, ether, petroleum benzin, and chloroform. There are some instances in manufacturing pharmacy where the method is used, but in the case of volatile liquids the expense attending their loss, if spontaneously evaporated, is great, and, as a usual thing, rapid evaporation or recovery of the solvent by distillation is not practicable where large and distinct crystals are desired.

5. *By Deposition from Solutions Through the Action of Feeble Electrical Currents*—This method is not used commercially but is mentioned because Becquerel and others have produced crystals of metals and metallic oxides by the slow but continuous action of feeble electrical currents through the solutions, kept up for months, sometimes for years. Beautiful crystals of gold and copper have been obtained in this way.

If a strip of zinc is suspended in a clear solution of lead acetate, beautiful crystalline spangles of metallic lead seem to sprout and grow until a large arborescent form results. This is called a *lead tree,* and is an interesting window display experiment.

6. *By Precipitation*—Crystals are produced in some cases by the precipitation resulting from the mixture of certain solutions (See Precipitation, page 216.) The crystals formed by this method are frequently granular (See Granulation, page 224.) A crystalline precipitate of potassium bitartrate is produced when solution of potassium hydroxide is added to a strong solution of tartaric acid.

7. *By the Addition of a Substance Having a Strong Affinity for the Water in a Solution*—If anhydrous calcium chloride is added to an aqueous solution of sodium chloride, the latter crystallizes out. Alcohol mixed with a solution of potassium nitrate causes the crystallization of the salt, because the potassium nitrate is not soluble in the mixture of alcohol and water. The crystallization of sugar is frequently observed in syrups to which alcohol in the form of a tincture or fluidextract has been added, and this is often a source of annoyance to the pharmacist. Crystallization sometimes unexpectedly occurs from this cause in extemporaneous dispensing and is one of the forms of incompatibility, described in Part XI.

Many substances in the act of crystallizing combine with water, and the water so combined is termed *water of crystallization* or *water of hydration.* The same substance does not always contain the same number of molecules of water of crystallization. Sodium carbonate, for instance, usually contains ten molecules. Under some conditions it may be made to crystallize with eight or with only five molecules, and in the official salt it contains but one molecule of water. This combination with water must be carefully distinguished from the mechanical retention of a liquid in the interstices of crystals, which takes place particularly where the crystals are large and have been formed rapidly. Water retained in this way is termed *interstitial water,* or *water of decrepitation,* as it is the cause of the *decrepitation* of bodies when exposed to heat. The sudden expansion of the water causes the substance to crackle and burst into fragments. Crystals containing water of crystallization frequently lose part of

it on exposure to the atmosphere, and the transparency noticed when the crystal was fresh is replaced by opacity and is finally followed by the crumbling and disintegration of the crystals. This change is termed *efflorescence.* There are very few substances which will part with all of their water of crystallization at ordinary temperatures, nearly all requiring a high heat to effect the object. The operation of driving off the water and reducing the crystals to the form of a dry powder is called *exsiccation* (see Exsiccation, page 224). Some substances absorb water from the atmosphere, and, instead of becoming dry, grow moist, and in some cases are converted entirely into liquids. Such substances are said to be *hygroscopic,* and the phenomenon is termed *deliquescence.* Examples are found in potassium acetate or in zinc chloride which have been exposed to moist air.

Salts containing water of crystallization are frequently distinguished from those that do not by being termed *hydrated.* Example, *monohydrated sodium carbonate.*

The liquid remaining after the crystals have formed is called *mother liquor,* and consists of a saturated solution of the salt together with any impurities that did not crystallize out with the substance. Usually it may be evaporated and another crop of crystals obtained, if desired, although the second crop of crystals is always less pure than the first.

Where two salts are in solution it is obvious that the more soluble salt must exist in larger proportion in the mother liquor. Chemical salts or active principles of plants are frequently separated from each other by taking advantage of their difference in solubility. Thus cinchonine is separated from quinine. The process is termed *fractional crystallization.*

Crystallizing vessels should be deep, and made of rough glazed stoneware or porcelain. On the large scale, wooden tanks or vats or glass-lined or enameled steel tanks or pans are employed.

Collection, Draining, Washing, and Drying of Crystals—On the small scale it is usually sufficient, after the mother liquor is decanted, to break the crust of crystals, and, having dropped a few pieces of clean broken glass in the throat of a funnel, to place the crystals upon them and drain thoroughly. They are then to be washed by pouring the proper solvent carefully and sparingly upon them. If the crystals are very soluble in water, and it is necessary to free them entirely from mother liquor, they must either be washed with alcohol or with some liquid in which they are not so soluble, or with ice cold distilled water, used very carefully but quickly by pouring it drop by drop upon the crystals, so that the smallest quantity will suffice. After draining or centrifuging they may be transferred to a double sheet of white filtering paper, placed on a bed of two or three newspapers or cloths, loosely covered with a clean sheet of white filtering paper, and removed to a dry atmosphere. If the crystals are liable to effloresce, they should be turned several times, and bottled as soon as fairly dry. When crystals are prepared on a large scale, as in the making of sugar or sucrose, the crystals are dried by passing them through a rotary dryer in which they are made to fall repeatedly through dry air, the exact time being regulated to avoid deliquescence.

Intermediate crystallization is a term used to define the process of crystallizing a substance which is comparatively insoluble in simple solvents, by causing it to dissolve in a hot solution of another substance. Red mercuric iodide may be made to crystallize in this way in brilliant scarlet crystals by dissolving it in a hot solution of sodium chloride, potassium iodide, or mercuric nitrate.

GRANULATION

Granulation is the process of producing, either by the process of interrupted crystallization or by precipitation, a finely crystalline, granular powder; granular crystals are sometimes described as sabulous (sandy) because of the appearance of the particles. The practical advantages of the granulated form of chemicals are so well recognized now at the prescription counter, that their use in preference to large crystals is rapidly extending. This is particularly true of salts which are not very soluble in water, or which are commonly found in commerce in hard, tough, crystalline lumps or masses. The process of granulation is one which requires care, but no great amount of skill. The solution of the substance is generally evaporated rapidly until a scum of minute crystals, called a *pellicle*, forms upon the surface. Then the heat is moderated, in order to prevent spurting or caking. Great care must be exercised at this stage of the process to stir the mass constantly, as there is a tendency to form a hard crust on the bottom of the dish, and when this crust is once formed and afterward broken up by the stirrer it is difficult to avoid the formation of lumps. If the crust is prevented from forming, by constant stirring, the salt will separate in distinct grains, which will not adhere to each other. Toward the end of the process the heat should be very moderate, and the product should be introduced at once into a clean, warm, dry bottle.

Sometimes commercial granulated salts are simply coarsely ground crystals made by the use of a drug mill. This form should not be called *granulated* but *ground*.

EXSICCATION

Exsiccation is the process of depriving a solid crystalline substance of its water of crystallization or moisture by heating it strongly.

The object of exsiccation is to reduce the bulk and weight of substances and thereby enable them to be given in a smaller weight or volume.

The product is usually a fine powder, and the original crystalline condition of the substance may be restored by redissolving it and evaporating the solution. The process is conducted by exposing the crystals to the air or to a warm temperature until they are effloresced, and then gradually heating, with stirring, until they cease to lose weight; the residue is then powdered and kept in well-stoppered containers.

The initial exposure at a low temperature is to prevent the fusing of the salts, which would interfere with the subsequent drying by reducing the amount of surface exposed. Thus ferrous sulphate crystals melt at 65° C., and if this salt were placed directly upon a water bath, at first it would liquefy, but if it be partly dried first by ordinary exposure, the latter part of the operation may be carried out at water bath temperature with no difficulty and with great advantage.

Exsiccated salts, in consequence of their having been deprived of water, are invariably very hygroscopic. Unless they are supplied in glass containers and kept properly protected, they will absorb enough moisture to cause them to lose their distinctive character. Some firms supplying chemicals do not furnish official exsiccated salts except on order specifying "U. S. P". The product usually furnished is commercially called "dried and powdered" and as supplied in pasteboard cartons is intermediate between the powdered hydrated chemical and the real exsiccated salt. Such products should not be accepted for use in dispensing operations where exsiccated salts are demanded.

CHAPTER XXI

EXPRESSION

Expression is a process of *forcibly* separating liquids from solids. It is generally effected by the use of a press, although for many pharmaceutical operations upon the small scale, the use of straining cloths with hand pressure suffices. Expression is no longer an important operation in pharmacy and will be but briefly discussed. At least six mechanical principles have been recognized in the operation of expression: namely, by the use of—1. The spiral twist press. 2. The screw press. 3. The roller press. 4. The wedge press. 5. The lever press. 6. The hydraulic press.

1. **The Spiral Twist Press**—The principle of this press is best and most practically illustrated in the usual process of expressing with the hands a substance contained in a cloth. The mixture to be expressed is placed in a bag or cloth held in one hand by the four corners, which are gathered together, and the lower portion, or bag, is rotated with the other hand, so that, beginning at the top, the point of smallest diameter, the strainer is spirally twisted, the pressure forcing the liquid between the meshes of the cloth. Figs. 373 and 374 show Gigot's press, in which this principle is used upon a larger scale. Upon the left is shown a sectional view of the press as it appears when filled with material. This principle may be effectively applied on the small scale by placing the material to be expressed, which has been placed in a muslin bag, between the folds of strong canvas, about fifteen inches wide and four or five feet long, sewed together like a roller towel. Round sticks, about eighteen inches long, are run through each end and twisted in opposite directions. Substances which are hot may be expressed by this plan without scalding the hands. It is necessary for two persons to perform this operation.

Fig. 373

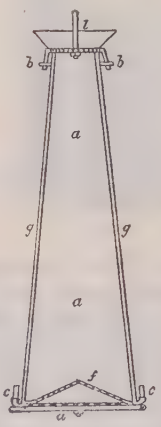


Fig. 374

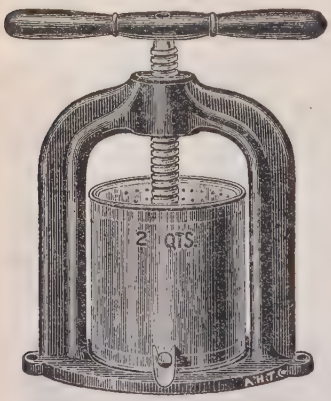
Gigot's press

2. **The Screw Press**—This is the most useful of all forms for pharmaceutical work where very great power is not desired. The screw is always used in combination with one or more levers, and this form of press is employed in great variety to accomplish special purposes. There are two kinds of screw presses: 1. Single screw presses. 2. Double screw presses. Each of these forms may be subdivided into those in which the position of the screw or screws is *vertical*, and those in which the position of the screw or screws is *horizontal*.

Single Screw Presses—In this form of press the single screw is generally used in a vertical position, and operated with a lever or a combination of levers. It is the simplest kind of press, and if well made will admirably answer the general purposes of the pharmacist. The screw should have a square faced thread, and be well made. The plunger should be disconnected from the end of the screw or else move freely around it. The parts of the press which come in direct contact with the material to be pressed should be coated with tin or

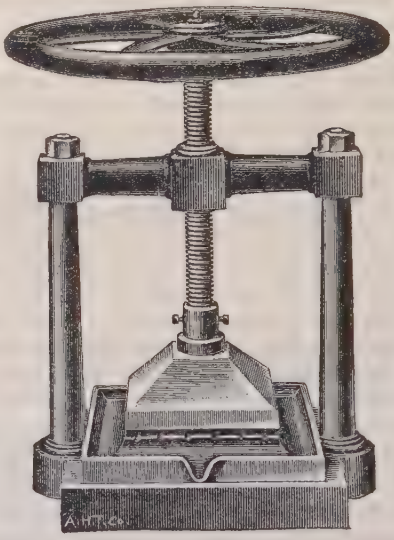
enamel, so that liquids containing acid or tannin shall not be affected injuriously. Fig. 375 shows a press of this description, with a perforated cylinder. The principal objection to the single screw press is, that unless the material in the press is nearly homogeneous, so that the press cake is equally pressed upon at all points, unequal action results, the press block is pressed against one side of the case, causing friction and resistance and the thread of the screw binds upon one side, full pressure thus being defeated. The main objection to the vertical screw is that the press block and plate must be in a horizontal position, the result being that

Fig. 375



Single screw press

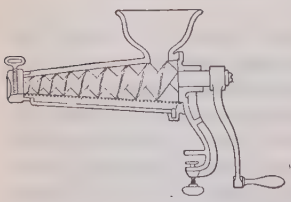
Fig. 376



Porcelain press

the liquid pressed out adheres to the cloth, and cannot be collected readily without tilting the press. Fig. 376 is an illustration of a porcelain press for materials which must not be allowed to come in contact with metals. Fig. 377 illustrates a horizontal screw press, made by the Enterprise Manufacturing Company, of Philadelphia, which is operated without a press cloth. It consists essentially of a tapering case, with a hopper on the upper side at its large end, and a strong screw fitting closely to the inner surface, the thread of which diminishes in size as the screw becomes smaller. Along the under side of the cylinder is formed a channel adapted to receive a perforated brass plate. This latter has a transverse concavity corresponding to that of the inner surface of the cylinder and the perforations allow the escape of the expressed fluids into the channel or gutter beneath, from which it escapes by a proper outlet.

Fig. 377



Enterprise press

Double screw presses are preferred by some users. These are always of the horizontal screw form as shown in Fig. 378.

It is apparent that the double screw press is very powerful, and the pressure being equalized, good results are obtained.

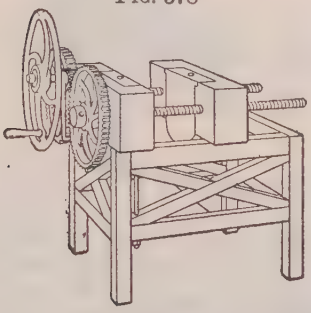
3. **The Roller Press**—This is used upon the large scale for pressing oily seeds, fatty substances, etc. Its principle is thoroughly shown in the well known clothes wringer, which, although made for the laundry, serves as a very efficient press for many substances. Care must be taken to apply the force

gradually to the bag containing the material to be pressed, and not to use it upon substances which will soften or dissolve the rubber rollers.

4. **The Wedge Press**—This form of press is powerful, economical, and inexpensive. It is objectionable principally on account of the noise necessarily made in driving the wedges. Fig. 379, taken from Knapp's *Technology*, illustrates the wedge press.

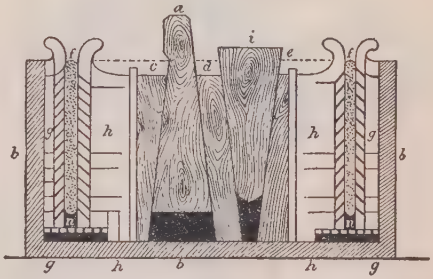
5. **The Lever Press**—The only advantages possessed by this press over those previously noticed are its cheapness, and that it may be made by any one possessed of even moderate mechanical ability. Prof. Wm. Procter, Jr. recommended the following method of construction. "A piece of timber twelve feet long, and with lateral dimensions sufficiently great to be inflexible with the force to be applied to it, has one of its ends securely attached to a wall or upright post in such a manner as to admit of the motion of the other end. The pressing box being placed about one foot from the fixed end, on a firm block of wood, is subjected to the action of the lever by placing a piece of wood vertically between the piston block of the pressing box and the lever. It is

FIG. 378



Double screw press

FIG. 379



Wedge press

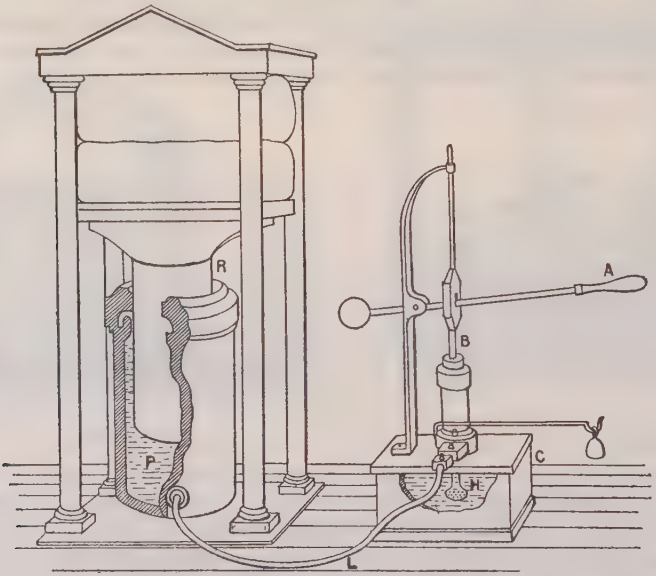
obvious that a weight of one hundred pounds at the opposite end causes a downward pressure equal to eleven hundred pounds at the box. The pressing box most usually employed is a cylinder, closed at one end, made of thick tinned iron, secured with bands of the same material, which are soldered on, and between these, numerous holes are perforated. This cylinder is set in a tin dish with a lateral spout. The piston block is constructed of hard oak wood with the grain running transversely to its axis". The objection to this press is that, compared with other presses, it yields but little power in proportion to the space occupied; but as an offset to this it can be made to work simply and quickly.

6. **The Hydrostatic or Hydraulic Press**—Of the presses heretofore mentioned, each has some especial advantage or use, but each has also some fault or objectionable feature. The spiral twist is not powerful, and its action is limited. The screw presses of both varieties have friction to contend with. The friction of a screw increases with the intensity of the pressure applied, and when a certain limit is reached all further force applied is wasted, and if persisted in, involves the destruction of the press. The roller press is very limited in its action; the lever press is unwieldy and not powerful; the wedge press is noisy and can be used only for special purposes. The hydrostatic press is expensive, but after the first cost it is the most economical, because the greatest power is obtained at the expense of the least labor. The principle is shown in Fig. 380. It must be remembered that the molecules of fluids move freely in contact with one another almost without friction, and, according to Pascal's

law, "Pressure exerted anywhere upon a mass of liquid is transmitted undiminished in all directions, and acts with the same force on all equal surfaces and in a direction at right angles to those surfaces".

Although it has been proved that liquids are to a slight extent compressible it has also been shown that they are *perfectly elastic;* so that if a plug be forced into a liquid which entirely fills the vessel, the pressure is felt equally upon every square inch of the surface of the vessel and upon every square inch of the surface of any body immersed in the liquid, and if the pressure is removed from the plug it will be immediately forced out of the vessel and the liquid will at once regain its original volume. Now, if a vessel is constructed having two columns communicating at the bottom, as in Fig. 380, and if water or other

FIG. 380



Hydraulic press

fluid is placed in it, it will be found that a pressure of one pound applied at the piston in the tube, B, will be communicated to every portion of the lower surface of the ram, R. If the area of R is ten times greater than that of B, it follows that a pressure of one hundred pounds on A, conveyed through the lever, exerts an upward pressure of one thousand pounds on R. By increasing the area of the ram the power may be greatly multiplied so that pressure applied by one man on the lever may be communicated to the liquid and made to exert an upward pressure of several tons.

The following maxims should be observed in operating presses:

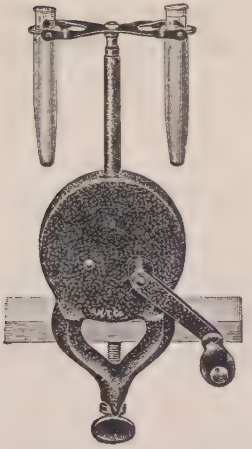
1. All moving parts of the press should be well lubricated before attempting expression.

2. Pressure should be *gradually* increased; sudden strains should always be avoided. If this precaution is neglected, either the press cloth or press bag will burst, the finer solid particles will be forced through the meshes, or breakage of press plates or press will result.

3. Pressure, to secure the best results, should be unrelaxed, but intermittent. After apparently reaching the limit of compression, the action of the

press should cease, and if the pressure is maintained unrelaxed it will be found that in a short time further pressure may be applied and more liquid separated. In this way, by alternately exerting pressure and resting, the utmost limit of

Fig. 381



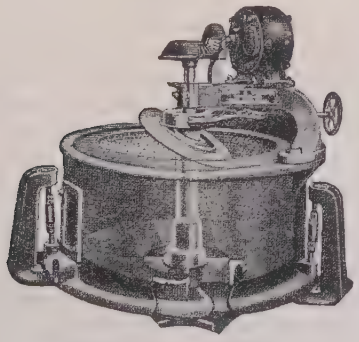
Hand laboratory centrifuge

Fig. 382

Covered laboratory centrifuge

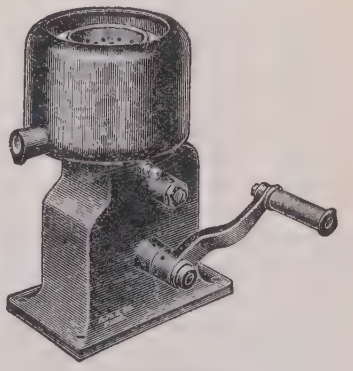
the power of the press may be gradually reached without undue strain. Screw presses have more ability to retain pressure than hydraulic presses; the valves of the latter frequently leak slightly, and the pressure has to be continually renewed.

Fig. 383



Self-balancing centrifuge

Fig. 384



Small centrifuge

Filter Presses—A form of apparatus known as a filter press has replaced for large scale industrial operations all of the presses but the hydraulic press. It is described under filtration (see page 209, Fig. 335).

Centrifugal Machines or Centrifuges—For separating liquids from solids the principle of centrifugal motion has been successfully used. Laboratory centrifuges are used for the rapid separation of sediments or precipitates, as in the examination of urine, and also for the rapid separation of immiscible liquids,

Figs. 381 and 382 illustrate two forms. The latter is electrically driven and covered to avoid injury from an accident. On a large scale centrifuges are used for the separation of mother liquor from crystals, the removal of solvents from insoluble residues, etc. This type is illustrated in Fig. 383. The machine consists of a central, perforated cylindrical cage surrounded by a case; the cage is attached to a vertical shaft, which is capable of being speeded to several thousand revolutions a minute. The wet material is placed in the cage, the machine started, and the liquid forced by rapid motion through the perforations into the space between the outer case and the cage. An experimental centrifuge of this type is shown in Fig. 384.

CHAPTER XXII

EXTRACTION BY MACERATION AND DIGESTION

Under these heads are included those operations which have for their object the separation of the soluble principles from drugs by treating them with a liquid capable of dissolving them, which is called the *menstruum*. *Extraction* differs from solution in the fact that the presence of insoluble matter is implied in the former, and the soluble constituents must therefore be *extracted* or separated, by appropriate methods, from those which are insoluble. The principal modes of extraction employed in pharmacy at present are as follows: 1. Maceration. 2. Percolation. 3. Infusion. 4. Decoction.

Maceration, and *digestion*, which is merely a modified form of maceration, are old processes and will be considered first; percolation is much more important and useful, and will be treated of in a separate chapter; infusion and decoction are processes which are used in producing separate classes of official preparations, hence they will be considered in Part II.

Maceration

The process of *maceration*, which is of ancient origin, consists simply in soaking the properly comminuted drug or substance in the menstruum until the cellular structure is thoroughly penetrated and the soluble portions softened and dissolved. The usual method is to introduce the drug into a bottle with the solvent or menstruum, stopper it tightly, and agitate it occasionally for a period ranging from two to fourteen days; then to pour off the liquid, express the residue to avoid loss, and filter the mixed liquids. An advantage is sometimes gained by suspending the ground drug, tied in a bag, in the upper part of the menstruum (see Fig. 262). This has been termed *circulatory maceration*. Maceration is the process directed by the German Pharmacopœia in preparing tinctures. The drugs are ordered in all cases to be macerated in definite weights of alcohol for a week in a closed bottle, in a dark place, with frequent agitation, at a temperature of about 15° C. The liquid is then separated by straining or expressing from the insoluble residue, and, after having been allowed to settle, it is filtered. Evaporation during filtration is to be avoided as much as possible. Maceration has no advantages over percolation in making the greater number of liquid preparations from drugs, except in the hands of the careless or unskilful. If an operator possesses no knowledge whatever of the process of percolation, it is safer to use the maceration process, for here no particular skill or judgment is necessary; the soaking process is completed in due time, and the separation of the absorbed liquid, while laborious and uncleanly, has at least the merit of leaving the tincture uniform in strength; if the process of expression is not thoroughly performed, pecuniary loss results through the smaller yield, but the finished preparation properly represents the drug. On the other hand, in percolation, if the operator, through careless packing, has failed to exhaust the drug thoroughly with the amount of menstruum used, a portion of the activity of the drug remains in the residue, which is thrown out, and the preparation is thus deficient in strength. The maceration process must be used in the extraction of some drugs, notably

those containing little or no cellular structure as benzoin, aloe, styrax, tolu, etc; this is recognized by the U.S.P. processes.

Maceration should be conducted at a temperature of from 15° to 20° C.

Digestion is that form of maceration which consists in the application of a gentle heat to the substance which is being treated. It is used in those cases where a moderately elevated temperature is unobjectionable; the heat increasing the solvent powers of the menstruum. If the solvent or menstruum is volatile it is necessary to attach a reflux condenser to the vessel in which the digestion is being conducted so that the solvent may be recovered and returned.

CHAPTER XXIII

EXTRACTION BY PERCOLATION

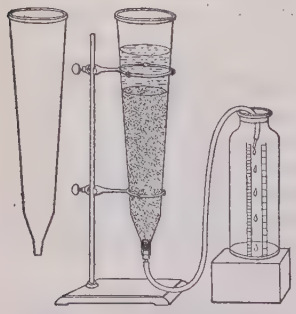
Percolation, or displacement, is the process in which a powder contained in a suitable vessel is deprived of its soluble constituents by the descent of a solvent through it. The importance of this process cannot be overestimated, as the progress made in pharmacy in America during the last century is largely due to the study and development of percolation, and the introduction of preparations which are the direct outgrowth of the process.

History—The practice of exhausting wood ashes of their soluble constituents by pouring water upon them after their introduction into a conical shaped wooden vessel, called a lye hopper, is an ancient one, and the process is still practiced and known as *lixiviation.* It is known that about 1813 a sort of percolator was used by Dumont in decolorizing syrups with charcoal in the refining of sugar and that in the Cafetière de Dubelloy a similar outfit was used in the preparation of coffee but the first attempt on record to apply the principle to powdered drugs was made by Count Real, who about the year 1815 invented a press which consisted of a metallic cylinder with a stopcock in the bottom and containing a perforated diaphragm for supporting the substance, and with a tight cover at the top, to which was attached an upright tube, ten or twelve feet high, having a funnel soldered to its upper extremity. The cylinder was packed with the coarsely ground drug, and water poured into the tube. The pressure of the column of water was so great, however, that the principal difficulty in using the apparatus was in securing tight joints, and in preventing the incomplete exhaustion of the drug on account of the too rapid passage of the water through it. M. Robiquet subsequently made some experiments to determine the power of ether as a solvent in extracting the fixed oil from the bitter almond. He observed that ether poured on powdered bitter almond displaced the fixed oil without mixing materially with it, and he published his observation. It was reserved, however, for the Boullays of Paris, in 1833, to apply the ideas of Real and Robiquet to drugs and medicinal substances in general, and to them belongs the credit of first demonstrating the value of the process of percolation in its pharmaceutical applications. The researches of the Boullays at once attracted the attention of American pharmacists, and the labors of Duhamel, Procter, Grahame, Squibb, Diehl, Oldberg, and others during the last century and the adoption of the process in all of the Pharmacopœias of the United States since 1840, sufficiently show the growth in favor of percolation. In Great Britian, France, and Germany the process is well known, and is practiced to some extent, but maceration still holds in these countries the chief place as a means of extracting the soluble principles of drugs. For a very complete history of percolation, see the *American Journal of Pharmacy,* 1919, page 16, written by James F. Couch.

Principle of Action—*When a powder placed in a cylindrical vessel with a porous diaphragm below is treated from above with a liquid capable of dissolving a portion of its substance, that portion of the fluid first in contact, in passing downward, exercises its solvent power on the successive layers of the powder until saturated, and is impelled downward by the combined force of its own gravity and that of the column of liquid above it, minus the capillary force with which the powder tends to retain it.* The physical forces playing an important part in percolation are *gravitation, viscosity, adhesion, friction, osmosis, capillarity,*

and *solution*. If the quantity of liquid added is not more than enough to satisfy the capillarity of the powder, no liquid will pass the diaphragm; but the careful addition of liquid upon the top displaces that absorbed in the powder without mixing materially with it, and takes its place, to be in turn displaced by a fresh portion of liquid. The instrument used to hold the powder is called a *percolator;* the liquid poured on top of the powder, the *menstruum;* the liquid coming from the percolator impregnated with the soluble principles, the *percolate*. In order thoroughly to understand the process of percolation as applied to powdered drugs, it must be remembered that the soluble principles of vegetable substances are in a hard and dry condition, and are generally contained in cells which are more or less disintegrated by the process of grinding. If the soluble principles could be perfectly separated from the insoluble cellular substance by any means, and be deposited in the interstices of the ground particles, percolation would indeed be a rapid process, for the descending column of liquid would immediately dissolve the soluble principles, which would be found in the receiving vessel, while the insoluble substances would remain in the percolator, and the separation would then be easily accomplished. But the powdering of the drug only partially separates the soluble principles from the insoluble, and the finest dust of the powder always contains a larger proportion of the soluble principles than of the insoluble substance, because the latter, often being largely ligneous, offers the greatest amount of resistance to disintegration. Hence the first portion of the percolate is always the most dense, the most highly colored, and contains the largest proportion of the soluble principles. This is because the first portion of menstruum, in its descent through the powder, has the first opportunity to come in contact with the largest proportion of the soluble principles, which are to be found in the finer dust scattered through the powder, and in the thoroughly disintegrated particles, which offer but slight resistance to the passage of the menstruum. In every well conducted experiment in percolation it will be noticed that, as the operation proceeds, each succeeding portion of percolate is less highly colored, and less active than the one preceding it; and in the case of drugs containing easily dissolved coloring matter, an examination of the percolate will show that the shading is very marked, the lowest portion being very dense and dark colored, the upper portion almost colorless, while in the intermediate liquid the gradations of the tint are clearly perceptible.

FIG. 385 FIG. 386



Official percolator Official percolation

Shape of the Percolator—In the U. S. P. 1880 the shape and size of the cylindrical percolator preferred for pharmacopœial operations were for the first time definitely fixed (Fig. 385). There can be no question that the glass cylindrical percolators (Fig. 387) commonly furnished by the manufacturers are proportionally too broad for use in percolating drugs for fluidextracts where the quantity of drug is large in proportion to the quantity of menstruum; but for ordinary tinctures, where the conditions are reversed, they answer admirably. The inference then is obvious, the pharmacist should have percolators not only of different sizes, but also of different shapes. Fig. 388 shows the narrow percolator first recommended by Prof. C. Lewis Diehl but commonly known as the "*Oldberg percolator*". It is narrower than the cylindrical percolator directed by the U. S. P. X. The studies on percolation during the last half century have been directed toward

simplifying the process, and the elaborate apparatus of Count Real and others has been replaced by the ordinary percolator and funnel. The conical percolator of the Pharmacopœia is understood to be a glass funnel (Fig. 389).

Judgment is required in selecting a percolator for an operation. In making a fluidextract, a comparatively narrow percolator should be chosen, because it is desirable that the menstruum should traverse a higher column of powder, for every drop of the menstruum must be economically applied. The rate of flow of the percolator is thereby proportionally diminished, the percolate becomes saturated more rapidly, and thus the operation is more easily controlled, provided the limit has not been exceeded. *The character of the drug influences the limit.* For instance, one which contains a large quantity of soluble matter, like kino, could not be successfully percolated in a narrow percolator, because the percolate would soon become so dense that it would cease to descend. In making tinctures and weaker preparations, a wider percolator is to be preferred, because the quantity of menstruum is greatly in excess of the amount necessary to exhaust the drug, and more rapid action is desirable. Figs. 390, 391 and 392 show three percolators of the same height, but of very different shapes. Exactly the same weight of powder is represented in each. The great difference in the height of the columns of powder will be readily noticed, and the necessity for judgment in selecting percolators is illustrated. If a fluidextract from the drug is to be made, the tall percolator, Fig. 390, should be selected; if a strong tincture, Fig. 391 indicates the shape; while for a weak tincture, the funnel shown in Fig. 392 would be preferred, it being understood that in each case the drug is not an exceptionally difficult one to percolate. The size of the percolator selected should be in proportion to the quantity of drug extracted. When properly packed, the drug should not occupy more than two-thirds of the height of the percolator. The percolator is best constructed of glass, but, unless otherwise directed, may be made of any suitable material not affected by the drug or menstruum. Metallic percolators are required for hot percolation.

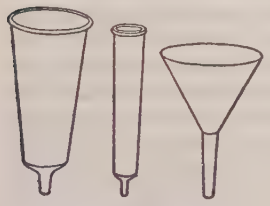


FIG. 387 — Plain percolator

FIG. 388 — Oldberg percolator

FIG. 389 — Conical percolator

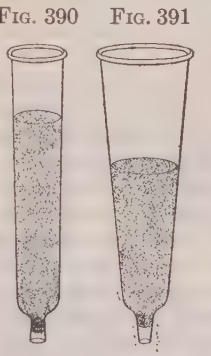


FIG. 390 — Narrow percolator (200 Gm. of powder)

FIG. 391 — Ordinary percolator (200 Gm. of powder)

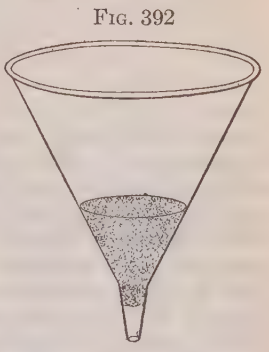


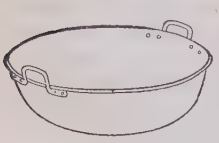
FIG. 392 — Conical percolator (200 Gm. of powder)

Comminution—The degree of comminution proper for each substance must depend upon the physical structure of the drug, the ease with which the menstruum dissolves the active or desirable constituents, the length of time required to exhaust the powder, and the relative proportion of menstruum to drug. Nux vomica and ignatia are drugs having a tough, horny structure, in which the soluble constituents are embedded. If these drugs are to be quickly exhausted of their soluble principles, they must be in fine powder. On the other hand, gentian and rhubarb are drugs which part easily with their active

constituents, because their structure is loose and quickly penetrated by the menstruum. Therefore these may be readily exhausted when in coarse powder. The relative proportion of menstruum to drug also has a bearing in determining the fineness of the powder, for it is clear that if a fluidextract is to be made in which one hundred volumes shall represent *one hundred* parts by weight of the drug, the powder should be a finer one than would be required for a tincture where one hundred volumes are used to exhaust *ten* parts by weight of the drug. In all cases, whether coarse or fine powder is directed, the powder should conform to the specifications of the Pharmacopœia for that degree of fineness and should be uniformly mixed. The object of this is to permit the uniform descent of the liquid, for fine particles offer more resistance to the passage of the menstruum than coarse ones; if the powder is not uniform, and the finer particles are deposited upon one side of the percolator, imperfect exhaustion may occur, through the passage of the greater portion of the menstruum down the channel of least resistance—*i. e.*, through the coarser particles.

Moistening the Powder—The general rule in percolation is to moisten the powder, and there are very few instances in the official processes where it is not directed. The object of moistening the powder is very apparent. If a perfectly dry sponge is held in the hand and a gentle stream of water poured upon it, it will be noticed that very little water is absorbed by it; but if the sponge is thoroughly soaked, and all the water squeezed out that possibly can be removed, it will greedily absorb water. Vegetable drugs are substances which in their natural state contained moisture, however the process of desiccation has hardened and dried the tissues, so that, like the sponges, they do not absorb moisture quickly, and when compressed, as they are when packed in a percolator, the resistance is still greater. If a dry powder, like ground orange peel, is tightly packed in a glass percolator and water poured upon it, it will be noticed that the water will penetrate the powder only a short distance. Its further passage is prevented by the particles which are immediately in contact with the water, which have become swollen to such a degree that they press tightly against the sides of the percolator, and thus entirely overcome the gravitating force and penetrating power of the water. If, on the other hand, the powdered orange peel is moistened *with sufficient water to satisfy its tendency to swell, before it is packed* in the percolator, the addition of water is followed by its slow percolation through the mass without stoppage, and the utility of moistening the powder is thus proved.

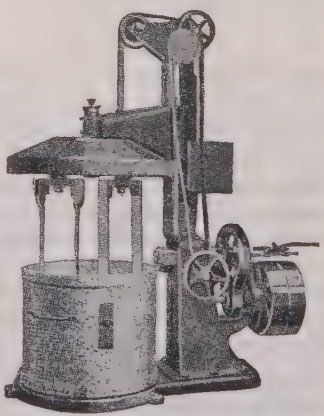
Fig. 393



Pan for moistening powders

The special cases in which the powder should not be moistened are those in which the addition of menstruum would produce adhesiveness and cause the powder to form lumps that could not be easily penetrated, those in which the moistened powder would offer too little resistance to the passage of the menstruum, and those in which the menstruum is too volatile or too inflammable to render moistening desirable or safe. An instance of the first case is found in the so-called cold percolation of sugar in making syrups; instances of

Fig. 394



Power moistener for drugs

the second and third cases, in the preparation of the oleoresins where ether is used as the menstruum. In a small operation the moistening may be best accomplished by adding the menstruum to the ground drug contained in a relatively large, shallow dish (Fig. 393), the drug being rubbed between the hands to secure uniformity. On a large scale a covered power mixer (Fig. 394) may be used. This is the so-called *pony mixer* and the one illustrated is made by the J. H. Day Company. Other forms are also available. The drug may also be placed in a wooden trough or on a clean cement floor, the menstruum added, and the mixing done with a shovel. The latter plan may serve for aqueous menstrua, as in the percolation of cascara sagrada, but would not be economical if the menstruum is alcoholic.

Packing the Powder—The directions of earlier pharmacopœias with regard to this important part of the process of percolation varied continually. Where the degree of pressure was immaterial, no special directions were given. Where there was a likelihood of too much pressure being exerted, so that percolation would cease before it should, the directions were, "pack it moderately"; on the other hand, if there was danger of the operator allowing the menstruum to pass through too rapidly, so that the drug would not be exhausted of its active principles, the directions were, "pack it firmly". Owing to the introduction of Type Processes, the U. S. P. has omitted this valuable aid to the beginner and it is necessary for each operator to determine for himself the degree of pressure to apply in packing the drug. Before beginning to pack the powder, the throat of the funnel or of the percolator must be obstructed by a loose plug of absorbent cotton or a deeply notched cork (Fig. 395), or by some other method. Care should be taken not to moisten the cotton or cork with water unless the menstruum is aqueous, because if the drug to be percolated is resinous, the first portions of percolate which come through will be precipitated by the water in the cotton or on the cork. Instances have occurred where the percolation has been stopped from this cause. Where the notched cork is used, it is well to place over the top of the cork, when it is in place, a small circle of scored filtering paper (Fig. 396). This must be slightly larger in diameter than the cork, and the edges are therefore deflected up the sides.

Fig. 395 Fig. 396

Notched cork Scored paper

Fig. 397

Packer

The moistened powder should be carefully deposited in the percolator in layers, each succeeding layer being packed according to the requirements, "moderately" or "firmly", as the case may be, care being taken to use the same degree of pressure with each layer. Fig. 397 shows a convenient utensil for packing a percolator. It should be made of hard wood, preferably lignum vitæ; for the narrow percolators a longer packer must be used. The skill used in this part of the process will be proved by the manner in which the menstruum permeates the moistened powder. If the descent is regular and uniform, it will be shown in a glass percolator by the line marking the descent of the menstruum being perfectly horizontal. If the line is irregular, it is easy to point out just where the pressure was insufficient or too great. Fig. 398 shows loose and irregular packing, too much pressure being made on the right side, the menstruum descending upon the left side more rapidly and escaping unsaturated. Fig. 399 illustrates a percolator which has been properly packed, the liquid descending uniformly.

Adding the Menstruum—When the last portion of moistened powder is introduced into the percolator, a sheet of filtering paper, scored at the edges

and slightly larger in diameter than the surface of the powder (Fig. 396), should be laid upon it, for the purpose of causing an even distribution of the menstruum. A weight of some kind is usually placed upon the paper, to keep it from floating out of place. Clean pebbles, a bottle stopper, or a small glass funnel may be used, but in Fig. 400 is shown a glass percolator weight, which has been made for this purpose by the Whitall Tatum Company. It is easily cleaned, is not readily broken, and does not take up much room. Where the percolator is large enough to hold the whole of the menstruum, it may be at once added carefully. When this is not the case, and the menstruum must be added in divided portions, care must be observed to follow with the succeeding portion before the first has entirely disappeared, or otherwise fissures may appear in the powder, and the menstruum will of course then seek the outlet offering the least obstruction, and will leak through the fissures instead of percolating through the powder. This is more apt to occur in percolating very fine powders than in percolating coarse ones, although it is liable to take place in either. Where a large quantity of menstruum is required, a contrivance for continually supplying the menstruum should be used, in the form of an inverted bottle or flask (Fig. 271), or any of the methods for continuous washing may be employed. The use of rubber tubing attached to the outlet, as illustrated in Fig. 386, and then bent with an upward curve so that the upper bend is above the level of the packed drug but the outlet below the percolator orifice, will prevent the drug from becoming dry should the operator fail to pour on additional menstruum.

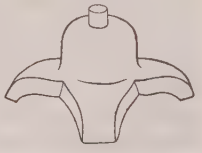
Fig. 398

Imperfect packing

Fig. 399

Proper packing

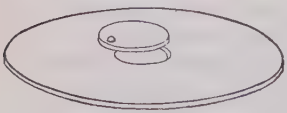
Fig. 400



Percolator weight

Previous Maceration—This is recommended when the structure of the powder is tough, when the soluble principles are not easily extracted by the menstruum, or when a comparatively large quantity of powder is to be exhausted by a small quantity of menstruum. It is obvious that maceration is going on constantly while the menstruum is traversing the powder during its gradual descent, and when the amount of menstruum is more than sufficient to exhaust the drug, previous maceration is merely a waste of time. Nevertheless, the experts of the Pharmacopœia, in order to prevent the possibility of an unskilful or ignorant operator failing to exhaust a drug with the quantity of menstruum directed, have adopted in most cases the precaution of ordering previous maceration for a short time. This is best performed by moistening the drug, introducing it loosely into the percolator, and covering it closely to prevent loss by evaporation. This course has the additional advantage of allowing the drug to swell at the same time. A cover made of sheet rubber (Fig. 401),

Fig. 401



Sheet rubber cover

with a circular opening, is very useful in this connection. No attempt should ever be made to produce fluidextracts on the small scale without previous maceration.

Finishing the Process—The official directions are frequently definite in fixing the quantity of percolate to be received from a given quantity of powder, but the oft repeated direction to "percolate to exhaustion" at once raises the question of when a drug is exhausted of its activity. This question can be properly answered only by knowing beforehand the active principles of the drug. A few examples will sufficiently illustrate this. The activity of nux vomica, opium, and cinchona resides in the bitter alkaloids; hence the *absence of bitterness* in the percolate in such cases indicates exhaustion. Cochineal and saffron are valued in pharmacy for nothing but the coloring matter contained in them; hence the *absence of color* in the percolate shows the close of the process. Nutgall, kino, krameria, etc., contain tannin, and this is the only valuable principle; the *absence of astringency* in the percolate in these cases, therefore, shows the operator that percolation may be stopped. The exhaustion of resinous drugs may be known by the absence of precipitation when the percolate is dropped into water. Where two or more active principles exist in a drug, the latter is not exhausted until the percolate is free from all of them. *The intelligent practice of the process of percolation, therefore, requires an accurate knowledge of the constituents and physical properties of medicinal substances.*

Choice of Menstrua—Much labor has been bestowed by investigators in ascertaining the exact proportions of the usual solvents—water, alcohol, glycerin, etc.—that are best adapted for depriving drugs of such of their soluble principles as are desirable, and at the same time leaving untouched in the residue those principles which are either inert or objectionable. The special menstruum which is exactly adapted to the peculiar characteristics of the drug, and which will cause the retention of the soluble principles in a permanent form under the varying conditions of climate, and at the same time permit exposure to light, heat, and air without injury, can be determined only by experiment and observation. When new galenical preparations are proposed. the menstruum selected must therefore be merely tentative, and general principles must guide until positive knowledge is secured. Alcohol would be indicated for active resinous drugs, diluted alcohol for simple bitter tonics, cathartics, etc., and diluted alcohol with glycerin for astringent drugs, etc. The selection of proper menstrua will be given attention, as occasion demands, in the chapters upon infusions, tinctures, extracts, fluidextracts, etc.

Absorbed Menstruum—The amount of menstruum which a powder will absorb and retain after percolation ceases can never be accurately predetermined. If it is important to know beforehand the percentage of menstruum capable of being absorbed, a practical trial should be made upon the small scale, using the same powder and menstruum.

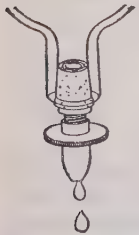
Substances possess very different capacities for retaining menstrua. Those having a light, spongy structure hold more than hard ligneous drugs, and even the same drug will often vary in its capacity in this respect, while the amount of moisture present in the drug before it is percolated is never a constant quantity, varying sometimes as much as from 8 to 20 per cent. The advantages of percolation over maceration are very apparent in respect to the character of the liquid left in the exhausted residue or marc. In maceration the liquid left in the residue is finished tincture. In percolation it is merely menstruum, the active portions of the drug having been dissolved in the preceding percolate. In large operations, from an economical point of view, it is

desirable to recover absorbed menstrua when the residues contain sufficient alcohol to make it worth the necessary time and labor. Distillation is then resorted to, or the residue is treated with weak alcohol and subsequently with water. Where water causes swelling of the substance and a stoppage of the percolation, the residue may be mixed with clean sawdust, rice chaff, or some other inert dry substance, and then percolated with water. Recovered distilled alcohol may be purified by treating it with potassium permanganate; twelve grains dissolved in a gallon of the percolate, and allowed to stand a few days, are usually sufficient. The purified alcohol may be decanted or filtered. Care must always be taken not to use unpurified recovered alcohol which is odorous on account of containing volatile oil obtained from a drug, or which may be otherwise impure.

Controlling the Flow of the Percolate—The necessity for some method of controlling the flow of the percolate is apparent. In simple percolation this is effected by the degree of pressure used in packing the moistened drug. Judgment and experience are absolutely necessary to guide the operator. Various mechanical expedients have been used to accomplish the same purpose. For the control of the flow of percolate by the official method (see Fig. 386) the neck of the funnel-end should be rather short, and should gradually and regularly become wider toward the orifice, so that a perforated cork, bearing a short glass tube, may be tightly wedged into it. The glass tube, which must not project above the inner surface of the cork, should extend from 3 to 4 cm. beyond the outer surface of the cork, and should be provided with a closely fitting rubber tube, at least one-fourth longer than the percolator itself, and ending in another short glass tube, whereby (when it is desired to interrupt the percolation) the rubber tube may be so suspended that its orifice shall be above the surface of the menstruum in the percolator, a rubber band or wire loop holding the tube in position.

In metallic percolators stopcocks or spigots have been employed. It is possible to improvise a control of the flow by employing a narrow homœopathic vial, having a one-eighth inch hole in the side, a half inch from the bottom, and passing it through a perforated cork fitting tightly in the neck of the percolator. By pulling the vial down, the hole is stopped by the encircling cork; by pushing it up, the hole is exposed so that the percolate runs through the vial, and thus the flow may be regulated. Fig. 402 illustrates a very useful method of controlling the flow of a percolate. This "sprinkler controller" was specially made but if not available the well known sprinkler, made of whitemetal, used for liquid dentifrice bottles may be employed. The flow of liquid can be perfectly controlled by its use. In the U. S. P. X the following directions are found:

Fig. 402



Stopper for percolation control

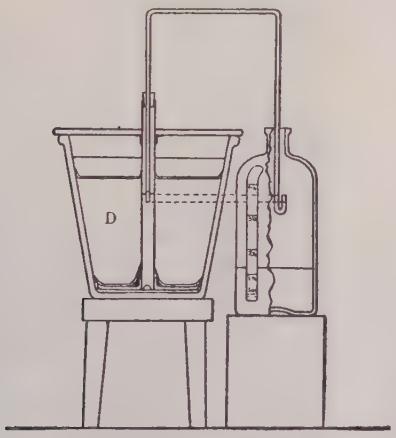
"*Rate of Flow*—The success of the process of percolation largely depends upon the regulation of the flow of the percolate; if this is too rapid, incomplete exhaustion will result, but if too slow, valuable time is wasted and considerable loss of menstruum occurs from evaporation. For fluidextracts using 1000 Gm. of powder, the rate of flow should not exceed ten drops a minute; for official quantities of tinctures and preparations of about the same strength, twenty drops a minute, and the word 'slowly' throughout the text is understood to mean a rate of flow corresponding to this. The proper rate of flow should vary with the quantity and character of the drug employed and the density of the menstruum".

Special Percolators

Well Tube Percolator—An excellent method of percolation which was used by Dr. E. R. Squibb for a number of years, and is still employed, is shown in Fig. 403. It is based upon the principle of drawing water from a well automatically as fast as it accumulates. This is effected by the use of a well tube placed in the center of an ordinary jar or pot and held in its place by the powdered drug which is packed around it. The menstruum is poured upon the drug, and, after percolating through, collects in the well tube, from which it is drawn off by an ingeniously constructed syphon. The illustration clearly shows the method of using this apparatus. It may be used for large or small operations.

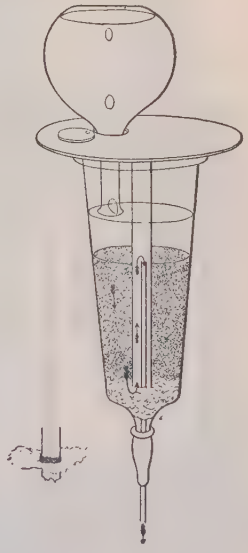
Double Tube Percolator—This differs from the well tube percolator just described in the use of an ordinary percolator, the absence of the syphon, and the substitution of a simple, straight tube which is free to move up and down inside of the well tube at the discretion of the operator. Fig. 404 illustrates its mode of action. A central well tube having the lower end irregularly broken

Fig. 403



Well tube percolator (Squibb)

Fig. 404



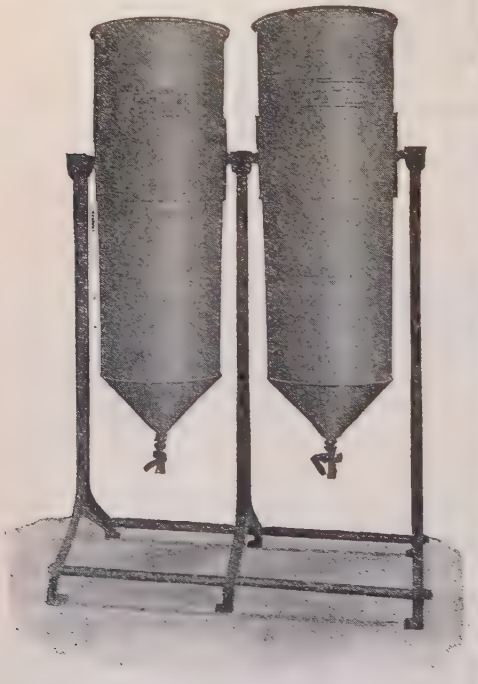
Double tube percolator

is placed in an ordinary glass percolator, upon a tuft of absorbent cotton, or, as in Doctor Squibb's percolator, a circular piece of muslin is securely tied upon the tube a short distance from the bottom, as shown in the small cut in Fig. 404, and the end of the tube rests upon a perforated cork fitting tightly in the neck of the percolator, as proposed by W. S. Thompson in his description of a similar apparatus. The control of the flow of the percolate is effected by raising or lowering the small tube which passes into the well tube, and which is held in place by passing through the perforated cork in the neck of the percolator already mentioned, or through a perforated rubber nipple slipped over the end, as suggested by Windolph, or through a piece of rubber tubing. If previous maceration is directed, the narrow tube may be pushed up until the upper orifice is above the level of the menstruum, and of course above the level of the percolate in the well tube. When it is desirable to begin percolating, the tube is gently rotated with a downward movement until the level of the percolate is reached, and then percolation proceeds regularly, the course of the

menstruum being indicated as shown by the arrows in Fig. 404. The rapidity of the flow is increased by lowering the tube, and decreased by raising it.

Percolation on the Large Scale—Ordinary glass percolators cannot be made of very large size, although well tube percolators are well suited for large operations, but tinned copper or galvanized iron percolators are most frequently employed. Brass stopcocks are mainly depended upon for controlling the flow of the percolate, but these are sometimes objectionable because of the difficulty in cleaning them, and on account of the liability of becoming clogged with evaporated percolate, it is often difficult to start or control the flow accurately. Fig. 407 illustrates a copper percolator, made by Arthur Colton, of Detroit, with diaphragm for supporting the disk of flannel or cloth. It is intended to be placed upon a counter or table.

FIG. 405



Percolators supported from the floor

FIG. 406

Percolator suspended from the ceiling

In large operations it is necessary to employ means to facilitate not only the percolation, but also the packing and emptying, the other subordinate but essential parts of the process. Figs. 405 and 406 show two plans by which this may be accomplished.

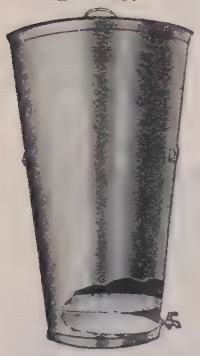
The emptying of the marc from the percolator, at the conclusion of an operation, is the special advantage secured. The entire residue may be dumped into a truck and carried to the still for alcohol recovery.

Fig. 408 illustrates a working model of the Lloyd Extractor and Con-

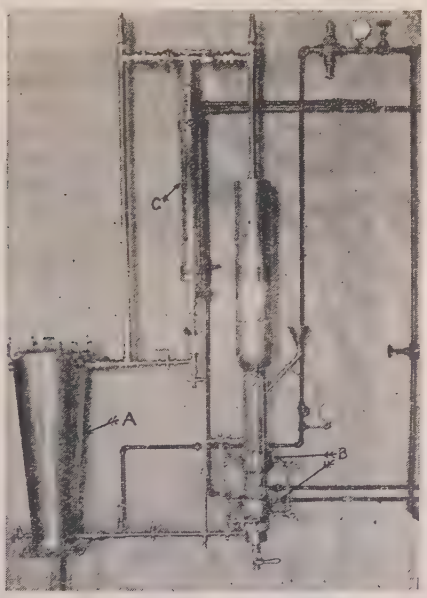
centrator, as used experimentally in the Philadelphia College of Pharmacy and Science. This patented percolating outfit is used on a manufacturing scale in the laboratories of Lloyd Brothers and Johnson and Johnson. All of the extract of belladonna needed for plaster making in the J. and J. laboratory has for years been made with such an outfit. The products obtained from this apparatus are of exceptional interest as contrasted with materials obtained by other processes and other forms of apparatus. The temperature applied to the percolate during evaporation is but for the fraction of a minute, and this permits of the extraction and concentration of the most delicate plant structures with a minimum of change in the product if, indeed, there be any change. The use of excessive heat has long been recognized as one of the

FIG. 408

FIG. 407



Copper percolator (Colton)



Lloyd extractor and concentrator

FIG. 409

Percolate returned as menstruum

weaknesses of many operations involving percolation and concentration and this apparatus seems to point the way to better methods.

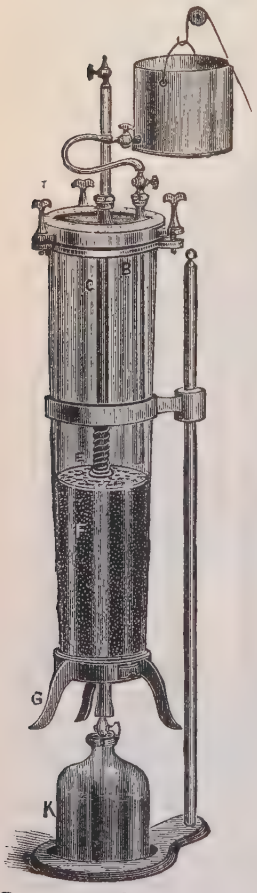
The drug is packed in the percolator *"A"*, the top is clamped on, connections made, the menstruum added, and in due time the percolate flows into one of the concentrators. These consist of narrow, steam-jacketed cylinders marked *"B"*. An adjustment permits the drawing off of the concentrated percolate after heating which is required for but a fraction of a minute. Either concentrator may be used at will. The volatilized menstruum is recondensed at *"C"* and flows back upon the drug for further extraction, thus using a minimum of heat and of menstruum, and ensuring complete drug extraction. Alcohol, ether, or other solvents may be safely employed and the apparatus is tightly closed.

Fig. 409 illustrates a type of percolator now being used on a large scale for the extraction of drugs with a smaller amount of menstruum. It is applicable to some unofficial preparations. The small electric pump returns the percolate to the drug so that it repercolates a number of times and is

finally very fully saturated. The objection to this plan is that valuable percolate remains in the drug at the close of the initial operation which must be removed by washing with fresh menstruum.

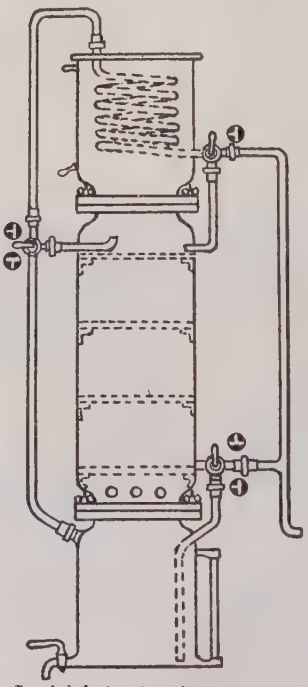
Pressure Percolator—Percolation by pressure was at one time employed. A typical apparatus is shown in Fig. 410. All forms of apparatus were based upon the same principle,—that of forcing the menstruum through the powder at a greater rate of speed than it would pass if it depended alone on the force of gravity. It will be noticed that Count Real's apparatus, invented in 1815, was based upon this principle (see page 233). Joseph P. Remington, after an extended practical trial of percolation by pressure, reached the conclusion, that, while there are some percolating operations in which it can be used advantageously, for the great majority the pressure is unnecessary, just as perfect results being reached by the use of as simple a percolator as a glass funnel or cylinder of the well known form.

Fig. 410



Pressure percolator (Suits)

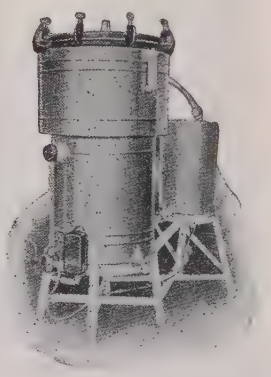
Fig. 411



Lewin's hot extraction apparatus

Percolation with Hot Extraction—In some cases it is desirable to exhaust drugs with hot menstrua. Lewin's extraction apparatus is shown in Fig. 411. The lower vessel is a still; immediately above it is the percolator having three movable sieves for the reception of the substance to be extracted; above the percolator is the condenser. By the use of the three-way stopcocks, the percolation, distillation, and extraction may be controlled at will. Fig. 412 illustrates the Hardesty vanilla percolator in which the principle of hot extraction is used. It is claimed for this outfit that complete exhaustion of the vanilla beans, prevention of loss from evaporation, rapidity of extraction and the avoidance of contamination from other flavors and odors of the laboratory make the adoption of this process of great value to the large manufacturer of flavoring extracts. The menstruum percolates through the drug, the percolate

Fig. 412



Hardesty vanilla percolator

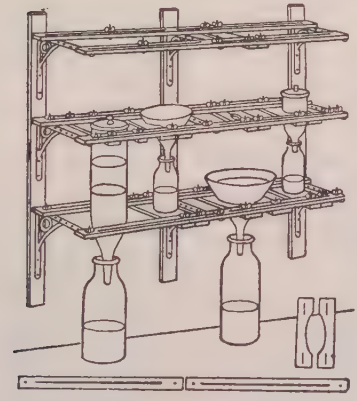
is then heated until vaporized and afterwards recondensed over the drug. This alcoholic liquid again percolates through the drug and the process is continued until complete extraction of flavor is effected, the temperature being carefully regulated throughout so that the aroma is not injured and undesirable constituents removed. This percolator is similar in principle to the Soxhlet extraction apparatus (see Fig. 159).

Methods of Supporting Percolators—The ordinary retort stands are often used to support percolators, but these are generally flimsy and unsatisfactory. The one shown in Fig. 182, particularly if used with split rubber tube sections, as seen in Fig. 187, is much to be preferred. The stand shown in Fig. 413 was devised by Joseph P. Remington in 1875, and because of its adjustability is very useful. Large percolators stand on tables or are suspended as illustrated in Figs. 405 and 406.

Sugar Percolation—The principle of percolation is also extensively applied to the solution of sucrose (sugar) in the preparation of syrups. For this purpose the ordinary percolator may be used but special percolators have also been devised, see Syrups, page 263, Fig. 416.

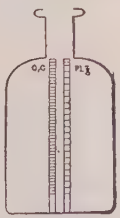
Receiving Bottles—A series of bottles of various sizes should be reserved for use in receiving percolates. Bottles with comparatively wide necks are to

Fig. 413



Percolator stand

Fig. 414



Graduated receiving bottle

Fig. 415

Receiving bottle for percolates

be preferred for receiving bottles. A strip of adhesive plaster may be pasted on the side and accurately measured quantities of water poured in, carefully marking the height of each addition; upon the opposite side corresponding metric quantities may also be placed (Fig. 414). Narrow receiving bottles (metric and old form, and both systems on the same bottle) (Fig. 415) are now available. The graduations are accurately engraved on the glass, to suit the quantities usually made by the pharmacist.

The tin-lined copper can, illustrated in Fig. 406, is used as a receiving vessel in large scale percolation.

Fractional Percolation—This is a term employed by Prof. C. Lewis Diehl and others to define percolation when applied to two successive portions of powder, the principle of action being identical with that of repercolation.

Repercolation—This, as its name indicates, is the process of percolating substances with percolates, or, as defined by Dr. E. R. Squibb, the author of the process, "the successive application of the same percolating menstruum

to fresh portions of the substance to be percolated". The principal object of repercolation is to effect the saving of alcohol and alcoholic menstrua by accomplishing the saturation of the menstrua, as nearly as possible, by passing the unsaturated or weaker percolate from one portion of the drug through another portion, and again passing the unsaturated or weaker percolate from this second portion through a third portion. The fact that no heat is required to concentrate the percolate in the manufacture of fluidextracts is one of the special advantages of repercolation. The weak percolate from this last portion is generally set aside, to be used in succeeding operations upon the same drug in the place of fresh menstruum. This process is useful only in those operations where the relative proportion of menstruum used is small, as in the fluidextracts and similar concentrated preparations. Practical illustrations of the use of this process may be seen by referring to the chapter on Fluidextracts, the principle having been adopted in Type Process C, for Fluidextracts.

PART III

GALENICAL AND OTHER PHARMACEUTICAL PREPARATIONS

MANY of the processes which are used in making the official preparations having been considered in Part II, such as solution, filtration, digestion, percolation, maceration, expression, etc., a natural grouping of the preparations is now considered. This classification presents to the student most of the processes in the order of their simplicity, the more difficult being taken up last. Related groups are of course studied together. Each chapter will begin with a definition and description of the class of preparations of which it treats; then will follow the individual preparations forming the class, with the official processes and explanation. All preparations are arranged alphabetically with those of the U. S. P. first, then those of the N.F. A table of abbreviated unofficial formulas will be found after each class, containing mainly preparations of the older U. S. Pharmacopœias, and also those of the British Pharmacopœia (1914), and others. The following diagram will serve to give a complete view of the classification; it should be carefully examined at the outset, and referred to again after the classes have been studied in detail:

CLASSIFICATION OF OFFICIAL PREPARATIONS

Liquids

MADE WITHOUT PERCOLATION OR MACERATION

Aqueous Solutions

English Title	*Latin Title*	*Genitive or Prescription Form*
Ampuls	Ampulla	Ampullæ
Waters	Aqua	Aquæ
Diluted Acids	Acidum Dilutum	Acidi Diluti
Solutions	Liquor	Liquoris

Aqueous Preparations Containing Sweet, Viscid, or Suspended Substances

Syrups	Syrupus	Syrupi
Honeys	Mel	Mellis
Oxymels	Oxymel	Oxymellis
Mucilages	Mucilago	Mucilaginis
Emulsions	Emulsum	Emulsi
Magmas	Magma	Magmatis
Mixtures	Mistura	Misturæ
Gargles	Gargarisma	Gargarismatis
Lotions	Lotio	Lotionis

Glycerin Solutions

Glycerites	Glyceritum	Glyceriti

Alcoholic and Hydroalcoholic Solutions

Spirits	Spiritus	Spiritus
Elixirs	Elixir	Elixiris
Washes	Lavatio	Lavationis
Dental Liniments	Dentilinimentum	Dentilimenti

Chloroformic Solutions

Chloroformic Solutions	Solutio Chloroformica	Solutionis Chloroformicæ

Ethereal Solutions

Collodions	Collodium	Collodii

Oleaginous Solutions

Liniments	Linimentum	Linimenti
Oleates	Oleatum	Oleati
Petroxolins	Petroxolinum	Petroxolini
Sprays	Nebula	Nebulæ
Medicated Oils	Oleum	Olei

MADE BY PERCOLATION OR MACERATION

Aqueous Preparations

English Title	*Latin Title*	*Prescription Form*
Infusions	Infus**um**	Infus**i**
Decoctions	Decoct**um**	Decoct**i**

Alcoholic Preparations

Tinctures	Tinctur**a**	Tinctur**æ**
Fluidextracts	Fluidextract**um**	Fluidextract**i**

Glycerin Preparations

Fluidglycerates	Fluidglycerat**um**	Fluidglycerat**i**

Oleoresinous Preparations

Oleoresins	Oleoresin**a**	Oleoresin**æ**

Oily Preparations

Infused oils	Oleum Infus**um**	Olei Infus**i**

Acetous Preparations

Vinegars	Acet**um**	Acet**i**

Solids

MADE BY PERCOLATION OR MACERATION

Extracts	Extract**um**	Extract**i**
Resins	Resin**a**	Resin**æ**

MADE WITHOUT PERCOLATION OR MACERATION

Artificial Salts	Sal Factiti**um**	Salis Factiti**i**
Effervescent Salts	Sal Effervescens	Salis Effervescent**is**
Powders	Pulv**is**	Pulver**is**
Oil Sugars	Oleosaccha**ra**	Oleosaccharor**um**
Triturations	Triturati**o**	Triturati**onis**
Teas	Speci**es**	Speci**ei**
Dentifrices	Dentifrici**um**	Dentifrici**i**
Masses	Mass**a**	Mass**æ**
Confections	Confecti**o**	Confecti**onis**
Pills	Pilul**æ**	Pilul**arum**
Troches	Trochisc**i**	Trochisc**orum**
Tablets	Tabell**æ**	Tabell**arum**
Ointments	Unguent**um**	Unguent**i**
Inunctions	Inunct**um**	Inunct**i**
Cerates	Cerat**um**	Cerat**i**
Glycerogelatins	Glycerogelatin**um**	Glycerogelatin**i**
Pastes	Past**a**	Past**æ**
Cataplasms	Cataplasm**a**	Cataplasmat**is**
Plasters	Emplastr**um**	Emplastr**i**
Mulls	Mull**a**	Mull**æ**
Papers	Chart**a**	Chart**æ**
Dressings (Medicated)	Curati**o**	Curati**onis**
Suppositories	Suppositori**a**	Suppositori**orum**
Pencils (Medicated)	Stil**us**	Stil**i**

LIST OF UNOFFICIAL CLASSES OF PREPARATIONS

Applicati**o-nis**	A preparation for external use
Auristilla-**æ**	A preparation for internal medication of the ear
Bacillula-**æ**	A rod-shaped lozenge
Bacill**um-i**	A bougie
Balne**um-i**	A bath for general application
Bol**us-i**	A large pill (over 5 grains)
Bougi**a-æ**	An instrument or form of medication for insertion into the urethra or other body cavities
Buginari**um-i**	A nasal bougie
Capsul**a-æ**	A capsule
Capsul**a** (æ) amylace**a** (æ)	A cachet or konseal
Carbas**us-i**	Gauze–plain or medicated
Cathet**us-i**	A tubular instrument used for withdrawing urine
Cereol**us-i**	A urethral bougie
Chartul**a-æ**	A folded powder
Chartul**a** (æ) amylace**a** (æ)	A sheet of cachet material
Chrisma-**tis**	A salve
Collunari**um-i**	A nose wash
Collutori**um-i**	A mouth wash
Collyri**um-i**	An eye wash
Conserv**a-æ**	A confection of fresh medicinal agents
Cordiale-**is**	A sweetened alcoholic preparation of high alcohol content
Cremor-**is**	A cream
Electuari**um-i**	A confection of dried medicinal agents
Embrocati**o-nis**	A liniment
Enem**a-tis**	A rectal injection—a clyster
Escharotic**a-æ**	A caustic application

Essentia-æ ..... An essence
Fomentum-i. ..... An aqueous preparation to be applied on a woolen cloth while hot
Fotus-i..... Same as fomentum—a fomentation
Gelatina-æ ..... A semisolid gelatinous preparation for internal or external use
Globule-is ..... A sphere of sugar
Glycerinum-i..... A glycerite
Granula-æ ..... An effervescing granular salt
Granule-is..... A sugar pellet impregnated with medicinal matter
Gutta-æ..... A drop
Haustus-us ..... A draught
Injectio-nis ..... An injection
Injectio hypodermica-æ ... A hypodermic injection
Insufflatio-nis ..... A snuff
Irrigatio-nis ..... A preparation to be applied continuously by means of a special device for the purpose
Jaconettum-i ..... Water-proofed jaconett
Lamella-æ ..... A glycerogelatin disc for use in the eye
Ligamentum-i ..... A bandage
Linctus-us ..... A thick viscid liquid which must be licked from a spoon
Linimentum (i) Exsiccantium (i)..... A drying liniment
Linteum-i ..... Lint—plain or medicated
Litus-i ..... A fluid preparation applied by means of a brush
Lohoch..... A linctus; a syrupy medicine to be administered by licking
Moxa-æ ..... A cone of combustible matter used for cauterization by burning
Oculentum-i ..... An ointment for the eye
Oleinata-æ..... An oleate
Orbicule-is..... A spherical globule of sugar
Parogenum-i ..... Petroxolin
Parvula-æ ..... A small sugar coated pill
Pastillus-i ..... A form of lozenge (chocolate lozenges are called pastillæ in the German Pharmacopœia and tabellæ in the British Pharmacopœia). Also applied to a combustible cone of aromatic drugs used for fumigation
Pellets..... Small spheres of sugar
Pessum-i..... } A pessary
Pessarium-i ..... }
Pigmentum-i ..... A medicinal preparation to be applied by means of a brush
Pilula (æ) comprimata (æ).. A compressed pill, a tablet
Pilula (æ) enterica (æ) .... An enteric pill
Pomatum-i ..... A fat saturated with odorous principles
Plasma-tis ..... A non-fatty unctuous preparation
Potus-us ..... } A draught
Potio-nis..... }
Politzer Plug..... A pledget of cotton, attached to a thread, for insertion in the ear
Rotula-æ ..... A globule or orbicule
Sericum (i) oleatum (i).... Oiled silk
Sinapismus-i ..... A blister
Sindon (i) oleata (æ)..... Oiled cambric
Solvella-æ ..... A soluble tablet
Steatina-æ..... A salve mull
Stilus (i) dissolubilis (is) .. A pencil containing a caustic or an astringent
Stilus (i) unguentis (is)..... A salve pencil; cooling, antiseptic, or astringent
Stupa-æ ..... Tow, plain or medicated
Tabletta-æ..... A tablet
Tela-æ ..... Tissue
Unguenta (æ) extensa (æ) . A mull
Vapor-is..... A vapor, generated by the use of steam or boiling water or by the use of a specially constructed apparatus
Vapor-is Siccus-i ..... A dry inhalation
Vinum-i..... Wines — Preparations similar to tinctures and using wine as the menstruum. These are no longer official and the important ones have been replaced by other preparations

CHAPTER XXIV

AQUEOUS SOLUTIONS

Aquæ—*Waters*

The class of preparations termed *waters* are known also as medicated, aromatic, or distilled waters, and may be simply defined as *aqueous solutions of volatile substances*. The German Pharmacopœia and the French Codex, however, recognize solutions of non-volatile substances as waters.

Waters are mostly saturated solutions and should be clear and free from empyreumatic (smoke-like) or other foreign odors. Strong light, or freezing, hastens their decomposition, and the tendency to form microscopic growths is retarded if purified cotton is used as a stopper for the containers in which they are stored.

The volatile oils from which aromatic waters are to be made should be of the best quality and in perfect condition if the finest flavors are to be obtained. The Pharmacopœia permits most of the aromatic waters to be made by any of the processes, the detailed formulas which follow indicating the exceptions.

The volatile substances used in the preparation of waters are either solid, liquid, or gaseous, and the following methods have been employed in effecting their solution: 1. Simple solution in cold distilled water, with or without filtration through paper. 2. Filtration with the aid of an absorbent powder. 3. Filtration with the aid of pulped or shredded filter paper. 4. Distillation.

Most of the medicated waters are solutions of aromatic volatile oils and are used as pleasant vehicles and solvents for the administration of various remedies.

1. **Simple Solution in Cold Water**—This method is followed when the proportion of the volatile substance is small enough to dissolve easily in the quantity of water required, as in the formerly official Bitter Almond Water. It is also recommended when an excess of a volatile liquid is added and after repeated agitation and standing for about twelve hours, the product is filtered through a paper filter which has been thoroughly washed with distilled water. The method of making medicated waters by agitation with an excess of volatile oil, permitting the excess to remain and drawing off the water as required, is not recommended on account of the liability of the oil to deteriorate through exposure to light and air. In the case of gaseous solutions, the gas is passed through the water until a solution of the desired strength is obtained. (See Solution of Gases, p. 182.)

2. **Filtration with the Aid of an Absorbent Powder** is the process most frequently employed; the object of using the powder is to thoroughly divide the oil, or volatile substance, and thus expose a greater surface, so that the water in filtering through it may become completely saturated. Magnesium carbonate was formerly employed for this purpose, but its slight solubility in water, causing the latter to show a trace of alkalinity, renders it unfit for use. Calcium phosphate, kaolin, powdered glass, silica, powdered pumice-stone, charcoal, precipitated chalk, sugar, etc., have been suggested as substitutes, but there are quite as strong objections to these as to the magnesium carbonate. The Pharmacopœia recommends the use of purified talc, in not finer than a No. 100 powder, for this purpose, with purified siliceous earth as an alternative, although the latter has not proved satisfactory for waters. It is, however, an excellent filtering medium for elixirs.

When solutions of alkaloids or of silver nitrate are prescribed, distilled water alone and not an aromatic water should be used.

3. **Filtration with the Aid of Pulped or Shredded Filter Paper**—This process is permitted by the U. S. P. (10th Revision) and consists in dropping the volatile oil upon white filter paper or filter paper pulp, tearing this into shreds, transferring it to a flask or stoneware jug, adding distilled water in portions, and shaking it thoroughly. The liquid is then filtered through paper and the quantity adjusted by pouring distilled water through the filter.

4. **Distillation**—The process of making waters by distillation is the most ancient of all processes of this class of preparations and in many instances is said to give a better product than any other method.

There is much lack of uniformity however in the directions for preparing even the same water by distillation when different authorities are consulted. For fresh drugs the proportions range from one part of drug to two of distillate, to two parts of drug to one part of distillate. For dried drugs such as cinnamon, anise, dill, caraway and fennel the proportion is one part of the drug to ten parts of distillate. In the case of dried leaf drugs such as peppermint the proportion is three parts of drug to ten parts of distillate. Metallic distillation apparatus is usually employed, sometimes using a current of steam passed through the still from the outside. The drug should be contused or coarsely ground. Most distilled waters acquire an unpleasant empyreumatic odor as soon as they are distilled; this passes off gradually upon exposure to air, if care has been taken not to expose the drug to the action of direct heat during distillation. If no precautions are taken to protect the drug from partial burning, the odor of the carbonized substance will always be noticeable in the distilled water, rendering the product worthless. Fig. 197 shows a copper wire cage suggested by Joseph P. Remington to obviate the difficulty just described; the surface of the cage is hemispherical; it rests, after being partially filled with the drug, upon the flat bottom of the still, and thus the contact of the substance with the heated surface is avoided; the meshes of the cage are coarse enough to permit the free passage of vapors and boiling water through them. In those waters, such as orange flower and rose, in which the flavor and odor are in small amount and delicate, the distillate is returned several times to the still with fresh portions of flowers, thus giving rise to the commercial terms "*double distilled*", "*triple distilled*", or "*quadruple distilled*", according to the number of redistillations. This process is called *cohobation.*

Among the official waters several are directly to be made only by distillation. They are Stronger Rose Water and Orange Flower Water of the Pharmacopœia and Hamamelis Water of the National Formulary.

Preservation—Distilled waters should not be made in larger quantities than can be used within a reasonable time, as they deteriorate when long kept, a flocculent precipitate forming and all traces of their usually agreeable odor disappearing. Should microscopic organisms develop, they render the water unsightly, and when in large proportion they must be regarded as injurious. The use of recently boiled, distilled water is preferable, to avoid as far as possible the presence of micro-organisms in the water used, as it is well known that ordinary distilled water contains many of them. The freshly prepared water may be introduced into a sterilized bottle with a side opening to which a sterilized rubber tube with a pinchcock is attached, and the bottle then closed with a pledget of sterilized cotton. This will materially assist in the preservation of the water. It usually suffices, however, to preserve the medicated water in small bottles, which are completely filled, tightly sealed, and kept in

a cool, dark place. No preservative should be added to medicated waters and if they become cloudy or otherwise deteriorate, they should be discarded.

The U. S. P. X has introduced the following general processes by which most of the official waters are to be made, the choice being left to the pharmacist. Theoretically, all processes produce identical products, but in practice the distillation method yields quite a differently flavored water. However, in pharmacies in the United States one of the other processes is almost universally followed and if care has been taken in the selection of the volatile oil and in the preservation of the product, the waters are satisfactory.

AQUÆ AROMATICÆ. U. S. Aromatic Waters

Official Type Processes for Aromatic Waters

(*a*) *Distillation*—Place the odoriferous portion of the plant or drug from which the Aromatic Water is to be prepared in a suitable still with sufficient water, and distil most of the water, carefully avoiding the development of empyreumatic odors through the burning of the substances. Separate any excess of oil, and preserve or use the clear aqueous portion, which should be saturated with the flavoring or aromatic principles of the plant.

(*b*) *Solution*—

	Metric	Alternative
The Volatile Oil, or Other Specified Volatile Substance	**2 cc. or 2 Gm.**	30 minims or grains
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Shake the volatile substance with 1000 cc. [2 pints] of distilled water in a capacious bottle, and repeat the shaking several times during a period of about fifteen minutes. Set the mixture aside for twelve hours or over night, filter through paper, and pass enough distilled water through the filter to obtain 1000 cc. [2 pints].

If preferred, the Aromatic Water may be prepared by the above formula but with the addition of about 15 Gm. [220 grains], of purified talc, or a sufficient quantity of purified siliceous earth, or pulped filter paper, with which the volatile substance is thoroughly incorporated. Agitate the mixture well, and filter, returning the first portions of the filtrate until it comes through clear.

AQUA ANISI. U. S. Anise Water

[Aq. Anisi]

A saturated solution of oil of anise in distilled water, prepared by one of the processes for aromatic waters (page 252).

Uses—A flavored vehicle, especially pleasing to children.

Average dose—4 fluidrachms (15 cc.).

AQUA AURANTII FLORUM. U. S. Orange Flower Water

[Aq. Aurant. Flor.—Aqua Aurantii Florum Fortior U. S. P. IX, Triple Orange Flower Water, Aqua Naphæ]

Note—This is the former Stronger Orange Flower Water, the weaker water, of one-half strength, having been deleted. This should be remembered in using it in the renewal of old prescriptions.

A saturated solution of the odoriferous principles of the flowers of *Citrus Aurantium* (var. *amara*) Linné (Fam. *Rutaceæ*), prepared by distilling the

fresh flowers with water and separating the clear, saturated portion of the distillate. Its odor is best preserved by allowing a limited access of fresh air to the container.

Description and Physical Properties—Nearly colorless and clear or only faintly opalescent, possessing a strong, pleasant odor and taste of orange blossoms.

It must be free from empyreuma, mustiness, or fungoid growths.

Tests for Purity—Orange Flower Water is neutral or only slightly acid to litmus paper.

Evaporate 100 cc. of the Water on a water bath, and dry the residue to constant weight at 100° C.: not more than 0.001 Gm. of residue remains.

Orange Flower Water shows no reaction with hydrogen sulphide T.S. or with sodium sulphide T.S. (*metallic impurities*).

U. S. P. Preparations—Syrupus Aurantii Florum; Trochisci Acidi Tannici.

N. F. Preparations—Elixir Amygdalæ Compositum; Elixir Aurantii Amari; Elixir Glycyrrhizæ Aquosum; Liquor Hypophosphitum Compositus; Liquor Phosphatum Compositus; Syrupus Calcii Lactophosphatis.

Uses—It is employed as a flavor in syrups, elixirs, and solutions.

Average dose—2 fluidrachms (8 cc.).

AQUA CAMPHORÆ. U. S. Camphor Water

[Aq. Camph.]

A saturated solution of camphor in distilled water, prepared by one of the processes for aromatic waters (page 252), using 2 Gm. [30 grains] of powdered camphor in each 1000 cc. [2 pints].

N. F. Preparations—Mistura Camphoræ Acida; Mistura Camphoræ Aromatica.

Uses—Frequently employed as a vehicle in eye and mouth washes; also as a mild nerve sedative.

Average dose—2½ fluidrachms (10 cc.).

AQUA CHLOROFORMI. U. S. Chloroform Water

[Aq. Chlorof.]

Chloroform,
Distilled Water, each, a sufficient quantity.

To a convenient quantity of distilled water contained in a dark amber-colored bottle, add enough chloroform to maintain a slight excess after the contents have been repeatedly and thoroughly shaken.

When Chloroform Water is required for use, pour off the needed quantity, refill the bottle with distilled water, and saturate it by thorough agitation, taking care that there is always an excess of chloroform present.

Preserve in well-stoppered, amber-colored bottles.

Chloroform water is used as the menstruum in the following preparations:

N. F. Preparations—Extractum Ergotæ Aquosum; the Fluidglycerates.

Uses—It is employed as a sedative in cough mixtures and as a vehicle for administering active remedies. Because of its antiseptic value it frequently replaces water as a menstruum, the chloroform being evaporated during the concentration of the percolate. The saturated water contains about 0.5 per cent of chloroform.

Average dose—4 fluidrachms (15 cc.).

AQUA CINNAMOMI. U.S. Cinnamon Water

[Aq. Cinnam.]

A saturated solution of oil of cinnamon in distilled water, prepared by one of the processes for aromatic waters (page 252).

U. S. P. Preparations—Infusum Digitalis; Mistura Cretæ.
N. F. Preparations—Liquor Ferri Albuminati; Syrupus Cinnamomi; Syrupus Ipecacuanhæ et Opii; Tinctura Ferri Pomata; Tinctura Rhei Aquosa.

Uses—A pleasantly flavored vehicle.

Average dose—4 fluidrachms (15 cc.).

AQUA DESTILLATA. U.S. Distilled Water

[Aq. Dest.]

Water [H_2O] purified by distillation.

The U. S. P. X suggests no method for preparing Distilled Water, simply establishing its degree of purity, but the former official process is copied below. The pharmacist who is preparing sterile solutions, and must therefore have freshly distilled water, may advantageously follow this plan, but he must use "insoluble-glass" flasks for distilling and for receiving the distillate and a block tin, or "insoluble-glass" condenser. If this precaution is not taken, distilled water will contain soluble silicates, and be unfitted for injection. The first 100 volumes are discarded to eliminate foreign volatile substances found in ordinary water and only 750 volumes are collected, since the residue in the still will contain dissolved solids. Distilled water, conforming to the U. S. P. X requirements, may also be prepared by one of the automatic stills described under Distillation (see page 142).

The U. S. P. IX process was as follows:

Water	**1000 Vol.**
To make	**750 Vol.**

Distil the water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first 100 volumes and reject this portion. Then collect 750 volumes and keep the distilled water in glass-stoppered bottles, which have been rinsed with hot distilled water immediately before being filled.

For the U. S. P. X standards and tests for Distilled Water see Part IV.

AQUA DESTILLATA STERILISATA. U.S. Sterilized Distilled Water

[Aq. Dest. Steril.]

The formula for sterilized distilled water and a discussion concerning its manufacture will be found under the Chapter on Sterilization (Part XI).

AQUA FŒNICULI. U.S. Fennel Water

[Aq. Fœnic.]

A saturated solution of oil of fennel in distilled water, prepared by one of the processes for aromatic waters (page 252).

Uses—A flavored vehicle.

Average dose—4 fluidrachms (15 cc.).

AQUA MENTHÆ PIPERITÆ. U.S. Peppermint Water

[Aq. Menth. Pip.]

A saturated solution of oil of peppermint in distilled water, prepared by one of the processes for aromatic waters (page 252).

N. F. Preparation—Liquor Sodæ et Menthæ (alternative with Spearmint Water).

Uses—A flavored vehicle.

Average dose—4 fluidrachms (15 cc.).

AQUA MENTHÆ VIRIDIS. U.S. Spearmint Water

[Aq. Menth. Vir.]

A saturated solution of oil of spearmint in distilled water, prepared by one of the processes for aromatic waters (page 252).

N. F. Preparation—Liquor Sodæ et Menthæ.

Uses—A flavored vehicle.

Average dose—4 fluidrachms (15 cc.).

AQUA ROSÆ. U.S. Rose Water

[Aq. Ros.]

Stronger Rose Water
Distilled Water, each, 1 volume.

Mix them immediately before use.

Rose Water complies with the description and tests under *Aqua Rosæ Fortior*.

Uses—Because of its delightful rose odor it is largely employed for its perfume value in eye and skin lotions.

AQUA ROSÆ FORTIOR. U.S. Stronger Rose Water

[Aq. Ros. Fort.—Triple Rose Water]

A saturated solution of the odoriferous principles of the flowers of *Rosa centifolia* Linné (Fam. *Rosaceæ*), prepared by distilling the fresh flowers with water and separating the clear saturated portion of the distillate. Its odor is best preserved by allowing a limited access of fresh air to the container.

Description and Physical Properties—Rose Water is nearly colorless and clear, possessing a strong, pleasant odor and taste of fresh rose blossoms. It must be free from empyreuma, mustiness, or fungoid growths.

Tests for Purity—It is neutral or only slightly acid to litmus paper.

Evaporate 100 cc. of the Water on a water bath, and dry the residue to constant weight in an oven at 100° C.: not more than 0.001 Gm. of residue remains.

Stronger Rose Water shows no reaction with hydrogen sulphide T.S. or with sodium sulphide T.S. (*metallic impurities*),

U. S. P. Preparations—Aqua Rosæ; Unguentum Aquæ Rosæ.
N. F. Preparation—Confectio Rosæ.

Uses—As a perfume in cold creams and lotions.

AQUA HAMAMELIDIS. N.F. Hamamelis Water

[Aq. Hamam.—Witch Hazel Water, Distilled Extract of Witchhazel]

	Metric	Alternative
Hamamelis Twigs, not less than	**1000 Gm.**	33 oz. av. 167 gr.
Water	**2000 cc.**	4 pints
Alcohol	**150 cc.**	4 fl. oz. 384 min.
To make about	**1000 cc.**	2 pints

Macerate the hamamelis twigs in the water during twenty-four hours, then distil until 850 cc. [27 fl. oz. 96 min.] of distillate are obtained, add the alcohol and mix thoroughly.

Description—Hamamelis Water is clear and colorless, having a characteristic odor and taste. It is neutral, or only faintly acid to litmus paper.

Specific gravity: 0.979 to 0.982 at 25° C.

Tests for Purity—It must be free from mucoid or fungous growths, and must not have an acetous odor.

Evaporate 100 cc. of Hamamelis Water on a water bath: not more than 0.025 Gm. of residue remains (*dissolved impurities*). It contains not less than 14 per cent of absolute alcohol by volume.

Ten cc. of Hamamelis Water gives no test for methanol when subjected to the official test for methanol under *Alcohol.*

A ten cc. portion of Hamamelis Water does not show the presence of acetone when subjected to the official test for acetone under *Alcohol.*

Hamamelis Water does not respond to tests for isopropyl alcohol or diethylphthalate when tested as directed under *Spiritus Frumenti*, U. S. P. X.

Add 8 drops of an aqueous solution of resorcinol (1 in 200) to 5 cc. of Hamamelis Water and carefully superimpose this upon 5 cc. of sulphuric acid, contained in a test tube. After standing for three minutes a rose-red ring does not appear at the line of contact of the liquids, nor does a distinct white layer appear above this zone (*formaldehyde*).

Preserve the product in tightly-closed containers in a cool place.

Approximate alcohol content, by volume, 14 per cent.

Uses—This is practically a solution of alcohol and water, the volatile oil of the bark coming over in such minute amount that it can have no therapeutic value. It is used popularly as an embrocation.

AQUA PHENOLATA. N.F. Phenolated Water

[Aq. Phenol.—Carbolic Acid Water, Solutio Phenoli, P. I.]

	Metric	Alternative
Liquefied Phenol	**22 cc.**	338 min.
Distilled Water	**978 cc.**	31 fl. oz. 142 min.
To make	**1000 cc.**	2 pints

Mix.

Uses—As a disinfectant wash for wounds, and as a local application to relieve itching of the skin.

Unofficial Waters

Title	*Directions*
Aqua Amygdalæ Amaræ, U. S. P. IX	Add 1 cc. oil of bitter almond to 1000 cc. of distilled water Note—This water contains but a trace of hydrocyanic acid and is used only as a flavor. The International Protocol preparation of the same name contains 0.1 per cent of hydrocyanic acid
Aqua Anethi Br. Dill Water	Saturated aqueous distillate from dill fruit [1]
Aqua Carui Br.	Saturated aqueous distillate from caraway fruit [1]
Aqua Creosoti, U. S. P. IX	Add 10 cc. of creosote to 990 cc. of distilled water and filter
Aqua Laurocerasi Br. Cherry Laurel Water	Aqueous distillate from cherry laurel leaves and containing 0.1 per cent, by weight, of hydrocyanic acid

Liquores—*Solutions*

Under this head the U. S. Pharmacopœia places all aqueous solutions of non-volatile substances except such as naturally form separate distinctive classes, as the syrups, infusions, and decoctions.

This classification is adopted only by the U. S. Pharmacopœia, the British standard embracing, in addition, gaseous and saccharine solutions, as Liquor

[1] These waters may be prepared by triturating the corresponding oil with twice its weight of calcium phosphate, adding 500 volumes of distilled water and filtering.

Ammoniæ, Liquor Calcis Saccharatus, etc., while the German Pharmacopœia does not adopt any definite method, solutions of volatile and non-volatile substances both being in the class Aquæ and also in the class Liquores, Aqua Rosæ and Aqua Plumbi together, and Liquor Ammonii Caustici and Liquor Natri Caustici in the same class. Liquor Formaldehydi was added to this class in the U. S. P. (8th Rev.) since paraformaldehyde, a solid substance, is formed upon heating.

The official solutions constitute a most interesting group of preparations. They are usually very active medicinal agents, and some of them are powerful poisons.

As the official solutions all involve individual chemical consideration, and as no general discussion would be of value, they will be taken up in detail under their appropriate classification; the arsenic solutions under arsenic, the ferric solutions under iron, etc. A discussion of the principles and various manipulative methods will be found under *Solution*, page 171. The list of official solutions is as follows:

LIQUORES, U. S. P. X

1. Simple Solutions (aqueous)

Liquor Acidi Arsenosi.....0.975 to 1.025 Gm. As_2O_3 in 100 cc. 5 per cent diluted HCl
Arseni et Hydrargyri Iodidi.....0.95 to 1.05 Gm. AsI_3 and 0.95 to 1.05 Gm. HgI_2 in 100 cc.
Calcii Hydroxidi.....Not less than 0.14 Gm. $Ca(OH)_2$ in 100 cc.
Cresolis Compositus.....50 per cent Cresol with Linseed Oil Soap
Epinephrinæ Hydrochloridi.....0.095 to 0.105 Gm. $C_9H_{13}O_3N$ in 100 cc.
Iodi Compositus.....4.8 to 5.2 Gm. of I and 9.8 to 10.2 Gm. of KI in 100 cc.
Pituitarii.....Water-soluble principles extracted from the posterior lobe of the pituitary body and standardized
Potassii Hydroxidi.....4.5 to 5.5 Gm. of KOH in 100 cc.
Sodii Chloridi Physiologicus.....8.5 Gm. Sodium Chloride in 1000 cc. of freshly distilled water and the solution sterilized
Sodii Hydroxidi.....Not less than 4.5 per cent of NaOH

2. Chemical Solutions (aqueous)

Liquor Ammonii Acetatis.....6.5 to 7.5 Gm. $NH_4C_2H_3O_2$ in 100 cc. (Ammonium Carbonate with Diluted Acetic Acid)
Ferri Chloridi.....Ferric Chloride, corresponding to from 10 to 11 per cent of Iron
Ferri et Ammonii Acetatis.....4 per cent by volume of Tincture of Ferric Chloride in Diluted Acetic Acid, Solution of Ammonium Acetate, Aromatic Elixir, Glycerin, and Water
Ferri Tersulphatis.....Normal Ferric Sulphate, corresponding to from 9.5 to 10.5 per cent of Iron
Formaldehydi.....37 per cent by weight of HCHO
Hydrogenii Dioxidi.....3 per cent by weight H_2O_2
Magnesii Citratis.....Magnesium Citrate, corresponding to not less than 1.5 Gm. of MgO in 100 cc. of Solution (made from Magnesium Carbonate, Citric Acid, Syrup, Oil of Lemon, Sodium or Potassium Bicarbonate, and water)
Plumbi Subacetatis.....Lead Subacetate corresponding to not less than 18 per cent of Lead (made from Lead Acetate, Lead Monoxide and Distilled Water)
Potassii Arsenitis.....Potassium Arsenite corresponding to from 0.975 to 1.025 Gm. of As_2O_3 in each 100 cc. (made from Arsenic Trioxide, Potassium Bicarbonate, Compound Tincture of Lavender, and Distilled Water)
Potassii Citratis.....Not less than 8 per cent $K_3C_6H_5O_7$ (made from Potassium Bicarbonate, Citric Acid, and Distilled Water)
Sodæ Chlorinatæ.....2.5 per cent of available Chlorine (made from Chlorinated Lime, Monohydrated Sodium Carbonate, and Water)
Sodæ Chlorinatæ Chirurgicalis.....0.43 to 0.48 per cent of available chlorine
Zinci Chloridi.....48.5 to 52 per cent of $ZnCl_2$

LIQUORES, N. F. V

1. Simple Solutions (aqueous)

Liquor Antisepticus.....Solution of Boric Acid, Thymol, Eucalyptol, Methyl Salicylate, Oil of Thyme, and Menthol with 30 per cent by volume, of Alcohol
Aromaticus Alkalinus.....Solution of Potassium Bicarbonate, Sodium Borate, Thymol, Eucalyptol, and Methyl Salicylate, with 5 per cent of Alcohol and 10 per cent of Glycerin by volume, the whole colored red with Cudbear

1. Simple Solutions (aqueous)—*Continued*

Liquor Bismuthi	Bismuth and Sodium Tartrate, corresponding to about 1.6 Gm. of Bismuth Oxide in each 100 cc. of Solution (made from Glycerite of Bismuth, Alcohol and Water)
Carmini	6.5 Gm. of Carmine in 100 cc. using Ammonia Water, Glycerin, and Water
Cocci	6.5 Gm. of Cochineal in 100 cc. extracted with the aid of Potassium Carbonate, Alum, Potassium Bitartrate, Glycerin, and Water
Hydrastinæ Compositus	About 0.3 per cent of Hydrastine Hydrochloride with Aluminum Chloride, Calcium Chloride, Magnesium Chloride, Potassium Chloride, Glycerin, and Distilled Water
Hypophosphitum Compositus	Made from Calcium, Potassium, Sodium, Ferric, Manganese, and Quinine Hypophosphites, Strychnine, Potassium Citrate, Hypophosphorous Acid, Orange Flower Water, Glycerin, and Distilled Water
Iodi et Zinci Phenolsulphonatis	Made from Potassium Iodide, Iodine, Zinc Phenolsulphonate, Glycerin, and Distilled Water
Iodi Phenolatus	Made from Compound Solution of Iodine, Liquefied Phenol, Glycerin, and Water
Pancreatini	1.75 Gm. of Pancreatin in 100 cc. with Sodium Bicarbonate, Glycerin, Compound Spirit of Cardamom, Alcohol, Magnesium Carbonate, Sodium Chloride, and Distilled Water, with Chloroform as a preservative
Pepsini	5 per cent by volume of Glycerite of Pepsin with Diluted Hydrochloric Acid, Glycerin, and Distilled Water
Pepsini Antisepticus	5 Gm. of Pepsin in 100 cc. with Menthol, Eucalyptol, Methyl Salicylate, Alcohol, Glycerin, Diluted Hydrochloric Acid, and Distilled Water
Pepsini Aromaticus	1.75 Gm. of Pepsin in 100 cc. with Oils of Cinnamon, Pimenta, and Clove, Alcohol, Diluted Hydrochloric Acid, Glycerin, and Distilled Water
Phosphori	0.07 Gm. of Phosphorus in 100 cc. with Spirit of Peppermint, Glycerin, and Dehydrated Alcohol
Picis Carbonis	Made from Coal Tar, Quillaja, and Alcohol
Plumbi Subacetatis Dilutus	3.5 per cent by volume of Solution of Lead Subacetate in Distilled Water
Potassii Iodidi	From 97 to 103 Gm. of KI in 100 cc. (made from Potassium Iodide, Sodium Thiosulphate, and Distilled Water
Procainæ Hydrochloridi	Made from Procaine Hydrochloride, Sodium Chloride, Thymol, and Sterilized Distilled Water
Sodæ et Menthæ	5 Gm. of Sodium Bicarbonate in 100 cc. with Aromatic Spirit of Ammonia and Spearmint or Peppermint Water
Sodii Arsenatis	1 per cent of Exsiccated Sodium Arsenate in Distilled Water
Sodii Arsenatis, Pearson	0.1 per cent of Exsiccated Sodium Arsenate in Distilled Water. (Note—This is one-tenth the strength of the Solution of Sodium Arsenate)
Sodii Boratis Compositus	Made from Sodium Borate, Sodium Bicarbonate, Liquefied Phenol, Glycerin, and Water
Sodii Phosphatis Compositus	100 Gm. of Sodium Phosphate in 100 cc. with Citric Acid, Glycerin, and Distilled Water

2. Chemical Solutions (aqueous)

Liquor Alumini Acetatis	4.5 to 5.5 Gm. neutral Aluminum Acetate in 100 cc. (made from Lead Acetate, Aluminum Sulphate, and Water)
Alumini Subacetatis	7.5 to 8 Gm. of Basic Aluminum Acetate in 100 cc. (Made from Aluminum Sulphate, Acetic Acid, Precipitated Calcium Carbonate, and Water)
Auri et Arseni Bromidi	Made from Arsenic Trioxide, Bromauric Acid, Bromine, and Water
Calcis Sulphuratæ	Made from Calcium Oxide, Sublimed Sulphur, and Water
Chlori Compositus	0.35 Gm. of available chlorine in 100 cc. (made from Potassium Chlorate, Hydrochloric Acid, and Distilled Water)
Ferri Albuminati	Made from Albuminized Iron, Cinnamon Water, Aromatic Elixir, Alcohol, and Distilled Water
Ferri Citratis	Ferric Citrate, corresponding to not less than 8.75 per cent of Iron (made from Solution of Ferric Sulphate, Citric Acid, Ammonia Water, and Water)
Ferri Peptonati	Made from Peptonized Iron, Sodium Citrate, Alcohol, Syrup, Glycerin, Oil of Orange, Acetic Ether, Vanillin, and Distilled Water
Ferri Peptonati et Mangani	Made from the same ingredients as Solution of Iron Peptonate but with the addition of Soluble Manganese Citrate
Ferri Salicylatis	Made from Sodium Salicylate, Tincture of Ferric Citro-Chloride, Ammonium Carbonate, Citric Acid, Methyl Salicylate, Glycerin and Distilled Water
Ferri Subsulphatis	Basic Ferric Sulphate, corresponding to 20 to 22 Gm. of Fe in 100 cc. (made from Ferrous Sulphate, Sulphuric Acid, Nitric Acid, and Distilled Water)
Phosphatum Acidus	Made from Precipitated Calcium Carbonate, Magnesium Carbonate, Phosphoric Acid and Distilled Water
Phosphatum Compositus	Made from Precipitated Calcium Carbonate, Ferric Phosphate, Ammonium Phosphate, Sodium Citrate, Citric Acid, Glycerin, Phosphoric Acid, Orange Flower Water and Distilled Water
Sodii Citratis	About 2.5 per cent Sodium Citrate (made from Citric Acid, Sodium Bicarbonate, and Distilled Water)

Table of Some Unofficial Solutions

Title	*Directions*
Liquor Acidi Chromici (Br. 1914)	Dissolve 25 Gm. of chromic anhydride in enough distilled water to make 100 cc.
Alumini Acetico-Tartratis (N. F. IV)	Dissolve 75 Gm. of ammonium alum and 30 Gm. of monohydrated sodium carbonate each in 1000 cc. of water. Mix the solutions, wash the precipitate until free from sulphate, drain, add 15 Gm. of glacial acetic acid and 13.5 Gm. of tartaric acid and heat until solution is effected. Evaporate to 100 Gm.
Ammonii Citratis (N. F. IV)	Dissolve 12.5 Gm. of citric acid in 60 cc. of distilled water, add 30 cc. of ammonia water, cautiously neutralize with ammonia water and add distilled water to make 100 cc. Dose: one fluidrachm (4 cc.)
Arsenicalis, Clemens (N. F. IV)	Dissolve 1 Gm. of arsenic trioxide and 4.05 Gm. of potassium bicarbonate in 20 cc. of water, by boiling. Add 50 cc. of water, 0.5 cc. of bromine and water enough to make 100 cc. Stand for twelve hours and filter Dose: three minims (0.2 cc.)
Atropinæ Sulphatis (Br. 1914)	Dissolve 1 Gm. of atropine sulphate in enough recently boiled distilled water to make 100 cc. Prepare freshly as needed Dose: one half minim (0.03 cc.)
Bromi (N. F. IV)	Dissolve 12.5 Gm. of potassium bromide in 80 cc. of water in a bottle, add 8.3 cc. of bromine, shake until solution is effected and add water to make 100 cc.
Epispasticus (Br. 1914)	Dissolve 0.4 Gm. of cantharidin, 2.5 cc. of castor oil and 1.2 gm. of rosin in enough acetone to make 100 cc.
Ferri Acetatis (N. F. IV)	Mix 85 cc. of ammonia water with 300 cc. of cold water, and 80 Gm. of solution of ferric sulphate with 1000 cc. of cold water. Add the iron solution slowly to the ammonia solution, and wash the precipitate by decantation with 600 cc. portions of boiling water, until free from sulphate. Collect the precipitate, concentrate to 70 Gm. by pressure, and add it to 26 Gm. of glacial acetic acid. Add enough water to make 100 Gm., allow to settle and decant the clear solution Dose: five minims (0.3 cc.)
Ferri Hypophosphitis (N. F. IV)	Triturate 16.5 Gm. of ferric hypophosphite with 35 cc. of water, add 21.5 Gm. of potassium citrate, 15 cc. of glycerin, and heat gently until solution is effected. Add water to make 100 cc. and filter Dose: fifteen minims (1 cc.)
Ferri Nitratis (N. F. IV)	Mix 16 cc. of ammonia water with 50 cc. cold water, and 14.5 Gm. of solution of ferric sulphate with 150 cc. cold water. Add the iron sulution to the ammonia solution. Wash the precipitate by decantation with 100 cc. portions of boiling water until free from sulphate. Collect the precipitate, drain thoroughly, transfer to a dish, add 7.1 Gm. of nitric acid, stir until a clear solution is effected and add distilled water to make 100 Gm. Dose: five minims (0.3 cc.)
Ferri Oxychloridi (N. F. IV)	Dilute 30 cc. of solution of ferric chloride with 150 cc. of distilled water, add with constant stirring to 60 cc. of ammonia water diluted with 300 cc. of distilled water. Collect the precipitate and wash with distilled water until free from chloride, drain, express excess of liquid, transfer the precipitate to an evaporating dish, add 3 cc. of hydrochloric acid and stir occasionally during three days. Warm to 40° C., if necessary, to effect solution. Add 12.5 cc. of glycerin, and enough distilled water to make 100 cc. and filter Dose: thirty minims (2 cc.)
Ferri Oxysulphatis (N. F. IV)	Dissolve 16.5 Gm. of ferrous sulphate in 85 cc. of boiling distilled water, add 16.5 Gm. of nitric acid and heat until nitrous odor disappears. Cool and add enough distilled water to make 100 cc.
Ferri Perchloridi (Br. 1914)	Mix 25 cc. of strong solution of ferric chloride with enough distilled water to make 100 cc. Dose: fifteen minims (1 cc.)
Ferri Perchloridi Fortis (Br. 1914)	Place 70 Gm. of iron in a flask, add 250 cc. of hydrochloric acid and 140 cc. of distilled water. Allow to stand until effervescence ceases, boil, filter, rinse with a little distilled water, add 140 cc. of hydrochloric acid to the filtrate, and then pour the solution slowly into 30 cc. of nitric acid. Evaporate until a precipitate begins to form, add 20 cc. of hydrochloric acid and enough distilled water to make 250 cc.
Ferri Protochloridi (N. F. IV)	Place 16 Gm. of iron in a flask, add 35 cc. of distilled water and 62.5 Gm. of hydrochloric acid and heat gently until effervescence ceases. Boil, filter, rinse with a little distilled water, evaporate the filtrate until crystals begin to form and vapors cease to redden moistened blue litmus paper. Add 25 cc. of glycerin and 1 cc. of diluted hypophosphorous acid, heat until crystals are redissolved and add enough distilled water to make 100 cc. Dose: Ten minims (0.6 cc.)
Formaldehydi Saponatus (Br. 1914)	Dissolve 40 Gm. of soft soap in 30 cc. of 90 per cent alcohol and add 20 cc. of solution of formaldehyde and enough distilled water to make 100 cc.
Guttæ Perchæ (N. F. IV)	Shake 15 Gm. of gutta percha with 75 cc. of chloroform in a bottle until dissolved. Mix 17 Gm. of lead carbonate with 25 cc. of chloroform and add to the gutta percha solution. Shake several times at intervals of half an hour, allowing the insoluble matter to settle and decant the clear liquid preserving it in small cork-stoppered bottles
Hydrargyri et Potassii Iodidi (N. F. IV)	Triturate 2.5 Gm. of red mercuric iodide and 2 gm. of potassium iodide with 5 cc. of distilled water until solution is effected. Add enough distilled water to make 250 cc. Dose: three minims (0.2 cc.)
Hydrargyri Nitratis (N. F. IV)	Mix 45 Gm. of nitric acid with 15 Gm. of distilled water and dissolve 40 Gm. of red mercuric oxide in the mixture

Table of Some Unofficial Solutions—*Continued*

Title	*Directions*
Liquor Hydrargyri Nitratis Acidus (Br. 1914)	Dissolve 120 Gm. of mercury in a mixture of 150 cc. of nitric aid and 45 cc. of distilled water without heat, then evaporate by gentle heat to 360 Gm.
Hydrargyri Perchloridi (Br. 1914)	Dissolve 0.1 Gm. of mercuric chloride in enough distilled water to make 100 cc. Dose: thirty minims (2 cc.)
Hypophosphitum	Dissolve 3.5 Gm. of calcium hypophosphite, 2 Gm. of sodium hypophosphite, 1.75 Gm. of potassium hypophosphite, with the aid of 0.6 cc. of hypophosphorous acid, in enough distilled water to make 100 cc. Dose: one fluidrachm (4 cc.)
Magnesii Bicarbonatis (Br. 1914)	Add a solution of 12.5 Gm. of sodium carbonate in 50 cc. of distilled water to a hot solution of 10 Gm. of magnesium sulphate in 50 cc. of distilled water, boil until CO_2 is no longer evolved, collect and wash the precipitate, dissolve it in 100 cc. of distilled water into which carbonic acid gas, under pressure, has been introduced, and store in tightly stoppered bottles Dose: one fluidounce (30 cc.)
Magnesii Sulphatis Effervescens (N. F. IV)	Dissolve 25 Gm. of magnesium sulphate and 4 Gm. of citric acid in 250 cc. of distilled water. Add 60 cc. of syrup of citric acid, filter into a strong 360 cc. bottle, add water to nearly fill the bottle, 2.5 Gm. of potassium bicarbonate, and immediately stopper the bottle Dose: Contents of one bottle
Morphinæ Acetatis (Br. 1914)	Dissolve 1 Gm. of morphine acetate in a mixture of 2 cc. of diluted acetic acid, 25 cc. of 90 per cent alcohol and 25 cc. of distilled water. Add enough distilled water to make 100 cc. Dose: fifteen minims (1 cc.)
Morphinæ Hydrochloridi (Br. 1914)	Dissolve 1 Gm. of Morphine hydrochloride in a mixutre of 2 cc. of diluted hydrochloric acid, 25 cc. of 90 per cent alcohol and 25 cc. of distilled water. Add enough distilled water to make 100 cc. Dose: fifteen minims (1 cc.)
Morphinæ Tartratis (Br. 1914)	Dissolve 1 Gm. of morphine tartrate in a mixture of 25 cc. of 90 per cent alcohol and 25 cc. of distilled water. Add enough distilled water to make 100 cc. Dose: fifteen minims (1 cc.)
Picis Alkalinus	Dissolve 12.5 Gm. of potassium hydroxide in 62.5 cc. of water, add 25 Gm. of tar and dissolve by agitation. Stand for twenty-four hours, strain and add water to make 100 cc.
Potassii Chlorinatæ (Javelle Water)	Mix 8 Gm. of chlorinated lime with 40 cc. of water. Dissolve 5.8 Gm. of potassium carbonate in 30 cc. of boiling water and add to the former mixture. Shake well, cool, add water to make 100 cc. and filter. Keep well stoppered and protect from light
Potassii Permanganatis (Br. 1914)	Dissolve 1 Gm. of potassium permanganate in enough distilled water to make 100 cc. Dose: Two fluidrachms (8 cc.)
Sodii-Citro-Tartratis Effervescens	Dissolve 24 Gm. of sodium bicarbonate in 250 cc. of distilled water, add 24 Gm. of tartaric acid and 2 Gm. of citric acid and when dissolved add 50 cc. of syrup of citric acid. Filter into a strong 360 cc. bottle, and add enough distilled water to make 300 cc. Dissolve 2 Gm. of sodium bicarbonate in 50 cc. of water, filter and pour into a bottle, stoppering immediately Dose: Contents of a bottle
Sodii Silicatis (Water Glass)	A nearly saturated solution
Strychninæ Acetatis	Dissolve 0.178 Gm. of strychnine in 3.5 cc. of diluted acetic acid, add 50 cc, of distilled water, 25 cc. of alcohol, 1 cc. of compound tincture of cardamom, enough distilled water to make 100 cc. and filter Dose: ten minims (0.6 cc.)
Strychninæ Hydrochloridi (Br. 1914)	Dissolve 1 Gm. of strychnine hydrochloride in a mixture of 25 cc. of 90 per cent alcohol and 25 cc. of distilled water and add enough distilled water to make 100 cc. Dose: three minims (0.2 cc.)
Zinci et Alumini Compositus	Dissolve 20 Gm. of zinc sulphate and 20 Gm. of aluminum sulphate in 80 cc. of water, by aid of heat, add 0.06 Gm. of betanaphthol and 0.2 cc. of oil of thyme and shake until cold. Add water to make 100 cc. Mix well, set aside for two days and filter
Zinci et Ferri Compositus	Dissolve 20 Gm. of zinc sulphate, 20 Gm. of ferrous sulphate and 65 Gm. of copper sulphate in 80 cc. of boiling water, add 0.06 Gm. of betanaphthol and 0.2 cc. of oil of thyme, and shake until cold. Add 0.4 cc. of hypophosphorous acid and enough water to make 100 cc. and filter

Ampula—*Ampuls*

This is the class name adopted by the N. F. V for solution in ampuls intended for hypodermic injection. They are also known by the title *Injectio Hypodermica* or simply as *Injections*. A discussion of these and a number of formulas will be found in Part XI.

Collyria—*Eye Lotions, Eye Washes*

Solutions for use on the mucous membrane of the eye should be free from undissolved foreign particles and usually require careful filtration. The use of "hardened" filter paper is desirable to avoid filaments of paper. A 1.4 per cent solution of sodium chloride in distilled water is *isotonic* with tears.

CHAPTER XXV

AQUEOUS SOLUTIONS CONTAINING SWEET OR VISCID SUBSTANCES

Syrupi—*Syrups, Sirups*

Syrups are concentrated solutions of sugar[1] in water or aqueous liquids. The liquids used sometimes contain acetic acid or other organic acids, and occasionally a small quantity of alcohol. When water *alone* is used in making the solution of sugar, the preparation is termed *syrup*, or *simple syrup*. When the water contains soluble principles from various medicinal substances, the syrup is called a *medicated* syrup. A *flavored* syrup is one which is not medicinal in its action, but which is made by the introduction of various aromatic or pleasantly flavored substances. Syrups are useful preparations, because their sweet taste facilitates administration, while the presence of a large percentage of sugar renders them permanent if they are properly made.

Selection of the Sugar—The sugar which should be used exclusively in making syrups is clearly defined by the Pharmacopœia. It is described as "in white, dry, hard, distinctly crystalline granules, permanent in the air, odorless, having a purely sweet taste, and a neutral reaction". This description applies to that known commercially as "granulated sugar", and the official tests should be carefully observed. (See *Sucrosum.*) Sugar must be free from ultramarine, Prussian blue, and insoluble substances, as the presence of impurities, particularly ultramarine, has been proved to interfere with the stability and quality of syrups. The blue dyes mentioned were formerly used to cover the yellow tint of sugar improperly purified, but today the processes and quality of sugar or sucrose have been so improved that they are rarely employed. The direction that the sugar should be dry is all-important, because the permanency of syrups largely depends upon their containing the correct proportion of sugar and water. If an insufficient amount of sugar is present, the syrups will ferment; if they contain too much, crystallization of the excess takes place at first, while the subsequent growth of the crystals is accompanied by an abstraction of sugar from the liquid, and the result is such a weakening of the syrup that fermentation may result, as in the first instance. *Damp sugar* should never be used unless the amount of moisture has been carefully ascertained, and an allowance made for it. Commercial sugars of exceptional purity and whiteness are now offered under such names as "Druggists Standard", "Special Standard Granulated", "Confectioners Granulated", etc. The crystals are unusually large and perfect and are dry, with less tendency to become moist from atmospheric dampness than other sugars. They represent the crystallization from the first running of the filters in the sugar refinery, corresponding to the old "rock candy", and consequently produce a superior syrup, almost entirely free from yellowish tint, even when observed in large volume.

Preparation of Syrups—Syrups are prepared in various ways, and the choice of the proper method must always depend upon the physical and chemical characteristics of the substances entering into the preparation.

[1] The U. S. P. X has adopted the title sucrose for the well-known sugar, as it is the more correct chemical designation, but in this chapter the term sugar will be continued because of its almost universal use in practice.

Five methods are officially recognized, which may be summarized as follows: 1. By solution with heat. 2. By agitation without heat. 3. By the simple addition of a medicating liquid to syrup. 4. By digestion or maceration. 5. By percolation.

1. **By Solution with Heat**—This is the usual method of making syrups when the valuable constituent is neither volatile nor injured by heat, and when it is desirable to make the syrup rapidly. The sugar is usually added to the water or aqueous solution and heated until solution is effected, then skimmed or strained, and sufficient water added to make the desired weight or measure. If the syrup is made from an infusion, a decoction, or an aqueous solution containing organic matter, it is usually proper to heat the syrup to the boiling point in order to coagulate albuminous matter; this is separated subsequently by straining. If the albumin or other impurities were permitted to remain in the syrup, fermentation would probably be induced in warm weather. Saccharometers (see page 63) are very useful in making syrups by the hot process where the proper specific gravity of the finished syrup is known. The saccharometer may be floated in the syrup *while boiling*, and thus the exact degree of concentration determined without waiting to cool the syrup and having to heat it again to concentrate it further.

Excessive heating of syrups at the boiling temperature is undesirable since more or less inversion of the sugar occurs with an increased tendency to ferment.

Syrups cannot be sterilized in an autoclave without some caramelization and discolor resulting from the high temperature.

2. **By Agitation without Heat**—This process is directed by the Pharmacopœia in those cases where heat would cause the loss of valuable volatile constituents. The sugar should be added to the aqueous solution in a bottle of twice the size required for the syrup. This permits active agitation and rapid solution. A "five-pint", glass-stoppered, tincture bottle is well adapted for the making of 1000 cc. of syrup by this process. The stoppering of the bottle is important, as it prevents contamination and loss during the process. The bottle should be allowed to lie upon its side when not being agitated. Glass lined tanks with mechanical agitators, especially adapted to the dissolving of sugar, are used in the large laboratories for the making of syrups on the large scale.

3. **By the Simple Addition of a Medicating Liquid to Syrup**—This method is resorted to in those cases in which fluidextracts, tinctures, or other liquids are added to syrup to medicate it. Syrups made in this way usually develop precipitates since alcohol enters into most of the liquids thus used, and the resinous and oily substances dissolved by the alcohol precipitate when mixed with the syrup, producing unsightly preparations. A modification of this process, frequently adopted, consists of the mixing of the fluidextract or tincture with the water, allowing the mixture to stand to permit the separation of insoluble constituents, filtering, and then dissolving the sugar in the filtrate. This procedure is sometimes resorted to by manufacturing pharmacists to insure permanency in their products, but it is not permissible when the precipitated ingredients are the valuable medicinal agents. In such cases the syrup must be dispensed with the precipitate and a "shake label", or some other form of medication adopted.

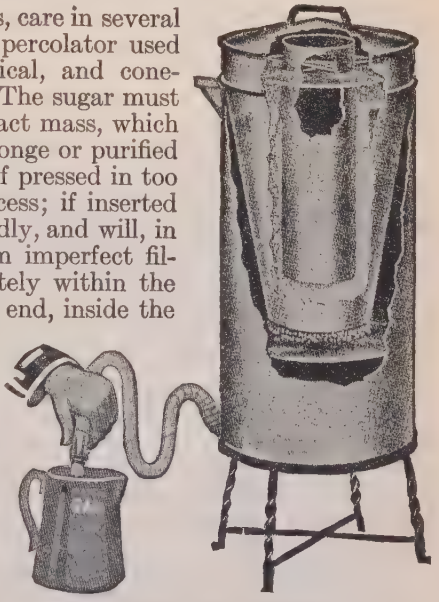
4. **By Maceration or Digestion**—This method is not recommended as either accurate or efficient. A solution of a comparatively insoluble substance can always be effected in a more rapid and thorough manner by dissolving the substance in alcohol, suspending the resinous tincture in a mixture of absorbent powder (especially magnesium carbonate) and water, filtering, and

dissolving sugar in the filtrate, as in the U. S. P. processes for syrups of tolu and ginger.

5. **Percolation in Making Syrups**—This method originated with Orynski, and is conducted as follows: Into the lower orifice of an ordinary percolator is introduced a small piece of sponge or purified cotton; the sugar (granulated) is then poured in, and upon this is added the water, the apparatus being arranged as is usual in the process of percolation. The percolator may be covered loosely, and the operation will proceed without further attention, the syrup coming through drop by drop. If, after the liquid has all passed, there remains a quantity of undissolved sugar in the percolator, enough percolate may be poured back to dissolve it, afterwards adding sufficient water to secure the required measure.

To be successful in using this process, care in several particulars must be exercised: 1. The percolator used should be cylindrical or semi-cylindrical, and cone-shaped as it nears the lower orifice. 2. The sugar must be coarse, else it will form into a compact mass, which the liquid cannot permeate. 3. The sponge or purified cotton must be introduced with care. If pressed in too tightly, it will effectually stop the process; if inserted too loosely, the liquid will pass too rapidly, and will, in consequence, be weak and turbid (from imperfect filtration); it should be inserted completely within the neck of the percolator, as a protruding end, inside the percolator, up through the sugar, will permit the last portions of water to pass out at the lower orifice without dissolving all of the sugar.

Fig. 416



Hardesty sugar percolator

The process of percolation has been applied on a commercial scale for the making of syrup for wholesale distribution or for use at the soda fountain. The Hensel or Hardesty Syrup Percolator, used in this way for making syrup in large quantities (see Fig. 416), consists of an outer galvanized iron syrup reservoir, and an inner vessel, conical in shape, for the sugar, fitting tightly inside of the reservoir and perforated to form a diaphragm, the perforations being covered with a straining medium. A smaller galvanized iron water cylinder fits inside of the sugar vessel and is perforated to permit the water to mix with the sugar and form syrup. If sufficient sugar and water are kept in the several vessels, the action of the percolator is automatic, and brilliantly clear, filtered syrup, saturated at the prevailing temperature, collects in the outer vessel and may be drawn off as desired. A valuable improvement on this percolator is the elimination of the old type of spigot, which was so unsatisfactory, replacing it with a pure gum rubber tubing, which has no shut-off. When not in use, the tube fits under a lip at the top of the percolator, thus protecting it from dust and insects.

An improvised syrup percolator may be made by suspending a galvanized iron can, having a perforated bottom inside of a larger galvanized-iron can to which a brass spigot has been attached. Canton flannel is fastened inside the smaller can and the sugar poured in. So long as an excess of sugar is maintained beneath the water strata, the apparatus will deliver clear, saturated

syrup to the lower can from which it may be drawn at will, by means of the spigot. Cans such as described are available in the form commonly called "ash cans".

Preservation of Syrups—Syrups should not be made in larger quantities than can be used within a few months, except in those cases where special facilities can be employed for their preservation. A low temperature is the best method of preservation for syrups; concentration without supersaturation is also a condition favorable to preservation. The addition of such substances as benzoates, boric acid, salicylic acid, alcohol, fluorides, calcium sulphite, etc., to prevent the fermentation of syrups, is not recommended, for if used in sufficient quantity to act as preservatives they communicate their own flavor to the syrup or are otherwise objectionable and they are usually illegal. The practice of restoring syrups which have been spoiled through fermentation by heating them and "working them over" is a reprehensible one. The practice of good pharmacy demands the possession of sufficient moral courage to find a place for fermented syrups where they will do the least harm—*i. e.*, in the sink and sewer-pipe.

A simple and yet effective method of preserving syrups, especially adapted to fruit syrups, is as follows: A number of bottles are provided holding not more than a pint each, even when the quantity of syrup is large; the bottles are thoroughly cleaned, and kept hot by immersion in boiling water until ready for use; a sufficient number of good corks, which have been thoroughly soaked in hot water, and of the proper size for the bottles, should be at hand. The syrup should be heated to the boiling point (strained, if necessary, and reheated), and poured into the hot bottles until they are filled to the brim. The corks are inserted by forcibly pressing them into the necks of the bottles, thereby displacing a small portion of the syrup, and are tied down with twine in the usual manner. Then, while the necks of the bottles are still hot (and before the syrup can contract in volume through cooling) they are dipped into melted sealing-wax contained in a suitable vessel. By this method the organisms which produce fermentation are destroyed by the heat, and no air, carrying new contamination, can find its way to the syrup, as the bottles are hermetically sealed.

The official syrups should be preserved in well-dried bottles, preferably those which have been sterilized. These bottles should not hold more than is likely to be required during four to six weeks and should be completely filled, carefully stoppered and stored in a cool, dark place.

SYRUPUS ACIDI CITRICI. U.S. Syrup of Citric Acid

[Syr. Acid. Cit.]

	Metric	Alternative
Tincture of Lemon Peel	**10 cc.**	2½ fl. dr.
Citric Acid	**10 Gm.**	146 gr.
Distilled Water	**10 cc.**	2½ fl. dr.
Syrup, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the citric acid in the distilled water and mix the solution with 950 cc. [30 fl. oz.] of syrup. Add the tincture and enough syrup to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

This preparation must not be dispensed if it has a terebinthinate odor or taste or shows other deterioration.

Preserve in containers which have previously been washed with boiling water.

N. F. Preparations—Liquor Magnesii Citratis Effervescens; Liquor Sodii Citro-Tartratis Effervescens.

Uses—It is employed solely as a pleasant vehicle, the formula making it possible to prepare a syrup having the flavor of lemon at all seasons of the year. For soda fountain use, however, *Syrup of Lemon* should always be freshly made from the fruit as the flavor is much more delicate and acceptable.

SYRUPUS. U.S. Syrup

[Sirup, Simple Syrup]

	Metric	Alternative
Sucrose	**850 Gm.**	7 lbs. 1½ oz. av.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	8 pints

Insert into the neck of a percolator of suitable size a pledget of purified cotton, not too tightly, in such a manner that the cotton shall nearly fill the neck of the percolator, and moisten it with a few drops of distilled water. Place the sucrose in the percolator, make its surface level without shaking or jarring, then carefully pour upon it 450 cc. [58 fl. oz.] of distilled water, and regulate the flow of the liquid, if necessary, so that it will pass out in rapid drops. Collect the liquid in a 1000 cc. [8 pint] graduated container and return portions to the percolator if necessary until all of the sucrose has been dissolved. Then pass enough distilled water through the cotton to make the product measure 1000 cc. [8 pints] and mix thoroughly.

Syrup may also be prepared in the following manner:

Heat 450 cc. [58 fl. oz.] of distilled water to boiling, add the sucrose, and continue the heat cautiously, stirring until the sucrose is dissolved and the syrup has a temperature of 100° C. Then filter it through purified cotton and pass enough distilled water through the cotton to make the product measure 1000 cc. [8 pints] when cold.

Syrup has been discussed in the general article on pages 261 to 264. The quantity of the sugar, the amount of heat used, and the exact degree of concentration are all important factors in the production of a satisfactory syrup, as has already been stated.

Syrup properly prepared has a specific gravity of about 1.313 at 25° C.

U. S. P. and N. F. Preparations—Elixirs, Emulsions, Liquors, Mixtures, Syrups, etc.

Uses—Employed as a sweetening agent, an excipient in pills, and as the basis for many flavored and medicated syrups.

SYRUPUS ACIDI HYDRIODICI. U.S. Syrup of Hydriodic Acid

[Syr. Acid. Hydriod.]

Syrup of Hydriodic Acid contains not less than 1.3 Gm. and not more than 1.5 Gm. of HI in each 100 cc.

	Metric	Alternative
Diluted Hydriodic Acid	**130 cc.**	4 fl. oz. 77 min.
Sucrose	**450 Gm.**	15 oz. av. 9 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the diluted hydriodic acid with 550 cc. [17 fl. oz. 288 min.] of distilled water and dissolve the sucrose in this mixture by agitation. Add sufficient distilled water to make the product measure 1000 cc. [2 pints] and filter.

(For tests and comments, see page 556.)

Uses—As an alterative in the same class of cases for which potassium iodide is employed.

SYRUPUS AURANTII. U.S. Syrup of Orange

[Syr. Aurant.]

	Metric	Alternative
Tincture of Sweet Orange Peel	**50 cc.**	1 fl. oz. 288 min.
Citric Acid	**5 Gm.**	73 gr.
Purified Talc	**15 Gm.**	219 gr.
Sucrose	**820 Gm.**	27 oz. av. 163 gr.
Distilled Water, a sufficient quantity, To make	**1000 cc.**	2 pints

Triturate the purified talc with the tincture and citric acid, and gradually add 400 cc. [12 fl. oz. 384 min.] of distilled water. Then filter, returning the first portions of the filtrate until it becomes clear, and wash the mortar and filter with enough distilled water to make the filtrate measure 450 cc. [14½ fl. oz.]. Dissolve the sucrose in this filtrate by agitation, and add enough distilled water to make the product measure 1000 cc. [2 pints]. Mix thoroughly and strain.

This preparation must not be dispensed if it has a terebinthinate odor or taste or shows other deterioration.

Alcohol content, by volume, 2 to 5 per cent.

Uses—A pleasant vehicle.

SYRUPUS AURANTII FLORUM. U.S. Syrup of Orange Flowers

[Syr. Aurant. Flor.]

	Metric	Alternative
Orange Flower Water	**225 cc.**	7 fl. oz. 96 min.
Sucrose	**850 Gm.**	28 oz. av. 164 gr.
Distilled Water, a sufficient quantity, To make	**1000 cc.**	2 pints

Mix the orange flower water with 225 cc. [7 fl. oz. 96 min.] of distilled water, dissolve the sucrose in the mixture by agitation, without heat, and add sufficient distilled water to make the product measure 1000 cc. [2 pints]. Mix thoroughly and strain.

Syrup of Orange Flower Water may also be made in the following manner:

Prepare a percolator in the manner described under *Syrupus*. Pour the mixture of orange flower water and water upon the sucrose, return the first portions of percolate until it runs through clear, and when all of the liquid has run through, follow it with distilled water until the sucrose is dissolved and the product measures 1000 cc. [2 pints]. Mix thoroughly.

Uses—A flavored vehicle.

SYRUPUS FERRI IODIDI. U.S. Syrup of Ferrous Iodide

[Syr. Ferr. Iod.—Ferri Iodidi Syrupus P. I.]

Syrup of Ferrous Iodide contains not less than 6.5 Gm. and not more than 7.5 Gm. of FeI_2 in each 100 cc., representing approximately 5 per cent of FeI_2 (309.68), by weight.

	Metric	Alternative
Iron, in the form of fine, bright wire	20 Gm.	292 gr.
Iodine	60 Gm.	2 oz. av. 1 gr.
Hypophosphorous Acid	5 cc.	77 min.
Sucrose	850 Gm.	28 oz. av. 164 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Place the iron in a flask having a capacity of about 500 cc. [1 pint], add the iodine and 200 cc. [6½ fl. oz.] of distilled water, and shake the mixture occasionally, checking the reaction if necessary by placing the flask in cold water. When the liquid has acquired a green color and has lost the odor of iodine, heat it to boiling, and dissolve 100 Gm. [3 oz. av. 148 gr.] of sucrose in the hot liquid. Filter the solution at once into a flask, graduated to 1000 cc. [2 pints] and containing the remainder of the sucrose, and rinse the flask containing the iron with 240 cc. [7½ fl. oz.] of hot distilled water, in divided portions, passing the rinsings successively through the filter. Agitate the mixture until the sucrose is dissolved, warming if necessary, cool to 25° C., add the hypophosphorous acid and enough distilled water to make the product measure 1000 cc. [2 pints]. Mix well and strain.

(For tests and comments, see page 718.)

Uses—As an alterative tonic, especially in scrofulous conditions.

Average dose—15 minims (1 cc.).

SYRUPUS IPECACUANHÆ. U.S. Syrup of Ipecac

[Syr. Ipecac]

	Metric	Alternative
Fluidextract of Ipecac	70 cc.	2 fl. oz. 115 min.
Glycerin	100 cc.	3 fl. oz. 96 min.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the fluidextract with the glycerin, and add enough syrup to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Alcohol content, by volume, 1.5 to 2 per cent.

Uses—A valuable emetic, especially for children suffering from croup; also used as an expectorant in acute bronchitis. In croup it may be given in repeated doses, appropriate to the age of the child, every fifteen minutes until vomiting is produced.

Average dose—{Expectorant, 12 minims (0.75 cc.).
Emetic, 4 fluidrachms (15 cc.).

SYRUPUS PICIS PINI. U. S. Syrup of Pine Tar

[Syr. Pic. Pin.—Syrupus Picis Liquidæ U. S. P. IX, Syrup of Tar]

	Metric	Alternative
Rectified Oil of Tar	1 cc.	15 minims
Sucrose	850 Gm.	26 oz. av. 164 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the oil with 450 cc. [14½ fl. oz.] of water and agitate the mixture frequently during fifteen minutes. Then set aside for twenty-four hours, shaking it occasionally during that time. Filter, dissolve the sucrose in the clear filtrate, and add sufficient water to make the product measure 1000 cc. [2 pints]. Mix thoroughly and strain.

Uses—A stimulant expectorant in bronchitis.

Average dose—2½ fluidrachms (10 cc.).

SYRUPUS PRUNI VIRGINIANÆ. U. S. Syrup of Wild Cherry

[Syr. Prun. Virg.]

	Metric	Alternative
Wild Cherry, in coarse powder	150 Gm.	5 oz. av.
Sucrose	800 Gm.	26 oz. av. 308 gr.
Glycerin	50 cc.	1 fl. oz. 288 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the glycerin with 200 cc. [6 fl. oz. 192 min.] of water, moisten the wild cherry with 100 cc. [3 fl. oz. 96 min.] of this mixture, pack it in a cylindrical percolator and pour the remaining 150 cc. [4 fl. oz. 384 min.] of menstruum upon it. When this has disappeared from the surface of the drug, add enough water to saturate the powder and leave a stratum above it. Close the lower orifice, cover the percolator, and macerate the drug for twenty-four hours. Then allow the percolation to proceed slowly, allowing the percolate to drop into the sucrose contained in a bottle graduated to 1000 cc. [2 pints] and having a capacity of 2000 cc. [4 pints]. Add enough water, to the menstruum, to make the combined sucrose and percolate measure 1000 cc. [2 pints], stopper the bottle, and dissolve the sucrose by agitation without heat. Restore the volume by adding enough water to make the product measure 1000 cc. [2 pints], and strain.

Preserve in tightly-stoppered bottles, in a cool place.

When wild cherry bark is moistened with water and allowed to stand in a warm place, a glucosidal body, known as mandelonitrile, existing normally in the bark, is decomposed by the ferment emulsin, also normally present, resulting in the production of benzaldehyde and hydrocyanic acid. These substances exist only in small amounts and are readily volatilized. The syrup should never be made from the fluidextract as it rarely contains these constituents. Heat must be avoided throughout the process to prevent the destruction of the ferment and the loss of the volatile constituents.

This Syrup should be stored in non-metallic, tightly-closed containers, in a cool place, as it rapidly loses hydrocyanic acid even under the most favorable conditions.

Uses—Employed chiefly as a vehicle for cough syrups. The hydrocyanic acid is so fleeting in its effects and so often absent that its therapeutic value can rarely be depended upon.

Average dose—2½ fluidrachms (10 cc.).

SYRUPUS RHEI. U.S. Syrup of Rhubarb
[Syr. Rhei]

	Metric	Alternative
Fluidextract of Rhubarb	100 cc.	3 fl. oz. 96 min.
Spirit of Cinnamon	4 cc.	1 fl. dr.
Potassium Carbonate	10 Gm.	146 gr.
Water	50 cc.	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the spirit of cinnamon with the fluidextract, add the potassium carbonate, previously dissolved in the water, and add to this mixture enough syrup to make the product measure 1000 cc. [2 pints].

The potassium carbonate is added to prevent precipitation of the constituents in the fluidextract.

Alcohol content, by volume, 5 to 6 per cent.

Uses—A laxative syrup of special value for children in summer diarrhea because of its combined astringent and laxative action.

Average dose—2½ fluidrachms (10 cc.).

SYRUPUS RHEI AROMATICUS. U.S. Aromatic Syrup of Rhubarb
[Syr. Rhei Arom.]

	Metric	Alternative
Aromatic Tincture of Rhubarb	150 cc.	4 fl. oz. 384 min.
Potassium Carbonate	1 Gm.	15 gr.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the potassium carbonate in the tincture and add to the mixture enough syrup to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Alcohol content, by volume, 6 to 7 per cent.

Uses—Similar in action to plain syrup of rhubarb. It is especially adapted to the treatment of infants but is too weak for adults. When mixed with an equal volume of castor oil, it makes a palatable laxative which is readily administered, even to children.

Average dose—2½ fluidrachms (10 cc.).

SYRUPUS SARSAPARILLÆ COMPOSITUS. U.S. Compound Syrup of Sarsaparilla
[Syr. Sarsap. Co.]

	Metric	Alternative
Fluidextract of Sarsaparilla	200.0 cc.	6 fl. oz. 192 min.
Fluidextract of Glycyrrhiza	15.0 cc.	230 min.
Oil of Sassafras	0.2 cc.	3 min.
Oil of Anise	0.2 cc.	3 min.
Methyl Salicylate	0.2 cc.	3 min.
Alcohol	19.4 cc.	298 min.
Syrup	765.0 cc.	24 fl. oz. 230 min.
To make about	1000 cc.	2 pints

Mix the fluidextracts and add the alcohol, in which the methyl salicylate and the oils have been dissolved. Gradually add this solution to the syrup, and mix thoroughly.

Alcohol content, by volume, 8.5 to 11 per cent.

N. F. Preparation—Syrupus Bromidorum.

Uses—It is employed chiefly as a vehicle for the alkaline iodides and other saline drugs and in itself possesses little, if any, therapeutic activity as an alterative.

Average dose—4 fluidrachms (15 cc.).

SYRUPUS SCILLÆ. U. S. Syrup of Squill

[Syr. Scill.]

	Metric	Alternative
Vinegar of Squill	450 cc.	14 fl. oz. 192 min.
Sucrose	800 Gm.	26 oz. av. 308 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the sucrose in the vinegar of squill with the aid of a gentle heat, strain the syrup, and, when cold, add enough water through the strainer to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Uses—Used in bronchitis as a stimulating expectorant.

Average dose—30 minims (2 cc.).

SYRUPUS SCILLÆ COMPOSITUS. U. S. Compound Syrup of Squill

[Syr. Scill. Co.—Hive Syrup, Coxe's Hive Syrup]

	Metric	Alternative
Fluidextract of Squill	80 cc.	2 fl. oz. 4½ fl. dr.
Fluidextract of Senega	80 cc.	2 fl. oz. 4½ fl. dr.
Antimony and Potassium Tartrate	2 Gm.	29 gr.
Sucrose	720 Gm.	24 oz. av. 15 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the antimony and potassium tartrate in 360 cc. [11½ fl. oz.] of distilled water, add the fluidextracts, and allow the mixture to stand for twelve hours with occasional shaking. Filter, dissolve the sucrose in the clear filtrate by agitation, and add sufficient distilled water to make the product measure 1000 cc. [2 pints]. Mix thoroughly and strain.

Alcohol content, by volume, 7 to 8 per cent.

Uses—As an emetic in croup, also as a diaphoretic and expectorant.

Average dose—30 minims (2 cc.).

SYRUPUS SENEGÆ. U. S. Syrup of Senega

[Syr. Seneg.]

	Metric	Alternative
Fluidextract of Senega	200 cc.	6 fl. oz. 192 min.
Ammonia Water	10 cc.	154 min.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the ammonia water with the fluidextract, add the syrup, and mix well.

Alcohol content, by volume, 9 to 10 per cent.

Uses—A nauseating expectorant in bronchitis.

Average dose—1 fluidrachm (4 cc.).

SYRUPUS SENNÆ. U. S. Syrup of Senna

[Syr. Senn.]

	Metric	Alternative
Fluidextract of Senna	250 cc.	8 fl. oz.
Oil of Coriander	5 cc.	77 min.
Sucrose	635 Gm.	22 oz. av. 420 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the oil of coriander with the fluidextract and gradually add 330 cc. [10½ fl. oz.] of water. Allow the mixture to stand for twenty-four hours in a cool place, with occasional shaking, filter, and pass enough water through the filter to obtain 580 cc. [18½ fl. oz.] of filtrate. Dissolve the sucrose in this liquid, and add sufficient water to make the product measure 1000 cc. [2 pints]. Mix well and strain.

Alcohol content, by volume, 5.5 to 6.75 per cent.

Uses—As a laxative; frequently in combination with other drugs. Coriander is usually added to senna on the assumption that it lessens its griping action.

Average dose—2 fluidrachms (8 cc.).

SYRUPUS TOLU. U. S. Syrup of Tolu

[Syr. Tolu—Syrupus Tolutanus U. S. P. IX]

	Metric	Alternative
Tincture of Tolu	50 cc.	1 fl. oz. 288 min.
Magnesium Carbonate	10 Gm.	146 gr.
Sucrose	820 Gm.	27 oz. av. 163 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the tincture intimately with the magnesium carbonate and 60 Gm. [2 oz. av.] of sucrose, in a mortar. Gradually add 430 cc. [13½ fl. oz.] of water, with trituration, and filter. Dissolve the remainder of the sucrose in the clear filtrate with the aid of a gentle heat, strain the syrup while warm, and add sufficient water through the strainer to make the product measure 1000 cc. [2 pints].

Syrup of Tolu may also be made in the following manner:

Prepare a percolator as described under *Syrupus*. Pour the filtrate obtained as directed in the above formula upon the remainder of the sucrose contained in the percolator, return the first portions of the percolate until it runs through clear, and, when all of the liquid has passed, follow with water until the sucrose is dissolved and the product measures 1000 cc. [2 pints]. Mix thoroughly.

Alcohol content, by volume, 3.5 to 4.5 per cent.

U. S. P. Preparation—Trochisci Ammonii Chloridi.
N. F. Preparations—Emulsum Olei Morrhuæ cum Vitello; Mistura Pectoralis.

Uses—Used chiefly for its agreeable flavor in cough syrups.

Average dose—2½ fluidrachms (10 cc.).

SYRUPUS ZINGIBERIS. U. S. Syrup of Ginger

[Syr. Zingib.]

	Metric	Alternative
Fluidextract of Ginger	30 cc.	461 min.
Alcohol	20 cc.	307 min.
Magnesium Carbonate	10 Gm.	146 gr.
Sucrose	820 Gm.	27 oz. av. 163 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the fluidextract and alcohol, and triturate the liquid in a mortar with the magnesium carbonate and 60 Gm. [2 oz. av.] of the sucrose. Then gradually add 430 cc. [13½ fl. oz.] of water with constant trituration, and filter. Dissolve the remainder of the sucrose in the clear filtrate, with the

aid of a gentle heat, strain the syrup while warm, and, when cold, add enough water through the strainer to make the product measure 1000 cc. [2 pints].

Syrup of Ginger may also be made in the following manner:

Prepare a percolator as described under *Syrupus*. Pour the filtrate obtained as directed in the above formula upon the remainder of the sucrose, return the first portions of the percolate, and, when all of the liquid has passed, follow with water until the sucrose is dissolved and the product measures 1000 cc. [2 pints]. Mix thoroughly.

Alcohol content, by volume, 3.5 to 4.5 per cent.

Average dose—2½ fluidrachms (10 cc.).

Uses—As a vehicle, especially in prescriptions for colic and diarrhea.

SYRUPUS ALLII. N.F. Syrup of Garlic
[Syr. Allii]

	Metric	Alternative
Garlic, sliced and bruised	**200 Gm.**	6 oz. av. 296 gr.
Sucrose	**800 Gm.**	26 oz. av. 308 gr.
Diluted Acetic Acid, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Macerate the garlic in 300 cc. [9½ fl. oz.] of diluted acetic acid during four days, and express the liquid, avoiding the use of metallic utensils. Then mix the residue with 200 cc. [6½ fl. oz.] more of diluted acetic acid, and again express. Mix the expressed liquids, and filter. Pour the filtrate upon the sucrose, contained in a suitable vessel, and agitate the mixture until the sucrose is dissolved. Lastly, add sufficient diluted acetic acid to make the product measure 1000 cc. [2 pints], and mix thoroughly.

Average dose—1 fluidrachm (4 cc.).

Uses—A stimulant expectorant, its virtue depending upon the presence of a sulphureted volatile oil.

SYRUPUS ALTHÆÆ. N.F. Syrup of Althea
[Syr. Althea]

	Metric	Alternative
Althea, cut into small pieces	**50 Gm.**	1 oz. av. 293 gr.
Alcohol	**30 cc.**	461 min.
Glycerin	**100 cc.**	3 fl. oz. 96 min.
Sucrose	**700 Gm.**	23 oz. av. 160 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Wash the althea with cold water, then macerate it during three hours with 400 cc. [12 fl. oz. 384 min.] of water, previously mixed with the alcohol, at room temperature without stirring, and strain the residue without expressing. In the strained liquid dissolve the sucrose by agitation, without heat, add the glycerin and sufficient water to make the product measure 1000 cc. [2 pints], and mix thoroughly.

Preserve the syrup in well-stoppered, completely filled bottles in a cold place.

Approximate alcohol content, by volume, 2.5 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—A demulcent.

SYRUPUS AMMONII HYPOPHOSPHITIS. N.F. Syrup of Ammonium Hypophosphite
[Syr. Ammon. Hypophos.]

	Metric	Alternative
Ammonium Hypophosphite	**35 Gm.**	1 oz. av. 74 gr.
Hypophosphorous Acid	**1 cc.**	15 min.
Distilled Water	**100 cc.**	3 fl. oz. 96 min.
Glycerin	**50 cc**	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the ammonium hypophosphite in the distilled water, add the hypophosphorous acid, filter, and then add the glycerin and sufficient syrup to make the product measure 1000 cc. [2 pints].

Average dose—1 fluidrachm (4 cc.).

Uses—The popularity of this preparation is largely due to the advertising of a proprietary form. It is doubtful if its claim for tonic and alterative properties has any basis in fact.

SYRUPUS ASARI COMPOSITUS. N. F. Compound Syrup of Asarum

[Syr. Asar. Co.]

	Metric	Alternative
Asarum, in moderately coarse powder	62.0 Gm.	2 oz. av. 30 gr.
Cochineal, in fine powder	1.5 Gm.	22 gr.
Potassium Carbonate	2.5 Gm.	37 gr.
Fluidextract of Ipecac	3.0 cc.	46 min.
Sucrose	700.0 Gm.	23 oz. av. 160 gr.
Alcohol	200.0 cc.	6 fl. oz. 192 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the asarum intimately with the cochineal and potassium carbonate, previously triturated together. Moisten the powder with a sufficient quantity of a menstruum prepared by mixing the alcohol with 375 cc. [12 fl. oz.] of water, and allow the moistened drugs to macerate, in a covered vessel, for twenty-four hours. Then transfer them to a percolator, and pour on the remainder of the menstruum. Allow the percolation to proceed slowly, and when all of the menstruum has been added follow it with water, until the percolate measures 500 cc [1 pint]. To this add the fluidextract of ipecac, and afterwards the sucrose and dissolve the latter by agitation. Finally, add sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 16 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—A feeble aromatic, used as an adjuvant and flavor in tonic mixtures.

SYRUPUS BROMIDORUM. N. F. Syrup of the Bromides

[Syr. Bromidor.]

	Metric	Alternative
Potassium Bromide	80 Gm.	2 oz. av. 293 gr.
Sodium Bromide	80 Gm.	2 oz. av. 293 gr.
Ammonium Bromide	50 Gm.	1 oz. av. 293 gr.
Calcium Bromide	25 Gm.	365 gr.
Lithium Bromide	8 Gm.	117 gr.
Tincture of Vanilla	32 cc.	1 fl. oz. 12 min.
Compound Tincture of Cubbear	16 cc.	246 min.
Compound Syrup of Sarsaparilla	450 cc.	14 fl. oz. 192 min.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the bromides in the compound syrup of sarsaparilla and 400 cc. [12 fl. oz. 384 min.] of syrup; then add the tinctures, and sufficient syrup to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 5 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—A nerve sedative.

SYRUPUS CACAO. N. F. Syrup of Cocoa

[Syr. Cacao]

	Metric	Alternative
Cocoa	50 Gm.	1 oz. av. 293 gr.
Tincture of Vanilla	2 cc.	31 min.
Alcohol	50 cc.	1 fl. oz. 288 min.
Sucrose	800 Gm.	26 oz. av. 308 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the cocoa with 400 cc. [12 fl. oz. 384 gr.] of distilled water and heat to boiling. Add the sucrose with stirring and continue the heat until the liquid again boils. Then allow to cool, add the alcohol and tincture of vanilla and sufficient distilled water to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Approximate alcohol content, by volume, 4 per cent.

Uses—As a vehicle; especially used for administering quinine to young children.

SYRUPUS CALCII ET SODII HYPOPHOSPHITUM. N.F. Syrup of Calcium and Sodium Hypophosphites

[Syr. Calc. et Sod. Hypophos.]

	Metric	Alternative
Calcium Hypophosphite	35.0 Gm.	1 oz. av. 74 gr.
Sodium Hypophosphite	35.0 Gm.	1 oz. av. 74 gr.
Hypophosphorous Acid	1.5 cc.	23 min.
Glycerin	50.0 cc.	1 fl. oz. 288 min.
Sucrose	750.0 Gm.	25 oz. av. 15 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the hypophosphites with the aid of the hypophosphorous acid in 450 cc. [14 fl. oz. 192 min.] of distilled water, filter the solution, add the sucrose to the filtrate and after this has been dissolved by agitation, add the glycerin and sufficient distilled water to make the product measure 1000 cc. [2 pints].

Average dose—1 fluidrachm (4 cc.).

Uses—See Syrupus Hypophosphitum.

SYRUPUS CALCII HYPOPHOSPHITIS. N.F. Syrup of Calcium Hypophosphite

[Syr. Calc. Hypophos.]

	Metric	Alternative
Calcium Hypophosphite	35.0 Gm.	1 oz. av. 74 gr.
Hypophosphorous Acid	1.5 cc.	23 min.
Sucrose	775.0 Gm.	25 oz. av. 380 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the calcium hypophosphite with the aid of the hypophosphorous acid in 500 cc. [1 pint] of distilled water, filter the solution, add the sucrose to the filtrate, and after this has been dissolved by agitation, add sufficient distilled water to make the product measure 1000 cc. [2 pints].

Average dose—1 fluidrachm (4 cc.).

Uses—A convenient form for administering calcium phosphate.

SYRUPUS CALCII IODIDI. N.F. Syrup of Calcium Iodide

[Syr. Calc. Iodid.]

	Metric	Alternative
Iodine	76 Gm.	2 oz. av. 235 gr.
Iron Wire, thin, bright, and finely cut	28 Gm.	409 gr.
Precipitated Calcium Carbonate	34 Gm.	1 oz. av. 59 gr.
Sucrose	700 Gm.	23 oz. av. 160 gr.
Distilled Water,		
Syrup, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Add the iron wire to 57 Gm. [1 oz. av. 395 gr.] of the iodine and 175 cc. [5 fl. oz. 288 min.] of distilled water, and apply a gentle heat, until the iodine is combined, and the liquid has acquired a greenish color. Filter the liquid through a small filter into a flask containing the remainder of the iodine, wash the filter with about 62 cc. [1 fl. oz. 472 min.] of distilled water and then warm the solution gently until the iodine is dissolved, taking care that no iodine is lost by volatilization. Heat to boiling 235 cc. [7 fl. oz. 250 min.] of distilled water

in a capacious dish, and add to it alternately, in small portions, first the precipitated calcium carbonate, then the solution of iron iodide, stirring briskly and waiting until the violence of the reaction moderates before adding a fresh portion. From time to time, add a little distilled water, to replace that lost by evaporation. When all of the iron solution and calcium carbonate have been added, continue heating the mixture until it commences to boil, then filter it through a wetted filter, and wash the filter with sufficient distilled water to make the product, when cold, measure 500 cc. [1 pint]. In this dissolve the sucrose by agitation, then add sufficient syrup to make the product measure 1000 cc. [2 pints], and strain.

Average dose—30 minims (2 cc.).

Uses—An alterative, similar in action to other alkaline iodides.

SYRUPUS CALCII LACTOPHOSPHATIS. N. F. Syrup of Calcium Lactophosphate

(U. S. P. IX)

[Syr. Calc. Lactophos.]

	Metric	Alternative
Precipitated Calcium Carbonate	**25 Gm.**	365 gr.
Lactic Acid	**60 cc.**	1 fl. oz. 442 min.
Phosphoric Acid	**36 cc.**	1 fl. oz. 73 min.
Orange Flower Water	**50 cc.**	1 fl. oz. 288 min.
Sucrose	**650 Gm.**	21 oz. av. 305 gr.
Glycerin	**50 cc.**	1 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

To the lactic acid, mixed with 100 cc. [3 fl. oz. 96 min.] of distilled water, gradually add the calcium carbonate, stirring until solution is effected. Add the phosphoric acid, previously diluted with 50 cc. [1 fl. oz. 288 min.] of distilled water and stir until the precipitate first formed is dissolved. Add 100 cc. [3 fl. oz. 96 min.] of distilled water, filter the solution, mix the orange flower water with the filtrate, add the glycerin and dissolve the sucrose in the mixed liquids by agitation; then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and strain.

N. F. Preparation—Syrupus Calcii Lactophosphatis et Ferri.

Average dose—2½ fluidrachms (10 cc.).

Uses—For those conditions in which lime is indicated, especially diseases of the bones.

SYRUPUS CALCII LACTOPHOSPHATIS ET FERRI. N. F. Syrup of Calcium Lactophosphate and Iron

[Syr. Calc. Lactophos. et Ferr.]

	Metric	Alternative
Ferrous Lactate	**8.5 Gm.**	124 gr.
Potassium Citrate	**8.5 Gm.**	124 gr.
Water	**62.5 cc.**	2 fl. oz.
Syrup of Calcium Lactophosphate, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the ferrous lactate and potassium citrate in the water with the aid of heat, cool, and add sufficient syrup of calcium lactophosphate to make the product measure 1000 cc. [2 pints].

Average dose—1 fluidrachm (4 cc.).

Uses—It combines the virtues of calcium phosphate and a soluble iron salt.

SYRUPUS CINNAMOMI. N. F. Syrup of Cinnamon

[Syr. of Cinnam.]

	Metric	Alternative
Cinnamon, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol	**50 cc.**	1 fl. oz. 288 min.
Sucrose	**800 Gm.**	26 oz. av. 309 gr.
Cinnamon Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the alcohol with 450 cc. [14 fl. oz. 192 min.] of cinnamon water, moisten the cinnamon with a sufficient quantity of this menstruum and allow it to macerate for two hours. Then transfer it to a small percolator, and percolate, in the usual manner, using first the remainder of the menstruum above directed, and afterwards, cinnamon water. Collect 480 cc. [15 fl. oz. 173 min.] of the percolate and dissolve the sucrose in this, then add a sufficient quantity of cinnamon water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 4 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—A pleasant flavor and vehicle.

SYRUPUS ERIODICTYI AROMATICUS. N. F. Aromatic Syrup of Eriodictyon

[**Syr. Eriodict. Arom.** Aromatic Syrup of Yerba Santa, Syrupus Corrigens]

	Metric	Alternative
Fluidextract of Eriodictyon	**32.0 cc.**	1 fl. oz. 12 min.
Solution of Potassium Hydroxide	**25.0 cc.**	384 min.
Compound Tincture of Cardamom	**65.0 cc.**	2 fl. oz. 38 min.
Oil of Sassafras	**0.5 cc.**	8 min.
Oil of Lemon	**0.5 cc.**	8 min.
Oil of Clove	**1.0 cc.**	15 min.
Alcohol	**32.0 cc.**	1 fl. oz. 12 min.
Sucrose	**800.0 Gm.**	26 oz. av. 309 gr.
Magnesium Carbonate	**5.0 Gm.**	73 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the oils in the alcohol, add the fluidextract and the tincture, then the solution of potassium hydroxide and 325 cc. [10 fl. oz. 192 min.] of water. Shake the mixture thoroughly, add the magnesium carbonate, allow it to stand overnight, then filter and add sufficient water through the filter to make the liquid measure 500 cc. [1 pint]. Pour this filtrate upon the sucrose contained in a bottle, and dissolve it by placing the bottle in hot water, agitating the contents frequently. Lastly, cool the solution and add sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 7 per cent.

Average dose—2 fluidrachms (8 cc.).

Uses—A pleasantly flavored vehicle, especially adapted to the administration of bitter substances like quinine.

SYRUPUS FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. N. F. Syrup of the Phosphates of Iron, Quinine and Strychnine

[**Syr. Ferr. Quin. et Strych. Phos.** Easton's Syrup]

	Metric	Alternative
Soluble Ferric Phosphate	**20.0 Gm.**	292 gr.
Quinine	**26.0 Gm.**	380 gr.
Strychnine	**0.2 Gm.**	2⅞ gr.
Phosphoric Acid	**50.0 cc.**	1 fl. oz. 288 min.
Glycerin	**100.0 cc.**	3 fl. oz. 96 min.
Water	**50.0 cc.**	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the soluble ferric phosphate in the water with the aid of heat, then add the phosphoric acid, the quinine and the strychnine, and stir until solution is effected. Filter the liquid into the glycerin, contained in a graduated flask, add sufficient syrup to make the product measure 1000 cc. [2 pints], and mix thoroughly.

This product darkens on standing. Preserve it in amber-colored bottles.

Average dose—1 fluidrachm (4 cc.).

One average dose contains about:

0.0009 Gm. or 1/65 gr. of strychnine phosphate (anhydrous).

Uses—A popular combination employed as a chalybeate tonic.

SYRUPUS FERRI SACCHARATI SOLUBILIS. N.F. Syrup of Soluble Saccharated Iron

[Syr. Ferr. Sacch. Sol. Syrupus Ferri Oxydati Solubilis, Syrup of Saccharated Oxide of Iron, Syrup of Soluble Oxide of Iron]

	Metric	Alternative
Saccharated Ferric Oxide	**415 Gm.**	13 oz. av. 373 gr.
Syrup	**320 cc.**	10 fl. oz. 115 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the saccharated ferric oxide in 400 cc. [12 fl. oz. 384 min.] of water on a water bath, add the syrup and sufficient water to make the product, when cold, measure 1000 cc. [2 pints].

Average dose—1 fluidrachm (4 cc.).

Uses—A chalybeate tonic.

SYRUPUS FICUS COMPOSITUS. N.F. Compound Syrup of Figs

[Syr. Fic. Co.]

	Metric	Alternative
Figs, cut into small pieces	**300 Gm.**	10 oz. av. 6 gr.
Fluidextract of Senna	**200 cc.**	6 fl. oz. 192 min.
Aromatic Fluidglycerate of Cascara Sagrada	**100 cc.**	3 fl. oz. 96 min.
Oil of Fennel	**1 cc.**	15 min.
Spirit of Peppermint	**3 cc.**	46 min.
Sucrose	**400 Gm.**	13 oz. av. 154 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Add 1000 cc. [2 pints] of boiling water to the figs and digest the mixture at a gentle heat, during two hours, replacing the water from time to time as it evaporates, then strain with pressure and set the strained liquid aside. Again digest the residue with 500 cc. [1 pint] of boiling water for one hour, replacing the water as it evaporates, and strain. Mix the strained liquids, evaporate the mixture to 400 cc. [12 fl. oz. 384 min.], and while warm dissolve the sucrose in the liquid. When the solution is cold add it to a mixture of the fluidextract of senna, aromatic fluidglycerate of cascara sagrada, oil of fennel, and spirit of peppermint. Finally add sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 5 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—A laxative.

SYRUPUS GLYCYRRHIZÆ. N.F. Syrup of Glycyrrhiza

[Syr. Glycyrrhiz. Syrup of Licorice]

	Metric	Alternative
Fluidglycerate of Glycyrrhiza	**250 cc.**	8 fl. oz.
Syrup, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix.

Average dose—2 fluidrachms (8 cc.).

Uses—A flavored vehicle, especially adapted to the administration of bitter or nauseous substances.

SYRUPUS HYPOPHOSPHITUM. N.F. Syrup of Hypophosphites

(U. S. P. IX)

[Syr. Hypophos.]

	Metric	Alternative
Calcium Hypophosphite	**45 Gm.**	1 oz. av. 220 gr.
Potassium Hypophosphite	**15 Gm.**	219 gr.
Sodium Hypophosphite	**15 Gm.**	219 gr.
Hypophosphorous Acid	**1 cc.**	15 min.
Glycerin	**50 cc.**	1 fl. oz. 288 min.
Sucrose	**600 Gm.**	20 oz. av. 12 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the hypophosphites with 500 cc. [1 pint] of distilled water, until they are dissolved. Add the hypophosphorous acid, filter the liquid and pass sufficient distilled water through the filter to make the filtrate measure 540 cc. [17 fl. oz. 134 min.]. To this add the glycerin and sucrose, dissolve the latter by agitation without heat, and add sufficient distilled water, through the filter, to make the product measure 1000 cc. [2 pints]. Strain if necessary.

Average Dose—2½ fluidrachms (10 cc.).

Uses—The use of preparations of the hypophosphites has largely been stimulated by the advertisement of proprietary forms although their therapeutic value has been repeatedly questioned in medical literature. They have been proposed as alteratives and tonics.

SYRUPUS HYPOPHOSPHITUM COMPOSITUS. N.F. Compound Syrup of Hypophosphites

[Syr. Hypophos. Co.]

	Metric	Alternative
Calcium Hypophosphite	35.000 Gm.	1 oz. av. 74 gr.
Potassium Hypophosphite	17.500 Gm.	255 gr.
Sodium Hypophosphite	17.500 Gm.	255 gr.
Ferric Hypophosphite	2.250 Gm.	33 gr.
Manganese Hypophosphite	2.250 Gm.	33 gr.
Quinine	1.100 Gm.	16 gr.
Strychnine	0.115 Gm.	1⅞ gr.
Sodium Citrate	3.750 Gm.	55 gr.
Hypophosphorous Acid	5.000 cc.	77 min.
Sucrose	700.000 Gm.	23 oz. av. 160 gr.
Glycerin	50.000 cc.	1 fl. oz. 288 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Rub the ferric and manganese hypophosphites with the sodium citrate, add 30 cc. [461 min.] of water and warm the mixture with stirring, until a clear greenish solution is obtained. Dissolve the calcium, potassium and sodium hypophosphites in 450 cc. [14 fl. oz. 192 min.] of water, to which 2 cc. [31 min.] of hypophosphorous acid has been added; then dissolve the quinine and strychnine in 30 cc. [461 min.] of water and the glycerin, with the aid of 3 cc. [46 min.] of hypophosphorous acid, mix the solutions, and dissolve the sucrose in them by agitation. Add sufficient water to make the product measure 1000 cc. [2 pints], and filter.

Preserve the Syrup in amber-colored bottles.

Average dose—2 fluidrachms (8 cc.).

One average dose contains about:

0.0009 Gm. or 1/60 grain of Strychnine.

Uses—See Syrupus Hypophosphitum.

SYRUPUS IODOTANNICUS. N.F. Iodotannic Syrup

[Syr. Iodotan.]

	Metric	Alternative
Iodine	2.7 Gm.	39 gr.
Tannic Acid	5.4 Gm.	79 gr.
Sucrose	800.0 Gm.	26 oz. av. 309 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Reduce the iodine to a powder, introduce it into a flask with the tannic acid and 450 cc. [14 fl. oz. 192 min.] of distilled water, and heat the mixture on a water bath, at a temperature not exceeding 50° C., agitating the flask from time to time, until a drop of the liquid ceases to give a blue color with starch T.S. Then add the sucrose, and when this is dissolved remove the flask from the water bath, allow the syrup to cool, and add sufficient distilled water to make the product measure 1000 cc. [2 pints].

Average dose—1 fluidrachm (4 cc.).

Uses—An alterative and astringent.

SYRUPUS IPECACUANHÆ ET OPII. N. F. Syrup of Ipecac and Opium

[Syr. Ipecac. et Opii. Syrup of Dover's Powder]

	Metric	Alternative
Tincture of Ipecac and Opium	85 cc.	2 fl. oz. 346 min.
Spirit of Cinnamon	4 cc.	1 fl. dr.
Cinnamon Water	32 cc.	1 fl. oz. 12 min.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the tincture, spirit and water, add sufficient syrup to make the product measure 1000 cc. [2 pints], and mix thoroughly.

Approximate alcohol content, by volume, 1.4 per cent.

Average dose—1 fluidrachm (4 cc.).

One average dose contains about:

0.34 cc. or 5 minims of Tincture of Ipecac and Opium.

Uses—A diaphoretic and sedative expectorant.

SYRUPUS KRAMERIÆ. N. F. Syrup of Krameria

[Syr. Kramer.]

	Metric	Alternative
Fluidextract of Krameria	450 cc.	14 fl. oz. 192 min.
Syrup, a sufficient quantity		
To make	1000 cc.	2 pints

Mix them.

Approximate alcohol content, by volume, 15 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—An intestinal astringent.

SYRUPUS MANNÆ. N. F. Syrup of Manna

[Syr. Mann.]

	Metric	Alternative
Manna, in flakes	125 Gm.	4 oz. av. 75 gr.
Sucrose	775 Gm.	25 oz. av. 380 gr.
Alcohol	65 cc.	2 fl. oz. 38 min.
Water, a sufficient quantity		
To make	1000 cc.	2 pints

Dissolve the manna in 400 cc. [12 fl. oz. 384 min.] of hot water, add the alcohol, set the liquid aside for twelve hours in a moderately warm place, and then filter it. Dissolve the sucrose in the filtrate, with the aid of a gentle heat, allow the syrup to cool, and add sufficient water, passed through the filter previously used, to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 6 per cent.

Average dose—2 fluidrachms (8 cc.).

Uses—A feeble laxative usually combined with senna or rhubarb.

SYRUPUS PHOSPHATUM COMPOSITUS. N. F. Compound Syrup of Phosphates

[Syr. Phos. Co. Chemical Food]

	Metric	Alternative
Compound Solution of Phosphates	500 cc.	1 pint
Syrup	334 cc.	10 fl. oz. 330 min.
Glycerin	150 cc.	4 fl. oz. 384 min.
Tincture of Cudbear	16 cc.	246 min.
To make	1000 cc.	2 pints

Mix the tincture of cudbear with the glycerin and add the other ingredients.

Preserve the syrup in amber-colored bottles.

Average dose—1 fluidrachm (4 cc.).

Uses—It has been used as a general tonic, but it is of doubtful value.

SYRUPUS PHOSPHATUM CUM QUININA ET STRYCHNINA. N.F. Syrup of Phosphates with Quinine and Strychnine

[Syr. Phos. c. Quin. et Strych.]

	Metric	Alternative
Compound Solution of Phosphates	**500.00 cc.**	1 pint
Quinine Hydrochloride	**4.40 Gm.**	64 gr.
Strychnine Nitrate	**0.14 Gm.**	2 gr.
Glycerin	**150.00 cc.**	4 fl. oz. 384 min.
Syrup, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the quinine and strychnine salts in the glycerin with the aid of heat and add the other ingredients.

Preserve the syrup in amber-colored bottles.

Average dose—1 fluidrachm (4 cc.).

One average dose contains the equivalent of about:
0.00056 Gm. or $\frac{1}{125}$ grain of Strychnine Nitrate.

Uses—A bitter tonic.

SYRUPUS PINI ALBÆ COMPOSITUS. N.F. Compound Syrup of White Pine

[Syr. Pin. Alb. Co.—Syrupus Pini Strobi Compositus N.F. IV]

	Metric	Alternative
White Pine Bark, in moderately coarse powder	**85.0 Gm.**	2 oz. av. 366 gr.
Wild Cherry, in moderately coarse powder	**85.0 Gm.**	2 oz. av. 366 gr.
Aralia, in moderately coarse powder	**10.0 Gm.**	146 gr.
Balsam Poplar Buds, in moderately coarse powder	**10.0 Gm.**	146 gr.
Sanguinaria, in moderately coarse powder	**8.0 Gm.**	117 gr.
Sassafras, in moderately coarse powder	**7.0 Gm.**	102 gr.
Cudbear	**1.0 Gm.**	15 gr.
Chloroform	**6.0 cc.**	92 min.
Sucrose	**650.0 Gm.**	21 oz. av. 305 gr.
Glycerin	**100.0 cc.**	3 fl. oz. 96 min.
Oil of Sassafras	**0.2 cc.**	3 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the vegetable drugs and moisten the powder with a sufficient quantity of a menstruum composed of the glycerin, 100 cc. [3 fl. oz. 96 min.] of alcohol, and 200 cc. [6 fl. oz. 192 min.] of water, pack it in a percolator, and macerate for twelve hours. Then continue the percolation, using first the remainder of the menstruum and then a mixture of one volume of alcohol and three volumes of water until the percolate measures 600 cc. [19 fl. oz. 96 min.]. In this percolate dissolve the sucrose, add the chloroform and oil of sassafras and mix thoroughly. Add sufficient water to make the product measure 1000 cc. [2 pints], and strain.

Approximate alcohol content, by volume, 10 per cent.

N. F. Preparation—Syrupus Pini Albæ Compositus Cum Morphina.

Average dose—1 fluidrachm (4 cc.).

Uses—An expectorant.

SYRUPUS PINI ALBÆ COMPOSITUS CUM MORPHINA. N.F. Compound Syrup of White Pine with Morphine

[Syr. Pin. Alb. c. Morph.—Syrupus Pini Strobi Compositus cum Morphina, N.F. IV]

	Metric	Alternative
Morphine Sulphate	**0.4 Gm.**	$5\frac{1}{2}$ gr.
Compound Syrup of White Pine	**1000.0 cc.**	2 pints

Dissolve the morphine sulphate in the compound syrup of white pine, and mix well.

Approximate alcohol content, by volume, 10 per cent.

Average dose—30 minims (2 cc.).

One average dose contains about:
0.0008 Gm. or $\frac{1}{80}$ grain of Morphine Sulphate.

Uses—An expectorant which should be used only upon the advice of a physician as it contains about $\frac{1}{40}$ grain of morphine to the fluidrachm.

SYRUPUS QUINIDINÆ. N.F. Syrup of Quinidine

[Syr. Quinid.—Bitterless Syrup of Quinidine]

	Metric	Alternative
Quinidine, in fine crystals	33.0 Gm.	1 oz. av. 45 gr.
Oil of Orange	0.2 cc.	3 min.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Add the oil and the quinidine to 750 cc. [24 fl. oz.] of syrup, contained in a bottle, and shake the mixture thoroughly. Then add sufficient syrup to make the product measure 1000 cc. [2 pints]. Shake it well before dispensing.

Average dose—1 fluidrachm (4 cc.).

Uses—An antiperiodic; especially intended for young children.

SYRUPUS RHAMNI CATHARTICÆ. N.F. Syrup of Rhamnus Cathartica

[Syr. Rham. Cathart.—Syrup of Buckthorn Berry, Syrupus Spinæ Cervinæ]

	Metric	Alternative
Fluidextract of Rhamnus Cathartica	200.0 cc.	6 fl. oz. 192 min.
Oil of Fennel	0.2 cc.	3 min.
Oil of Cinnamon	0.2 cc.	3 min.
Syrup, a sufficient quantity,		
To make	1000 cc.	2 pints

Add the oils to the fluidextract and mix this with sufficient syrup to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 8 per cent.

Average dose—2 fluidrachms (8 cc.).

Uses—A cathartic frequently employed in veterinary practice for dogs.

SYRUPUS ROSÆ. N.F. Syrup of Rose

[Syr. Ros.]

	Metric	Alternative
Fluidextract of Rose	125 cc.	4 fl. oz.
Diluted Sulphuric Acid	10 cc.	154 min.
Sucrose	750 Gm.	25 oz. av. 15 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the fluidextract of rose and diluted sulphuric acid with 300 cc. [9 fl. oz. 288 min.] of water and allow the mixture to stand for two hours; then filter and add sufficient water through the filter to obtain 520 cc. [16 fl. oz. 307 min.] of filtrate. Dissolve the sucrose in the filtrate by agitation and add sufficient water to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Approximate alcohol content, by volume, 4.5 per cent.

Uses—A mildly astringent flavoring vehicle.

SYRUPUS RUBI. N.F. Syrup of Rubus

[Syr. Rubi]

	Metric	Alternative
Fluidextract of Rubus	250 cc.	8 fl. oz.
Syrup, a sufficient quantity		
To make	1000 cc.	2 pints

Mix them.

Approximate alcohol content, by volume, 9 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—An astringent; especially for diarrhea.

SYRUPUS RUBI IDÆI. N.F. Syrup of Raspberry
[Syr. Rubi Id.]

Fresh, Ripe Raspberries, any convenient quantity.
Sucrose, a sufficient quantity.

Garble the raspberries, wash them with water, drain, and reduce them to a pulp, and let this stand, at a temperature of about 20° C., until a small portion of the filtered juice produces a clear solution with half of its volume of alcohol. Then separate the juice by straining with pressure, heat it just to the boiling point, remove the scum and filter while hot. Add 200 Gm. [6 oz. av. 96 min.] of sucrose to every 100 cc. [3 fl. oz. 96 min.] of filtered juice and agitate the mixture until the sucrose is dissolved. Preserve the product in well-stoppered bottles in a cool and dark place.

N. F. Preparations—Elixir Bromidorum Quinque, Elixir Gentianæ Glycerinatum.

Uses—A pleasantly flavored vehicle.

SYRUPUS SENNÆ AROMATICUS. N.F. Aromatic Syrup of Senna
[Syr. Senn. Arom.]

	Metric	Alternative
Fluidextract of Senna	**125.0 cc.**	4 fl. oz.
Jalap, in moderately coarse powder	**50.0 Gm.**	1 oz. av. 293 gr.
Rhubarb, in moderately coarse powder	**17.5 Gm.**	255 gr.
Cinnamon, in moderately coarse powder	**4.0 Gm.**	58 gr.
Clove, in moderately coarse powder	**4.0 Gm.**	58 gr.
Myristica, in moderately coarse powder	**2.0 Gm.**	29 gr.
Oil of Lemon	**1.5 cc.**	23 gr.
Sucrose	**500.0 Gm.**	16 oz. av. 302 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the drugs, add the oil of lemon, moisten with sufficient diluted alcohol and, after macerating for twenty-four hours, percolate in the usual manner, using diluted alcohol as the menstruum. Reserve the first 550 cc. [17 fl. oz. 288 min.] of the percolate, add the fluidextract of senna, and dissolve the sucrose in the liquid with the aid of a gentle heat, but avoiding the loss of alcohol by evaporation. Allow the solution to cool, collect a further portion of the percolate, and add a sufficient quantity of it to the syrup to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 26 per cent.

Average dose—2 fluidrachms (8 cc.).

Uses—A pleasant laxative.

SYRUPUS STILLINGIÆ COMPOSITUS. N.F. Compound Syrup of Stillingia
[Syr. Stilling. Co.]

	Metric	Alternative
Compound Fluidextract of Stillingia	**250 cc.**	8 fl. oz.
Glycerin	**100 cc.**	3 fl. oz. 96 min.
Syrup	**650 cc.**	20 fl. oz. 384 min.
To make about	**1000 cc.**	2 pints

Mix the fluidextract with the glycerin, add the syrup and mix well.

Approximate alcohol content, by volume, 9 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—This syrup is of doubtful value although formerly used as an alterative.

SYRUPUS THYMI. N.F. Syrup of Thyme
[Syr. Thymi]

	Metric	Alternative
Fluidextract of Thyme	**200 cc.**	6 fl. oz. 192 min.
Syrup	**800 cc.**	25 fl. oz. 288 min.
To make about	**1000 cc.**	2 pints

Mix them.

Approximate alcohol content, by volume, 3.5 per cent.

N. F. Preparation—Syrupus Thymi Compositus.

Average dose—1 fluidrachm (4 cc.).

Uses—A carminative and antispasmodic.

SYRUPUS THYMI COMPOSITUS. N.F. Compound Syrup of Thyme

[Syr. Thymi Co.]

	Metric	Alternative
Ammonium Bromide	35 Gm.	1 oz. av. 74 gr.
Distilled Water	50 cc.	1 fl. oz. 288 min.
Syrup of Thyme, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the ammonium bromide in the water and add the syrup of thyme. Mix well.

Approximate alcohol content, by volume, 3 per cent.

Uses—In bronchitis and whooping-cough in a dose of 1 fluidrachm (4 cc.).

SYRUPUS TRIFOLII COMPOSITUS. N.F. Compound Syrup of Trifolium

[Syr. Trifol. Co.]

	Metric	Alternative
Compound Fluidextract of Trifolium	300.0 cc.	9 fl. oz. 288 min.
Powdered Tragacanth	1.0 Gm.	15 gr.
Oil of Sassafras	0.4 cc.	6 min.
Oil of Anise	0.2 cc.	3 min.
Methyl Salicylate	0.2 cc.	3 min.
Sucrose	650.0 Gm.	21 oz. av. 315 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the powdered tragacanth intimately with the fluidextract, add the oils and methyl salicylate and 250 cc. [8 fl. oz.] of distilled water; then add the sucrose and agitate until it is dissolved. Add sufficient distilled water to make the product measure 1000 cc. [2 pints], and mix thoroughly.

Approximate alcohol content, by volume, 4 per cent.

Uses—It is used as an emmenagogue in a dose of 2 fluidrachms (8 cc.).

Table of Some Unofficial Syrups

Title	*Directions*
Syrupus Acaciæ (U. S. P. IX)	Dissolve 10 Gm. of acacia in 43 cc. of distilled water; add 80 Gm. of sucrose and dissolve with the aid of a water bath. Strain while hot and add enough recently boiled distilled water to make 100 cc. Preserve in sterilized bottles
Amygdalæ (U. S. P. 1890) (Orgeat Syrup)	Rub 14 Gm. of blanched sweet almond and 4 Gm. of bitter almond with 10 Gm. of sucrose and 3 cc. of water to a paste, add 10 cc. of orange flower water and 20 cc. of syrup and strain. Add 10 cc. of water to the residue and again strain with strong pressure. Dissolve 10 Gm. of sucrose in the strained liquids and add enough syrup to make 100 cc. This is a flavoring syrup
Aromaticus (Br.1914)	Mix 25 cc. of tincture of orange with 25 cc. of cinnamon water, add a little purified talc, filter and add 50 cc. of syrup
Calcii Hydrochlorophosphatis (N. F. IV)	Triturate 1.75 Gm. of precipitated calcium phosphate with 3 cc. of water and dissolve with the aid of hydrochloric acid, avoiding an excess. Add 2 cc. of tincture of lemon peel, filter, wash the filter with a mixture of 3 cc. each of water and syrup. Add enough syrup to make 100 cc. Dose: one fluidrachm (4 cc.)
Calcis (U. S. P. VIII)	Slake 6.5 Gm. of lime with 3.5 cc. of water with heat and thoroughly mix 35 Gm. of sucrose. Boil the mixture with 50 cc. of water for five minutes, constantly stirring, dilute with enough water through the filter to make 100 cc. Dose: thirty minims (2 cc.)
Cascaræ Aromaticus (Br. 1914)	Mix 40 cc. liquid extract of cascara sagrada, 10 cc. tincture of orange, 5 cc. (90 per cent) alcohol and 15 cc. cinnamon water with enough syrup to make 100 cc.
Chloral (Br. 1914)	Dissolve 20 Gm. of chloral hydrate in 20 cc. of distilled water and add enough syrup to make 100 cc. Dose: one fluidrachm (4 cc.)
Cimicifugæ Compositus (N. F. IV)	Macerate 4 Gm. of wild cherry with 37 cc. of water for one hour. Add 4 cc. of fluidextract of cimicifuga, 2 cc. of fluidextract of glycyrrhiza, 2 cc. of fluidextract of senega, 1 cc. of fluidextract of ipecac, and 1.5 Gm. of purified talc, and agitate frequently and thoroughly during about fifteen minutes. Filter and add enough water to make 50 cc. of filtrate. Add 65 Gm. of sucrose, and dissolve by agitation, and add enough water to make 100 cc. Dose: one fluidrachm (4 cc.)
Codeinæ (N. F. IV)	Dissolve 0.2 Gm. of codeine sulphate in 100 cc. of warm syrup Dose: one fluidrachm (4 cc.)

Table of Some Unofficial Syrups—*Continued*

Title	*Directions*
Syrupus Ferri et Mangani Iodidi (N. F. IV)	Prepare a solution of ferrous iodide in the usual manner from 8.15 Gm. of iodine, 2.8 Gm. of iron and 20 cc. of distilled water. Filter directly upon 80 Gm. of sucrose, rinse the flask and filter with two portions of 2 cc. each of distilled water. Dissolve 2.65 Gm. of manganese sulphate in 10 cc. of distilled alcohol, mix and filter into the iron iodide solution. Wash the filter with 2.5 cc. of cold distilled water, dissolve the sugar by agitation and add enough distilled water to make 100 cc. Dose: fifteen minims (1 cc.)
Ferri Hypophosphitis (N. F. IV)	Dissolve 1.75 Gm. of ferric hypophosphite and 2.5 Gm. of potassium citrate in 23 cc. of distilled water, with the aid of heat, and filter. Mix the filtrate with 9 cc. of orange flower water and add enough distilled water to make 45 cc. Dissolve 85 Gm. of sucrose in this liquid and add enough distilled water to make 100 cc. Dose: one fluidrachm (4 cc.)
Ferri Iodidi, Ruspini	Dissolve 2 Gm. of iron and potassium tartrate and 2 Gm. of potassium iodide in 16 cc. of orange flower water and 100 cc. of syrup Dose: one fluidrachm (4 cc.)
Ferri Lactophosphatis (N. F. IV)	Dissolve 1.75 Gm. of ferrous lactate in 5 cc. of distilled water with the aid of 1.75 cc. of phosphoric acid. Dissolve 8 Gm. of sucrose in the solution and add enough syrup to make 100 cc. Dose: one fluidrachm (4 cc.)
Ferri Phosphatis (Br. 1914)	Dissolve 0.86 Gm. of iron in 6.25 cc. of phosphoric acid (66.3 per cent), previously diluted with 6.25 cc. of distilled water, filter, add 70 cc. of syrup and enough distilled water to make 100 cc. Dose: one fluidrachm (4 cc.)
Ferri Protochloridi (N. F. IV)	Mix 5 cc. of solution of ferrous chloride with 12.5 cc. of glycerin and 12.5 cc. of orange flower water and add enough syrup to make 100 cc. Dose: one fluidrachm (4 cc.)
Glucosi (Br. 1914)	Mix 25 Gm. of liquid glucose with 50 Gm. of syrup with the aid of gentle heat
Lactucarii (U. S. P. IX)	Mix 10 cc. of tincture of lactucarium with 20 cc. of glycerin, add 5 cc. of orange flower water in which 0.1 Gm. of citric acid has been dissolved, filter and add enough syrup to make the product measure 100 cc. Dose: two and one-half fluidrachms (10 cc.)
Limonis (Br. 1914)	Macerate 2 Gm. of fresh grated lemon peel in 3 cc. of alcohol during seven days, filter, adding alcohol to make 4 cc. Dissolve 76 Gm. of sucrose in 50 cc. of lemon juice, add to the alcoholic solution and mix
Morphinæ et Acaciæ (N. F. IV) (Jackson's Pectoral Syrup)	Dissolve 0.055 Gm. of morphine hydrochloride in about 6 cc. of syrup, add 0.05 cc. of oil of sassafras and enough syrup of acacia to make 100 cc. Dose: one fluidrachm (4 cc.)
Papaveris (N. F. IV)	Percolate 100 Gm. of poppy capsules, deprived of seed and powdered, with boiling water until practically exhausted. Heat the percolate to boiling for two minutes, concentrate on a water bath to 450 cc., filter, and dissolve 850 Gm. of sucrose in the concentrated liquid, add enough water to make 1000 cc. and strain Dose: one fluidrachm (4 cc.)
Rhœados (Br. 1914)	Infuse 26 Gm. of red poppy petals in 40 cc. of heated distilled water, allow to stand for twelve hours, frequently stirring, strain, dissolve 72 Gm. of sucrose in the liquid, add 5 cc. of alcohol and enough distilled water to make 100 cc. Dose: thirty minims (2 cc.)
Sanguinariæ (N. F. IV)	Mix 12.5 cc. of acetic acid, with 37 cc. of water, moisten 22.5 Gm. of sanguinaria with part of this menstruum and macerate for two hours. Percolate, first with the remaining menstruum and then with water, to make 75 cc. or to exhaustion, evaporate at moderate heat to 48 cc., filter, dissolve 80 Gm. of sucrose in the filtrate and add water to make 100 cc. Dose: thirty minims (2 cc.)
Sennæ Compositus (N. F. IV)	Dissolve 0.4 cc. of methyl salicylate in 6.5 cc. of alcohol, add 13.5 cc. of fluidextract of senna, 3.5 cc. of fluidextract of rhubarb, 3.5 cc. of fluidextract of frangula and enough syrup to make 100 cc. Dose: two fluidrachms (8 cc.)
Sodii Hypophosphitis (N. F. IV)	Dissolve 3.5 Gm. of sodium hypophosphite in 45 cc. of distilled water, add 0.2 cc. of hypophosphorous acid, filter, dissolve 80 Gm. of sucrose in the filtrate by agitation, and add enough distilled water to make 100 cc. Dose: one fluidrachm (4 cc.)

Mellita—*Honeys*

Official honeys are thick liquid preparations closely allied to the syrups, differing merely in the use of honey, instead of syrup as a base. They are not an important class of preparations today but at one time, before sugar was available, honey was the most common sweetening agent. The National Formulary recognizes a closely related preparation, under the title "Oxymel", which contains acetic acid, the title meaning "acid honey".

MEL ROSÆ. U. S. Honey of Rose

	Metric	Alternative
Fluidextract of Rose	**120 cc.**	440 min.
Honey, a sufficient quantity,		
To make	**1000 Gm.**	8 oz. av.

Mix the fluidextract of rose in a tared vessel with enough honey to make the product weigh 1000 Gm. [8 oz. av.].

U. S. P. Preparation—Massa Hydrargyri.
N. F. Preparation—Mel Rosæ et Sodii Boratis.

Average dose—1 fluidrachm (4 cc.).

Uses—It is used as a mildly astringent adjuvant in gargles and also in mass of mercury as a distributing agent; its action is purely mechanical.

MEL ROSÆ ET SODII BORATIS. N. F. Honey of Rose and Sodium Borate

[**Mel Ros. et Sod. Bor.** Honey of Rose with Borax]

	Metric	Alternative
Sodium Borate, in fine powder	**10 Gm.**	175 gr.
Glycerin	**5 Gm.**	88 gr.
Honey of Rose	**85 Gm.**	3 oz. av. 175 gr.
To make	**100 Gm.**	4 oz. av.

Mix the sodium borate with the glycerin, add the honey of rose, and stir until solution is effected.

Uses—In stomatitis and as an astringent in gargles.

MEL SODII BORATIS. N. F. Honey of Sodium Borate

[**Mel. Sod. Bor.** Mel Boracis, Honey and Borax]

	Metric	Alternative
Sodium Borate, in fine powder	**10 Gm.**	175 gr.
Glycerin	**5 Gm.**	88 gr.
Honey	**85 Gm.**	3 oz. av. 175 gr.
To make	**100 Gm.**	4 oz. av.

Mix the sodium borate with the glycerin, add the honey, and stir until solution is effected.

Uses—Same as Honey of Rose and Borax.

OXYMEL SCILLÆ. N. F. Oxymel of Squill

[**Oxymel Scill.**]

	Metric	Alternative
Vinegar of Squill	**50 Gm.**	2 oz. av.
Honey	**100 Gm.**	4 oz. av.
To make	**100 Gm.**	4 oz. av.

Mix the honey and the vinegar of squill in a tared porcelain dish or enameled iron vessel, and heat on a water bath until the mixture has been reduced to a weight of 100 Gm. [4 oz. av.]. Then strain the preparation, allow it to cool, and transfer it to bottles, which should be well stoppered.

Average dose—1 fluidrachm (4 cc.).

Uses—An expectorant.

Mucilagines—*Mucilages*

The official mucilages are thick, viscid, adhesive liquids, produced by dissolving gum in water, or by extracting with water the mucilaginous principles from vegetable substances. The mucilages are all prone to decomposition, and should never be made in larger quantities than can be used immediately, unless a preservative is added.

MUCILAGO ACACIÆ. U.S. Mucilage of Acacia

[**Mucil. Acac.**—MUCILAGE OF GUM ARABIC]

	Metric	Alternative
Acacia, in small fragments	350 Gm.	1 oz. av. 201 gr.
Sodium Benzoate	1 Gm.	2 gr.
Distilled Water, a sufficient quantity, To make	1000 cc.	4 fl. oz.

Place the acacia in a graduated bottle having a wide mouth and a capacity not exceeding 1000 cc. [4 fl. oz.], wash the drug with cold water, allow it to drain, and add enough warm distilled water, in which the sodium benzoate has been dissolved, to make the product measure 1000 cc. [4 fl. oz.]. After stoppering, lay the bottle on its side, rotating it occasionally, and when the acacia is dissolved, strain the mucilage.

Mucilage of Acacia must not be dispensed if it has become sour or mouldy.

NOTE—Although the Pharmacopœia directs small fragments of acacia in the preparation of this mucilage it is almost universally the custom of the pharmacist to employ granular or powdered acacia, and if this is of finest quality the mucilage is more quickly prepared and equally satisfactory. It is important in using this process to place the acacia in a mortar and quickly add, all at once, at least an equal bulk of the water, and then stir the mixture. If the water is added slowly, a gummy mass results which will dissolve only after hours of standing. If the pharmacist weighs 35 Gm. of acacia, 0.1 Gm. of sodium benzoate, and measures 65 cc. of water (equivalent to 65 Gm.), the product will weigh 100 Gm. without subsequently having to adjust the weight. The sodium benzoate is added to aid in the preservation of the product.

Average dose—4 fluidrachms (15 cc.).

Uses—A demulcent; also employed as an excipient in making pills and troches, and as an emulsifying agent for cod liver oil and other substances.

MUCILAGO TRAGACANTHÆ. U.S. Mucilage of Tragacanth

[**Mucil. Trag.**]

	Metric	Alternative
Tragacanth	6 Gm.	105 gr.
Glycerin	18 Gm.	315 gr.
Water, a sufficient quantity, To make	100 Gm.	4 oz. av.

Mix the glycerin with 75 cc. [2½ fl. oz.] of water in a tared vessel, heat the mixture to boiling, remove the heat, add the tragacanth, and macerate during twenty-four hours, stirring occasionally. Then add enough water to make the mixture weigh 100 Gm. [4 oz. av.], stir actively until of uniform consistence, and strain forcibly through muslin.

Uses—Used almost exclusively as a pill excipient.

MUCILAGO CHONDRI. N.F. Mucilage of Chondrus

[**Mucil. Chondr.** MUCILAGE OF IRISH MOSS]

	Metric	Alternative
Chondrus	30 Gm.	1 oz. av.
Water, a sufficient quantity, To make	1000 cc.	2 pints

Wash the chondrus with cold water, place it in a suitable vessel, add 1000 cc. [2 pints] of water and heat it, on a water bath, for fifteen minutes, stirring frequently. Then strain it through muslin with pressure and pass sufficient water through the strainer to make the product, when cold, measure 1000 cc. [2 pints].

Uses—An emulsifying agent and demulcent.

MUCILAGO SASSAFRAS MEDULLÆ. N. F. Mucilage of Sassafras Pith

[Mucil. Sassaf. Medul.]

	Metric	Alternative
Sassafras Pith	3 Gm.	56 gr.
Recently Boiled Distilled Water	150 cc.	6 fl. oz.
To make about	100 cc.	4 fl. oz.

Macerate the sassafras pith in the water, stirring constantly during ten minutes, and filter through a pledget of wet cotton.

This preparation should not be dispensed unless it has been recently prepared.

Average dose—4 fluidrachms (15 cc.).

Uses—A soothing application in eye inflammation.

Table of Some Unofficial Mucilages

Title	*Directions*
Mucilago Gummi Indici (Br. 1914)	Rapidly rinse 50 Gm. of Indian gum with a little water, then dissolve it in 150 cc. of distilled water in a closed vessel and strain. It should be recently prepared
Ulmi (U. S. P. VIII)	Digest 6 Gm. of bruised elm with 100 cc. of water in a water bath, in a covered vessel, during one hour and strain Dose: four fluidrachms (15 cc.)

Emulsa—*Emulsions*

The U. S. Pharmacopœia of 1890 introduced emulsions as a separate class of preparations; formerly they were included under the general heading of Misturæ. The necessity for differentiation in nomenclature, as preparations of established merit multiply, is apparent. Emulsions are aqueous liquids in which oleaginous substances are suspended by the intervention of gum, yolk of egg, or other viscid matter. Their method of preparation is fully considered under Part XI, Extemporaneous Liquids.

Flavors for Emulsions

The National Formulary suggests the following combinations as flavors for the N. F. Emulsions. Any other suitable flavor may, however, be used, the one considered most appropriate being selected by the prescriber or dispenser. The quantities given below are intended for 1000 cc. [2 pints] of finished product:

		Metric	Alternative
a.	**Oil of Betula**	4.0 cc.	1 fl. dr.
b.	**Oil of Betula**	2.0 cc.	31 min.
	Oil of Sassafras	2.0 cc.	31 min.
c.	**Compound Spirit of Orange**	1.5 cc.	23 min.
d.	**Oil of Betula**	2.00 cc.	31 min.
	Oil of Bitter Almond	0.25 cc.	4 min.
	Oil of Coriander	0.25 cc.	4 min.
e.	**Oil of Betula**	1.50 cc.	23 min.
	Oil of Sassafras	1.50 cc.	23 min.
	Oil of Bitter Almond	0.25 cc.	4 min.
f.	**Oil of Betula**	2.5 cc.	38 min.
	Oil of Bitter Almond	2.5 cc.	38 min.

EMULSUM ASAFŒTIDÆ. U. S. Emulsion of Asafetida

[Emuls. Asafœt. Milk of Asafetida]

	Metric	Alternative
Asafetida, in tears or selected masses	40 Gm.	146 gr.
Water, a sufficient quantity,		
To make	1000 cc.	8 fl. oz.

Rub the asafetida in a mortar with 900 cc. [7 fl. oz.] of water, at first very gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and rinse the mortar and strainer with enough water to make the product measure 1000 cc. [8 fl. oz.]. Mix thoroughly.

Average dose—4 fluidrachms (15 cc.).

Uses—A carminative frequently administered to infants for colic, either by mouth or by rectum. Powdered asafetida should never be used to replace the gum resin, since the most active constituent, the volatile oil, has been largely driven off in drying before powdering. The addition of the tincture to water, in the preparation of a milk of asafetida, as has been suggested, is also objectionable and should never be practiced, while concentrated glycerites should also be looked upon with suspicion as producing an inferior product. The only proper way to make this emulsion is from asafetida in tears. This preparation may also be made by suspending the tears contained in a muslin bag, in the water in a bottle. In a few hours, the drug will disintegrate and become distributed, producing a very satisfactory product.

This preparation, strictly speaking, is not an emulsion, but conforms to the definition for a true mixture (see page 291).

The use of a little lye solution, followed by soap and water, will assist in cleaning the mortar used in its preparation.

EMULSUM OLEI MORRHUÆ. U.S. Emulsion of Cod Liver Oil
[Emuls. Ol. Morrh.]

	Metric	Alternative
Cod Liver Oil	**500 cc.**	1 pint
Acacia, in very fine powder	**125 Gm.**	4 oz. av. 75 gr.
Syrup	**100 cc.**	3 fl. oz. 96 min.
Methyl Salicylate	**4 cc.**	1 fl. dr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Thoroughly mix the acacia with the cod liver oil in a dry mortar or other suitable vessel, then add at once 250 cc. [8 fl. oz.] of water, and complete the emulsification by trituration or by the aid of a suitable mechanical device. When a thick, white, homogeneous mixture is obtained, add the methyl salicylate and the syrup with sufficient water to make the product measure 1000 cc. [2 pints], and mix thoroughly.

NOTE—The methyl salicylate may be replaced by a suitable quantity of any other flavoring.

This Emulsion is intended to be freshly prepared as required. If it is to be kept for any length of time, 70 cc. of alcohol should be added, replacing a corresponding volume of water. The alcohol should be added last and in small portions, shaking after each addition.

Average dose—4 fluidrachms (15 cc.).

Uses—This is simpl a more palatable form of cod liver oil and possesses identical therapeutic action (see Cod Liver Oil, page 1189).

EMULSUM OLEI TEREBINTHINÆ. U.S. Emulsion of Oil of Turpentine
[Emuls. Ol. Tereb.]

	Metric	Alternative
Rectified Oil of Turpentine	**15 cc.**	288 min.
Acacia, in very fine powder	**5 Gm.**	91 gr.
Water, a sufficient quantity,		
To make	**100 cc.**	4 fl. oz.

Place the powdered acacia in a dry bottle, add the oil of turpentine, mix thoroughly, add exactly 10 cc. [192 min.] of water, and agitate briskly until an emulsion forms. Then add sufficient water to make the product measure 100 cc. [4 fl. oz.], and mix thoroughly.

Average dose—½ fluidrachm (2 cc.).

Uses—The U. S. P. X process is that known for many years as *Forbes'*. If the bottle is dry, the emulsion is quickly formed and is more permanent than when made by the U. S. P. IX process. A carminative in flatulent colic, also a stimulant expectorant in bronchitis. The rectified oil only should be used for internal administration as the crude oil frequently contains rosin.

EMULSUM OLEI MORRHUÆ CUM HYPOPHOSPHITIBUS. N. F. **Emulsion of Cod Liver Oil with Hypophosphites**

[Emuls. Ol. Morrh. c. Hypophos.]

	Metric	Alternative
Cod Liver Oil	**500 cc.**	1 pint
Acacia, in fine powder	**125 Gm.**	4 oz. av. 75 gr.
Calcium Hypophosphite	**10 Gm.**	146 gr.
Potassium Hypophosphite	**5 Gm.**	73 gr.
Sodium Hypophosphite	**5 Gm.**	73 gr.
Syrup	**100 cc.**	3 fl. oz. 96 min.
Flavoring (see page 287),		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the acacia with the cod liver oil in a dry mortar until uniformly mixed, then add at once 250 cc. [8 fl. oz.] of water and triturate lightly and rapidly until the oil is completely emulsified; add the flavoring and incorporate thoroughly. Dissolve the hypophosphites in 100 cc. [3 fl. oz. 96 min.] of water, mix the solution with the syrup, and add this liquid gradually to the emulsion with continued trituration. Finally add sufficient water to make the product measure 1000 cc. [2 pints], and mix thoroughly.

Average dose—2 fluidrachms (8 cc.).

Uses—The same as for Emulsion of Cod Liver Oil.

EMULSUM OLEI MORRHUÆ CUM MALTO. N. F. **Emulsion of Cod Liver Oil with Malt**

[Emuls. Ol. Morrh. c. Malt. EMULSUM OLEI MORRHUÆ CUM EXTRACTO MALTI]

	Metric	Alternative
Cod Liver Oil	**300 cc.**	9 fl. oz. 288 min.
Tragacanth, in fine powder	**3 Gm.**	44 gr.
Water	**150 cc.**	4 fl. oz. 384 min.
Extract of Malt, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the oil and tragacanth thoroughly in a bottle, add the water and shake the mixture until a homogeneous suspension is formed, finally add the extract of malt in portions, shaking the mixture thoroughly after each addition, until the product measures 1000 cc. [2 pints].

Average dose—4 fluidrachms (15 cc.).

Uses—The same as for Emulsion of Cod Liver Oil. This is a particularly palatable form.

EMULSUM OLEI MORRHUÆ CUM VITELLO. N. F. **Emulsion of Cod Liver Oil with Egg**

[Emuls. Ol. Morrh. c. Vitel.]

	Metric	Alternative
Cod Liver Oil	**500 cc.**	1 pint
Glycerite of Yolk of Egg	**175 cc.**	5 fl. oz. 288 min.
Syrup of Tolu	**100 cc.**	3 fl. oz. 96 min.
Alcohol	**120 cc.**	3 fl. oz. 403 min.
Flavoring (see page 287),		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the glycerite of yolk of egg in a mortar with the oil, added in small portions at a time, and thoroughly emulsify each portion before adding the next. Then, continuing the trituration, gradually add the syrup of tolu, then the alcohol and the flavoring and sufficient water to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Approximate alcohol content, by volume, 10 per cent.

Average dose—4 fluidrachms (15 cc.).

Uses—The same as for Emulsion of Cod Liver Oil.

EMULSUM OLEI RICINI. N.F. Emulsion of Castor Oil

[Emuls. Ol. Ricin.]

	Metric	Alternative
Castor Oil	35.0 cc.	2 fl. oz. 384 min.
Acacia, in fine powder	9.0 Gm.	329 gr.
Tincture of Vanilla	2.5 cc.	96 min.
Syrup	20.0 cc.	1 fl. oz. 288 min.
Water, a sufficient quantity, To make	100 cc.	8 fl. oz.

Triturate the acacia with the castor oil in a dry mortar, until uniformly mixed, than add 18 cc. [1 fl. oz. 211 min.] of water and triturate lightly and rapidly until the oil is completely emulsified. Gradually incorporate the syrup and tincture, and finally add sufficient water to make the product measure 100 cc. [8 fl. oz.]. Mix thoroughly.

Average dose—1½ fluidounces (45 cc.).

Uses—An agreeable form for the administration of castor oil, as a cathartic, especially for children.

EMULSUM PETROLATI. N.F. Emulsion of Petrolatum

[Emuls. Petrolat. EMULSUM PETROLEI]

	Metric	Alternative
Petrolatum	225 Gm.	7 oz. av. 224 gr.
Expressed Oil of Almond	225 cc.	7 oz. av. 224 gr.
Acacia, in fine powder	125 Gm.	4 oz. av. 75 gr.
Syrup	100 cc.	3 fl. oz. 96 min.
Tincture of Lemon Peel	15 cc.	230 min.
Water, a sufficient quantity, To make	1000 cc.	2 pints

Triturate the melted petrolatum with the expressed oil of almond in a warm, dry mortar, add the acacia and triturate until it is uniformly mixed. Then add 250 cc. [8 fl. oz.] of warm water and triturate lightly and rapidly until the oil is completely emulsified. Now add the syrup and the tincture, previously mixed, and sufficient water to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Average dose—4 fluidrachms (15 cc.).

Uses—As originally prepared from crude petroleum it was used as a stimulating expectorant and diaphoretic, but as now made from purified petrolatum from which all volatile constituents have been removed, it possesses no medicinal value beyond that of official petrolatum, taken internally. An emulsion of crude petrolatum is sometimes prescribed and this formula may then be used to advantage (see Emulsion of Terraline).

Table of Some Unofficial Emulsions

Title	*Directions*
Emulsum Ammoniaci (U. S. P. 1890)	Rub 4 Gm. of ammoniac in a warmed mortar, with 90 cc. of water, added very gradually, until emulsified, strain and add enough water to make 100 cc. Dose: four fluidrachms (15 cc.). This is a mixture and not a true emulsion
Amygdalæ (U. S. P. IX)	Blanch 6 Gm. of sweet almonds, add 1 Gm. of acacia and 3 Gm. of sucrose and triturate thoroughly in a mortar. Then rub with 90 cc. of water until uniform, strain and add enough water to make 100 cc. Dose: four fluidounces (120 cc.)
Chloroformi (U. S. P. VIII)	Mix 4 cc. of chloroform and 1 Gm. of tragacanth thoroughly in a dry bottle, add 25 cc. of water and shake vigorously. Then add 6 cc. of expressed oil of almond in portions, shaking after each addition, and afterwards enough water, added in the same manner, to make 100 cc. Dose: two fluidrachms (8 cc.)

Table of Some Unofficial Emulsions—*Continued*

Title	*Directions*
Emulsum Olei Morrhuæ cum Calcii Lactophosphate (N. F. IV)	Mix 50 cc. of cod liver oil and 12.5 Gm. of acacia in a dry mortar, add 25 cc. of water, triturate until emulsified and add 5 Gm. of calcium lactophosphate, dissolved in 6.5 cc. of water and 1.6 cc. of lactic acid. Add flavoring, 10 cc. of syrup of tolu and enough water to make 100 cc. Dose: four fluidrachms (15 cc.)
Olei Morrhuæ cum Calcii Phosphate (N. F. IV)	Mix 12.5 Gm. of acacia with 50 cc. of cod liver oil in a dry mortar and add 25 cc. of water, triturate until emulsified, add flavoring, 10 cc. of syrup of tolu, 3.5 Gm. of precipitated calcium phosphate and enough water to make 100 cc. Dose: four fluidrachms (15 cc.)
Olei Morrhuæ cum Pruno Virginiana (N. F. IV)	Mix 12.5 Gm. of acacia with 50 cc. of cod liver oil in a dry mortar, add 25 cc. of water, triturate until emulsified. Gradually add 6.5 cc. of fluidextract of wild cherry, 10 cc. of syrup of tolu, flavoring and enough water to make 100 cc. Dose: four fluidrachms (15 cc.)
Phosphatic Emulsion of Cod Liver Oil	Add 8 fl. oz. of cod liver oil, in successive portions, to 5 fl. oz. of glycerite of yolk of egg, emulsifying after each addition. When all is fully emulsified, add 1½ fl. oz. of diluted phosphoric acid, 8 fl. oz. of Jamaica rum, 25 min. of oil of bitter almond, and finally enough orange flower water to make 32 fl. oz.

Misturæ—*Mixtures*

Mixtures, in a properly restricted sense, are aqueous liquid preparations intended for internal use, which contain suspended insoluble solid substances. The main object in introducing this class into the Pharmacopœia was to secure uniformity in the formulas of certain well-known and largely used preparations. They are not permanent, as a rule, and it is not wise to keep them on hand for any considerable length of time. They belong properly under the head of Extemporaneous Preparations. (See Mixtures, Part XI.)

MISTURA CRETÆ. U. S. Chalk Mixture

[**Mist. Cret.**]

	Metric	Alternative
Prepared Chalk	6 Gm.	110 gr.
Glycerin	10 cc.	192 min.
Cinnamon Water	40 cc.	1 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	100 cc.	4 fl. oz.

Gradually add the glycerin to the prepared chalk, in a mortar, triturating until a smooth, uniform mixture is produced. Add the cinnamon water with trituration, transfer the mixture to a graduated vessel, and rinse the mortar with enough distilled water to make the product measure 100 cc. [4 fl. oz.]. Mix thoroughly.

This preparation must not be dispensed unless it has been recently prepared.

The formula of the U. S. P. X omits the sugar and acacia since these are readily fermentable.

Average dose—4 fluidrachms (15 cc.).

Uses—An antacid and mechanical protective agent in the alimentary canal. Used in diarrhea. It is frequently combined with astringents like the tinctures of kino and gambir.

MISTURA GLYCYRRHIZÆ COMPOSITA. U. S. Compound Mixture of Glycyrrhiza

[**Mist. Glycyrrh. Co.**—Brown Mixture]

	Metric	Alternative
Fluidextract of Glycyrrhiza	120.00 cc.	3 fl. oz. 403 min.
Antimony and Potassium Tartrate	0.24 Gm.	3½ gr.
Camphorated Tincture of Opium	120.00 cc.	3 fl. oz. 403 min.
Spirit of Ethyl Nitrite	30.00 cc.	461 min.
Glycerin	120.00 cc.	3 fl. oz. 403 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dilute the fluidextract with the glycerin and 500 cc. [1 pint] of water, add the antimony and potassium tartrate, dissolved in 12 cc. [184 minims] of hot water, then the other ingredients, and enough water to make the product measure 1000 cc. [2 pints].

Alcohol content, by volume, 9 to 11 per cent.

The U. S. P. X formula in which the extract of glycyrrhiza is replaced by the fluidextract will contain little precipitate, but it is intended to be dispensed without filtering to retain its universally known classification as a mixture.

Uses—An expectorant frequently used in bronchitis. Often combined with ammonium chloride. *Dose*—1 fluidrachm (4 cc.).

It contains only a minute trace of opium but as the laws of some states do not permit opium in any amount to be sold without a prescription it is customary in these states to omit the opium and state that fact upon the label.

MISTURA ADSTRINGENS. N. F. Astringent Mixture

[Mist. Adstring.]

	Metric	Alternative
Lead Acetate	**42 Gm.**	1 oz. av. 176 gr.
Copper Sulphate	**65 Gm.**	2 oz. av. 74 gr.
Zinc Sulphate	**65 Gm.**	2 oz. av. 74 gr.
Diluted Acetic Acid	**740 cc.**	23 fl. oz. 326 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the lead acetate in 500 cc. [1 pint] of diluted acetic acid, and filter the solution. Dissolve the copper sulphate and zinc sulphate in the remainder of the diluted acetic acid, add 150 cc. [4 fl. oz. 384 min.] of water, and filter the solution. Pour the lead solution slowly into the other solution, with constant stirring, and add sufficient water to make the product measure 1000 cc. [2 pints].

Shake this preparation well before dispensing so that the precipitate will be uniformly suspended.

Uses—An astringent for external application.

Mistura Carminativa. N. F. Carminative Mixture

[Mist. Carminat.—Dalby's Carminative]

	Metric	Alternative
Magnesium Carbonate	**65.0 Gm.**	2 oz. av. 74 gr.
Potassium Carbonate	**3.0 Gm.**	44 gr.
Tincture of Opium	**25.0 cc.**	384 min.
Oil of Caraway	**0.5 cc.**	8 min.
Oil of Fennel	**0.5 cc.**	8 min.
Oil of Peppermint	**0.5 cc.**	8 min.
Syrup	**160.0 cc.**	5 fl. oz. 58 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the oils with the magnesium carbonate and 750 cc. [24 fl. oz.] of water, gradually added. Then add the other ingredients and sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 0.4 per cent.

Average dose—8 minims (0.5 cc.) (infants).
One average dose (infants) contains about:
0.0125 cc. or ⅛ minim of Tincture of Opium.

Uses—A mild anodyne, especially for young children. It is improperly named, as its effect is not that of a carminative but chiefly as an opiate.

MISTURA CHLORALIS ET POTASSII BROMIDI COMPOSITA. N. F. Compound Mixture of Chloral and Potassium Bromide

[Mist. Chloral. et Pot. Brom. Co.—Chloral and Bromide Compound]

	Metric	Alternative
Chloral Hydrate	200 Gm.	6 oz. av. 296 gr.
Potassium Bromide	200 Gm.	6 oz. av. 296 gr.
Extract of Cannabis	2 Gm.	29 gr.
Extract of Hyoscyamus	2 Gm.	29 gr.
Pumice, in fine powder and well washed	20 Gm.	292 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Triturate the extracts in a mortar with the pumice, gradually added, until they are thoroughly mixed. Dissolve the chloral hydrate in 250 cc. [8 fl. oz.] of water, and gradually add this solution to the extracts and pumice with constant trituration. Dissolve the potassium bromide in 500 cc. [1 pint] of water and gradually add to the previous mixture. Set the mixture aside during twenty-four hours, shaking it occasionally, then filter and add sufficient water through the filter to make the product measure 1000 cc. [2 pints].

This is a clear preparation and is not a "mixture" in the strict interpretation of that term.

Average dose—1 fluidrachm (4 cc.).

Uses—A sedative and hypnotic.

MISTURA CHLOROFORMI ET MORPHINÆ COMPOSITA. N. F. Compound Mixture of Chloroform and Morphine

[Mist. Chlorof. et Morph. Co.—Chloroform Anodyne]

	Metric	Alternative
Chloroform	125.0 cc.	4 fl. oz.
Ether	32.5 cc.	1 fl. oz. 19 min.
Fluidextract of Cannabis	18.5 cc.	284 min.
Tincture of Capsicum	25.0 cc.	384 min.
Morphine Sulphate	2.5 Gm.	36 ½ gr.
Oil of Peppermint	2.0 cc.	31 min.
Glycerin	125.0 cc.	4 fl. oz.
Water	65.0 cc.	2 fl. oz. 38 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the oil of peppermint in 400 cc. [12 fl. oz. 384 min.] of alcohol, add the chloroform, ether and the tinctures and mix well. Then add the morphine sulphate, previously dissolved in the water and glycerin, to this solution, and sufficient alcohol to make the product measure 1000 cc. [2 pints].

This is a clear preparation and is not a "mixture" in the strict interpretation of that term.

Approximate alcohol content, by volume, 58 per cent.

Average dose—30 minims (2 cc.).

One average dose contains about:

0.005 Gm. or 1/13 grain of Morphine Sulphate.

Uses—An anodyne, useful in severe diarrhea and cholera morbus.

MISTURA COPAIBÆ. N. F. Copaiba Mixture

[Mist. Copaib.—Lafayette Mixture]

	Metric	Alternative
Copaiba	125 cc.	4 fl. oz.
Spirit of Ethyl Nitrite	125 cc.	4 fl. oz.
Compound Tincture of Lavender	125 cc.	4 fl. oz.
Solution of Potassium Hydroxide	30 cc.	461 min.
Syrup	300 cc.	9 fl. oz. 288 min.
Powdered Acacia	35 Gm.	1 oz. av. 74 gr.
Water, a sufficient quantity,		
To make about	1000 cc.	2 pints

Mix the copaiba intimately with the powdered acacia in a mortar, add 70 cc. [2 fl. oz. 115 min.] of water and triturate rapidly until a smooth emulsion is formed. Gradually add 200 cc. [6 fl. oz. 192 min.] of water, then the solution of potassium hydroxide, the spirit of ethyl nitrite, the compound spirit of lavender and the syrup, and mix well. Lastly, add sufficient water to make the product measure 1000 cc. [2 pints].

Shake the mixture well before dispensing.

Approximate alcohol content, by volume, 20 per cent.

Average dose—2 fluidrachms (8 cc.).

Uses—In gonorrhea.

MISTURA COPAIBÆ ET OPII. N.F. Mixture of Copaiba and Opium

[**Mist. Copaib. et Opii.** CHAPMAN'S MIXTURE]

	Metric	Alternative
Copaiba	**250 cc.**	8 fl. oz.
Spirit of Ethyl Nitrite	**250 cc.**	8 fl. oz.
Compound Tincture of Lavender	**65 cc.**	2 fl. oz. 38 min.
Tincture of Opium	**32 cc.**	1 fl. oz. 12 min.
Powdered Acacia	**65 Gm.**	2 oz. av. 74 gr.
Water, a sufficient quantity		
To make about	**1000 cc.**	2 pints

Mix the copaiba intimately in a mortar with the powdered acacia, add 130 cc. [4 fl. oz. 77 min.] of water, and triturate rapidly until a smooth emulsion is obtained. Gradually add 200 cc. [6 fl. oz. 192 min.] of water, the tincture of opium, the compound tincture of lavender and the spirit of ethyl nitrite, mix well and add sufficient water to make the product measure 1000 cc. [2 pints].

Shake the mixture well before dispensing.

Approximate alcohol content, by volume, 27 per cent.

Average dose—1 fluidrachm (4 cc.).
One average dose contains about:
0.125 cc. or 2 minims of Tincture of Opium.

Uses—In gonorrhea.

MISTURA MAGNESIÆ, ASAFŒTIDÆ ET OPII. N.F. Mixture of Magnesia, Asafetida and Opium

[**Mist. Mag., Asafœt. et Opii** DEWEES' CARMINATIVE]

	Metric	Alternative
Magnesium Carbonate	**50 Gm.**	1 oz. av. 293 gr.
Tincture of Asafetida	**75 cc.**	2 fl. oz. 192 min.
Tincture of Opium	**10 cc.**	154 min.
Sucrose	**100 Gm.**	3 oz. av. 148 gr.
Water, a sufficient quantity		
To make	**1000 cc.**	2 pints

Rub the magnesium carbonate and sucrose in a mortar, with the tincture of asafetida and the tincture of opium. Then gradually add sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 6 per cent.

Average dose—2 fluidrachms (8 cc.).
One average dose contains about:
0.08 cc. or 1⅓ minims of Tincture of Opium.

Uses—A mild anodyne and carminative, intended especially for infants.

MISTURA OLEO-BALSAMICA. N.F. Oleo-Balsamic Mixture

[Mist. Ol.-Balsam. HOFFMANN'S BALSAM]

	Metric	Alternative
Oil of Lavender	4 cc.	61 min.
Eugenol	4 cc.	61 min.
Oil of Cinnamon	4 cc.	61 min.
Oil of Thyme	4 cc.	61 min.
Oil of Lemon	4 cc.	61 min.
Oil of Myristica	4 cc.	61 min.
Balsam of Peru	16 cc.	246 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the oils, eugenol and balsam of Peru in 900 cc. [29 fl. oz.] of alcohol, filter, and add sufficient alcohol, through the filter, to make the product measure 1000 cc. [2 pints].

History—This preparation was originated as a secret nostrum by the celebrated Dr. Friedrich Hoffmann, in the early part of the eighteenth century, under the name *Balsamum Vitæ Hofmannii*.

Approximate alcohol content, by volume, 90 per cent.

This is strictly speaking not a mixture.

MISTURA OPII ET CHLOROFORMI COMPOSITA. N.F. Compound Mixture of Opium and Chloroform

[Mist. Opii et Chlorof. Co. SQUIBB'S DIARRHŒA MIXTURE]

	Metric	Alternative
Tincture of Opium	200 cc.	6 fl. oz. 192 min.
Spirit of Camphor	200 cc.	6 fl. oz. 192 min.
Tincture of Capsicum	100 cc.	3 fl. oz. 96 min.
Chloroform	80 cc.	2 fl. oz. 269 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix them.

Approximate alcohol content, by volume, 70 per cent.

Average dose—30 minims (2 cc.).

One average dose contains about:

0.40 cc. or 6 minims of Tincture of Opium.

Uses—In severe diarrheas.

MISTURA OPII ET RHEI COMPOSITA. N.F. Compound Mixture of Opium and Rhubarb

[Mist. Opii et Rhei Co. SUN CHOLERA MIXTURE]

	Metric	Alternative
Tincture of Capsicum	100 cc.	3 fl. oz. 96 min.
Tincture of Rhubarb	100 cc.	3 fl. oz. 96 min.
Tincture of Opium	200 cc.	6 fl. oz. 192 min.
Spirit of Camphor	200 cc.	6 fl. oz. 192 min.
Spirit of Peppermint	200 cc.	6 fl. oz. 192 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix them.

Approximate alcohol content, by volume, 70 per cent.

Average dose—30 minims (2 cc.).

One average dose contains about:

0.40 cc. or 6 minims of Tincture of Opium.

Uses—In serous diarrhea. This formula was given much publicity many years ago in the *New York Sun* as a cholera cure, hence its name.

MISTURA PECTORALIS. N.F. Expectorant Mixture

[**Mist. Pect.**—MISTURA PECTORALIS, STOKES', N.F. IV, STOKES' EXPECTORANT]

	Metric	Alternative
Ammonium Carbonate	**17.5 Gm.**	256 gr.
Fluidextract of Senega	**35.0 cc.**	1 fl. oz. 58 min.
Fluidextract of Squill	**35.0 cc.**	1 fl. oz. 58 min.
Camphorated Tincture of Opium	**175.0 cc.**	5 fl. oz. 288 min.
Water	**85.0 cc.**	2 fl. oz. 346 min.
Syrup of Tolu, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the fluidextracts with the camphorated tincture of opium and add the ammonium carbonate, previously dissolved in the water; then add sufficient syrup of tolu to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 10 per cent.

Average dose—1 fluidrachm (4 cc.).

One average dose contains about:

0.70 cc. or 10 minims of Camphorated Tincture of Opium.

Uses—An expectorant for acute bronchitis.

MISTURA RHEI ALKALINA. N.F. Alkaline Mixture of Rhubarb

[**Mist. Rhei Alk.**—ELIXIR RHEI ALKALINUM NEUTRALIZING CORDIAL]

	Metric	Alternative
Fluidextract of Rhubarb	**16 cc.**	246 min.
Fluidextract of Hydrastis	**8 cc.**	123 min.
Potassium Carbonate	**16 Gm.**	234 gr.
Tincture of Cinnamon	**64 cc.**	2 fl. oz. 23 min.
Spirit of Peppermint	**8 cc.**	123 min.
Syrup	**250 cc.**	8 fl. oz.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the potassium carbonate in the syrup, and add the solution to the fluidextracts, tincture, and spirit, previously mixed with 500 cc. [1 pint] of diluted alcohol. Mix well, add sufficient diluted alcohol to make the product measure 1000 cc. [2 pints], and filter.

This is a clear preparation and not a "mixture" in the strict interpretation of that term.

Approximate alcohol content, by volume, 36 per cent.

Average dose—1 fluidrachm (4 cc.).

Uses—A laxative and antacid, also a carminative for children.

MISTURA RHEI COMPOSITA. N.F. Compound Mixture of Rhubarb

[**Mist. Rhei Co.**—MISTURA RHEI ET SODÆ, MIXTURE OF RHUBARB AND SODA]

	Metric	Alternative
Fluidextract of Rhubarb	**15 cc.**	230 min.
Fluidextract of Ipecac	**3 cc.**	46 min.
Sodium Bicarbonate	**35 Gm.**	1 oz. av. 74 gr.
Spirit of Peppermint	**35 cc.**	1 fl. oz. 58 min.
Glycerin	**200 cc.**	6 fl. oz. 192 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the sodium bicarbonate in about 500 cc. [1 pint] of water, and add the fluidextracts, the glycerin, the spirit of peppermint, and sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 3 per cent.

Average dose—1 fluidrachm (4 cc.)

Uses—A laxative, antacid and carminative.

Table of Some Unofficial Mixtures

Title	*Directions*
Mistura Ammonii Chloridi (N. F. IV)	Dissolve 2.5 Gm. of ammonium chloride and 2.5 Gm. of pure extract of glycyrrhiza in enough water to make 100 cc. Dose: two fluidrachms (8 cc.)
Camphoræ Acida (N. F. IV)	Mix 1.75 cc. of nitric acid and 1.2 cc. of tincture of opium in enough camphor water to make 100 cc. Dose: two fluidrachms (8 cc.)
Camphoræ Aromatica (N. F. IV)	Dissolve 3.5 Gm. of sucrose in a mixture of 25 cc. of compound tincture of lavender and 50 cc. of camphor water, and add enough camphor water to make 100 cc. Dose: two fluidrachms (8 cc.)
Ferri Composita (N. F. IV)	Rub 1.8 Gm. of myrrh, 1.8 Gm. of sucrose and 0.8 Gm. of potassium carbonate with 70 cc. of rose water, added very slowly at first, until uniform. Then add 6 cc. of spirit of lavender and 0.6 Gm. of ferrous sulphate dissolved in 5 cc. of rose water, and enough rose water to make 100 cc. Dose: four fluidrachms (15 cc.)
Guaiaci (N. F. IV)	Add 12.5 cc. of tincture of guaiac slowly to 25 cc. of honey with brisk trituration, and then add enough cinnamon water to make 100 cc. Dose: four fluidrachms (15 cc.)
Olei Picis (N. F. IV)	Add 6.5 Gm. of pure extract of glycyrrhiza and 25 Gm. of sugar to 50 cc. of water and heat until dissolved. Cool and add 3.5 cc. of rectified oil of tar, 1 cc. of chloroform, 0.3 cc. of oil of peppermint dissolved in 16 cc. of alcohol, and enough water to make 100 cc. Dose: two fluidrachms (8 cc.)
Opii et Sassafras (N. F. IV)	Mix 3.5 cc. of tincture of opium with 0.1 cc. of oil of sassafras and 5 cc. of alcohol. Dissolve 0.8 Gm. of potassium carbonate in 50 cc. of water, add 33 cc. of syrup, the alcoholic solution just prepared and enough water to make 100 cc., and filter Dose: five minims (0.3 cc.)
Sennæ Composita (Br. 1914)	Dissolve 25 Gm. of magnesium sulphate in 50 cc. of infusion of senna, add 5 cc. of liquid extract of liquorice, 10 cc. of compound tincture of cardamom, 5 cc. of aromatic spirit of ammonia and enough infusion of senna to make 100 cc. Dose: one fluidounce (30 cc.)

Magmæ—*Magmas*

This title, for a class of preparations, has been introduced into the U. S. P. and N. F., as applying to a class of preparations closely related to the mixtures. The suspended, insoluble constituents are of inorganic chemical origin and are freshly precipitated in a fine state of subdivision. The titles of the official magmas are given below but the formulas, uses, and dosage of each will be found under the corresponding inorganic chemicals in Part IV.

Magmas of the U. S. P. and N. F.

Magma Magnesiæ, U. S. P. (see page 664).
Magma Bismuthi, N. F. (see page 774).

Unofficial Magma

Magma Ferri Hydroxidi (see page 732).

Cremor—*Cream*

A class of preparations under this title are recognized in the British Pharmaceutical Codex. They consist of creamy suspensions for external application. *Zinc cream, compound ammoniated mercury cream, and surgical shaving cream* are representative titles.

Gargarismæ—*Gargles*

Only one representative of this class of preparations is found in the official books. It is as follows:

GARGARISMA GUAIACI COMPOSITUM. N. F. **Compound Gargle of Guaiac**
[Garg. Guaiac. Co.]

	Metric	Alternative
Ammoniated Tincture of Guaiac	**100 cc.**	3 fl. oz. 96 min.
Compound Tincture of Cinchona	**100 cc.**	3 fl. oz. 96 min.
Honey	**200 cc.**	6 fl. oz. 192 min.
Potassium Chlorate	**40 Gm.**	1 oz. av. 147 gr.
Oil of Peppermint	**2 cc.**	31 min.
Water, a sufficient quantity, To make	**1000 cc.**	2 pints

Place the honey in a flask graduated to 1000 cc. [2 pints] and gradually add the previously mixed oil of peppermint and the tinctures, shaking the flask after each addition. Dissolve the potassium chlorate in 500 cc. [1 pint] of warm water, and add this solution to the honey mixture in divided portions, shaking continuously, then add sufficient water to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Approximate alcohol content, by volume, 12 per cent.

Uses—A stimulant gargle in sore throat.

Lotiones—*Lotions*

Representatives of this class of preparations are official only in the N. F., *four* being recognized. They are largely aqueous, usually contain insoluble, suspended matter, and are intended for use as washes or injections.

LOTIO ALBA VETERINARIA. N. F. Veterinary White Lotion

[Lot. Alba Vet.]

	Metric	Alternative
Zinc Sulphate	**23 Gm.**	336 gr.
Lead Acetate	**30 Gm.**	1 oz. av.
Water, a sufficient quantity		
To make about	**1000 cc.**	2 pints

Dissolve the zinc sulphate and lead acetate, each in 475 cc. [15 fl. oz. 96 min.] of water, and filter the two solutions. Pour the lead acetate solution slowly into the zinc sulphate solution with constant stirring, and add sufficient water to make the product measure 1000 cc. [2 pints]. Shake the Lotion well before dispensing.

Caution—This lotion must not be confused with the "Lotio Alba" so largely used in regular medical practice (see page 598).

Uses—A sedative for local application.

LOTIO AMMONIACALIS CAMPHORATA. N. F. Ammoniated Camphor Wash

[Lot. Ammon. Camph. Aqua Sedativa, Sedative Water, Eau Sedative de Raspail]

	Metric	Alternative
Sodium Chloride	**60 Gm.**	2 oz. av. 1 gr.
Ammonia Water	**60 cc.**	1 fl. oz. 442 min.
Spirit of Camphor	**10 cc.**	154 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the sodium chloride in about 900 cc. [28 fl. oz. 384 min.] of water, add the spirit of camphor, then the ammonia water and finally sufficient water to make the product measure 1000 cc. [2 pints].

Preserve it in well-stoppered bottles and shake the Lotion before dispensing.

Approximate alcohol content, by volume, 0.9 per cent.

Uses—A rubefacient.

LOTIO CALAMINÆ. N. F. Calamine Lotion

[Lot. Calam.]

	Metric	Alternative
Prepared Calamine, in very fine powder,	**80 Gm.**	2 oz. av. 293 gr.
Zinc Oxide, in very fine powder	**80 Gm.**	2 oz. av. 293 gr.
Glycerin	**20 cc.**	307 gr.
Solution of Calcium Hydroxide, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the powders intimately with the glycerin and about 100 cc. [3 fl. oz. 96 min.] of solution of calcium hydroxide and gradually add sufficient solution of calcium hydroxide to make the product measure 1000 cc. [2 pints]. Shake the Lotion thoroughly before dispensing.

N. F. Preparation—Lotio Calaminæ Composita.

Uses—Employed in skin diseases.

LOTIO CALAMINÆ COMPOSITA. N.F. Compound Calamine Lotion

[Lot. Calam. Co.]

	Metric	Alternative
Liquefied Phenol	10 cc.	154 min.
Calamine Lotion	990 cc.	31 fl. oz. 326 min.
To make	1000 cc.	2 pints

Mix them.

Shake the Lotion thoroughly before dispensing.

Uses—Employed in skin diseases.

LOTIO FLAVA. N.F. Yellow Lotion

[Lot. Flav. Yellow Wash, Aqua Phagedænica Flava]

	Metric	Alternative
Corrosive Mercuric Chloride	3 Gm.	44 gr.
Boiling Water	35 cc.	1 fl. oz. 58 min.
Solution of Calcium Hydroxide, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the corrosive mercuric chloride in the boiling water, and add the solution gradually, with constant agitation, to sufficient solution of calcium hydroxide to make the product measure 1000 cc. [2 pints].

Shake the Lotion thoroughly before dispensing.

Uses—Applied as a stimulant antiseptic application to syphilitic sores, and in some forms of eczema.

LOTIO NIGRA. N.F. Black Lotion

[Lot. Nigr. Black Wash, Aqua Phagedænica Nigra]

	Metric	Alternative
Mild Mercurous Chloride	8.75 Gm.	128 gr.
Water	15.00 cc.	219 min.
Solution of Calcium Hydroxide, a sufficient quantity,		
To make	1000 cc.	2 pints

Triturate the mild mercurous chloride with the water, and gradually add sufficient solution of calcium hydroxide, with trituration, to make the product measure 1000 cc. [2 pints].

Shake the Lotion thoroughly before dispensing.

Uses—Similar to yellow wash, but is not so active a stimulant.

LOTIO PLUMBI ET OPII. N.F. Lotion of Lead and Opium

[Lot. Plumb. et Opii. Lead and Opium Wash]

	Metric	Alternative
Lead Acetate	17.5 Gm.	255 gr.
Tincture of Opium	35.0 cc.	1 fl. oz. 58 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the lead acetate in about 650 cc. [20 fl. oz. 384 min.] of water, add the tincture of opium and sufficient water to make the product measure 1000 cc. [2 pints].

Shake the Lotion thoroughly before dispensing.

Approximate alcohol content, by volume, 0.6 per cent.

Uses—Applied externally as an astringent and sedative, for sprains and bruises.

Unofficial Lotions

Title	*Directions*
Lotio Alba	(See page 598)
Lotio Delphinii (Larkspur Lotion)	Boil 100 Gm. of ground delphinium with 800 cc. of water to which 50 cc. of acetic acid and 50 cc. of glycerin have been added, for ten minutes in a covered vessel. Set aside till cold, then add 100 cc. of alcohol and allow to macerate overnight. Then filter and add sufficient water through the filter to make the product measure 1000 cc.

CHAPTER XXVI

GLYCERIN SOLUTIONS

Glycerita—*Glycerites*

Glycerites are mixtures of medicinal substances with glycerin. Glycerin is a valuable solvent, and one of the principal advantages of the glycerites is that they afford a rapid and simple method of making aqueous solutions of substances which are not otherwise easily soluble. The solutions of phenol, tannic acid, tar, etc., in glycerin are permanent preparations, and they can be made very concentrated if necessary; the ease with which they can be diluted with water or alcohol, without precipitation, renders such glycerites especially useful at the prescription counter. This class of preparations is called "*glycerins*" in Great Britain.

GLYCERITUM ACIDI TANNICI. U.S. Glycerite of Tannic Acid

[Glycer. Acid. Tan.—Glycerite of Tannin]

	Metric	Alternative
Tannic Acid	**20 Gm.**	2 oz. av.
Sodium Citrate	**1 Gm.**	44 gr.
Glycerin	**79 Gm.**	7 oz. av. 394 gr.
To make	**100 Gm.**	10 oz. av.

Weigh the glycerin into a tared wide-mouthed bottle, having a capacity of 125 cc. [1 pint]. Suspend the tannic acid and sodium citrate, in a gauze bag, in the glycerin, place the bottle and contents in a water bath containing boiling water and continue the heat, stirring the mixture occasionally until solution results.

The sodium citrate is added to prevent the darkening which frequently occurs because of minute amounts of iron in the glycerin.

Uses—An astringent, especially useful as a local application in sore throat and in sore mouth, due to stomatitis. It is also used to harden the nipples to prevent soreness during nursing, and as a general astringent.

Average dose—40 minims (2.5 cc.).

GLYCERITUM AMYLI. U.S. Glycerite of Starch

[Glycer. Amyl.—"Plasma"]

	Metric	Alternative
Starch	**10 Gm.**	150 gr.
Water	**20 cc.**	5½ fl. dr.
Glycerin	**70 cc.**	2½ fl. oz.

Triturate the starch with the water until a homogeneous mixture is produced. Then gradually add this to the glycerin, contained in a porcelain dish, and heated to about 140° C. Continue the heat, keeping it below 144° C., constantly stirring the mixture until a translucent jelly is formed. Transfer the product to suitable vessels provided with well-fitting covers.

Uses—Used as a substitute for fatty ointment vehicles, also as a pill excipient, and as a basis for enemas.

GLYCERITUM BOROGLYCERINI. U.S. Glycerite of Boroglycerin

[Glycer. Boroglyc.—Glycerite of Glyceryl Borate, 50 per cent Boroglycerin]

	Metric	Alternative
Boric Acid, in fine powder	310 Gm.	4 oz. av. 420 gr.
Glycerin, a sufficient quantity,		
To make	1000 Gm.	16 oz. av.

Heat 460 Gm. [7 oz. av. 158 gr.] of glycerin in a tared porcelain dish on a sand bath to a temperature between 140° and 150° C. and add the boric acid in portions, constantly stirring. When all is added and dissolved, continue the heat at the same temperature, frequently stirring, and breaking up the film which forms on the surface until the mixture has been reduced to 500 Gm. [8 oz. av.], then add 500 Gm. [8 oz. av.] of glycerin, mix thoroughly, and immediately transfer the product to bottles and stopper them tightly.

When glycerin and boric acid are heated together in the proportion given in the formula, water is given off, and a new compound is formed as shown by the following equation:

$$\underset{\text{boric acid}}{H_3BO_3} + \underset{\text{glycerin}}{C_3H_5(OH)_3} = \underset{\text{boroglycerin}}{C_3H_5BO_3} + \underset{\text{water}}{3H_2O}$$

As the reaction proceeds, the product thickens, requiring frequent stirring to break up the film which forms, and finally produces a hard, partially transparent, and very hygroscopic mass. This substance is called "boroglycerin", and when dissolved in an equal weight of glycerin constitutes the official Glycerite of Boroglycerin. Care must be observed throughout the operation to avoid an excess of heat which causes a yellowish or brownish color.

Uses—A mild antiseptic, offering boric acid in soluble form. It is often used in washing out the bladder. If water is added in proportions larger than 1 part of the glycerite to 18 parts of water, boric acid will be reprecipitated, so that if weaker solutions than 1 to 18 are required, glycerin should be used as the diluent.

N. F. Preparation—Suppositoria Boroglycerini.

GLYCERITUM PHENOLIS. U.S. Glycerite of Phenol

[Glycer. Phenol.—Glycerite of Carbolic Acid]

	Metric	Alternative
Liquefied Phenol	20 cc.	384 min.
Sodium Citrate	1 Gm.	18 gr.
Boiling Distilled Water	1 cc.	19 min.
Glycerin	79 cc.	3 oz. av. 76 min.
To make	100 cc.	4 oz. av.

Dissolve the sodium citrate in 1 cc. [19 minims] of boiling distilled water, and add this solution to the mixture of glycerin and phenol, previously prepared. The sodium citrate is added to prevent discoloration due to traces of iron in the glycerin. Phenol in the presence of iron salts produces a red color.

Uses—For preparing antiseptic solutions of phenol. It mixes in any proportion with water. It is used also as an addition to gargles and mouth washes.

Average dose—5 minims (0.3 cc.).

GLYCERITUM BISMUTHI. N.F. Glycerite of Bismuth

[Glycer. Bism.]

One hundred cc. of Glycerite of Bismuth yields not less than 12.5 Gm. and not more than 13.5 Gm. of bismuth oxide (Bi_2O_3).

	Metric	Alternative
Bismuth Subnitrate	**180 Gm.**	6 oz. av.
Nitric Acid	**160 cc.**	5 fl. oz. 58 min.
Tartaric Acid	**238 Gm.**	7 oz. av. 414 gr.
Sodium Bicarbonate	**334 Gm.**	11 oz. av. 65 gr.
Glycerin,		
Water, Distilled, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the nitric acid with 250 cc. [8 fl. oz.] of distilled water in a bottle having a capacity of about 4000 cc. [8 pints] and dissolve the bismuth subnitrate in the mixture. Then slowly add 600 cc. [19 fl. oz.] of distilled water and dissolve 135 Gm. [4 oz. av. 222 gr.] of tartaric acid in the mixture. Now add, in small portions, 215 Gm. [7 oz. av. 78 gr.] of sodium bicarbonate, shaking frequently, and avoiding loss by effervescence; when all is added fill the bottle with distilled water and mix well.

Allow the magma to settle and decant the clear liquid. Again fill the bottle with distilled water and wash the magma by decantation as before, repeating the process until the wash-liquor has but a slight saline taste. Then pour the magma upon a filter and allow it to drain, rinsing the bottle with a little distilled water.

Transfer the moist magma to a porcelain evaporating dish, add 103 Gm. [3 oz. av. 192 gr.] of tartaric acid and then slowly, and in small portions, 119 Gm. [3 oz. av. 425 gr.] of sodium bicarbonate. Heat the mixture on a steam bath until solution is effected and the total volume is reduced to 475 cc. [15 fl. oz. 96 min.]. Then add 475 cc. [15 fl. oz. 96 min.] of glycerin, and, if necessary, enough distilled water to make the solution measure 950 cc. [30 fl. oz. 192 min.], and filter.

Determine the amount of bismuth oxide in the liquid by the process given below, and from the result thus obtained adjust the strength by evaporation, or the addition of equal volumes of glycerin and distilled water so that each 100 cc. [3 fl. oz. 193 min.] of the finished Glycerite will yield 13 Gm. of bismuth oxide.

A colorless or pale yellow liquid, having a slight odor, and a sweet, followed by a saline, taste. Specific gravity: about 1.378 at 25° C.

Assay—Dilute 5 cc. of Glycerite of Bismuth, accurately measured, with 100 cc. of distilled water, in a flask, add two drops of hydrochloric acid, and pass a current of hydrogen sulphide through the solution until it is saturated. Allow the precipitate to settle and decant the supernatant liquid (which should be clear and colorless) through a Gooch crucible or filter, retaining the precipitate in the flask. Wash the precipitate a few times by decantation, then transfer it completely to the filter and wash with water until the washings give no test for chloride. Now wash twice with alcohol, then with warm carbon tetrachloride and again with alcohol. Try at 100° C. and weigh. The weight of bismuth sulphide multiplied by 0.903 represents its equivalent in Bi_2O_3.

N. F. Preparations—Elixir Bismuthi; Elixir Cinchonæ Alkaloidorum, Ferri et Bismuthi; Elixir Pepsini et Bismuthi; Liquor Bismuthi.

Uses—A glycerin solution of bismuth and sodium tartrate used in preparation of elixirs and solutions of bismuth. Like other soluble forms of bismuth it does not represent the therapeutic value of the basic salts, but is employed in diarrhea.

GLYCERITUM PEPSINI. N.F. Glycerite of Pepsin

[Glycer. Pepsin.]

	Metric	Alternative
Pepsin (see note on page 303)	**87.5 Gm.**	2 oz. av. 403 gr.
Diluted Hydrochloric Acid	**5.0 cc.**	77 min.
Glycerin	**500.0 cc.**	1 pint
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the diluted hydrochloric acid with 350 cc. [11 fl. oz. 96 min.] of cold, distilled water, add the pepsin and stir very gently until the latter is dissolved. Filter the solution and pass enough distilled water through the filter to obtain 500 cc. [1 pint] of filtrate. To this

add the glycerin and sufficient distilled water to make the product measure 1000 cc. [2 pints].

NOTE—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly when at or above normal room temperature. To insure the dispensing of the Glycerite at standard strength it is strongly recommended that the quantity of pepsin directed in the formula be increased to 125 Gm. [4 oz. av. 75 gr.] to allow for such loss in activity and that the Glycerite be stored in a cool place.

N. F. Preparations—Elixir Pepsini, Liquor Pepsini.

Average dose—45 minims (3 cc.).

Uses—A concentrated liquid form of pepsin for making other preparations.

GLYCERITUM PICIS PINI. N. F. Glycerite of Tar

[Glycer. Pic. Pin.—GLYCERITUM PICIS LIQUIDÆ, N. F. IV]

	Metric	Alternative
Pine Tar	63 Gm.	2 oz. av. 45 gr.
Magnesium Carbonate	125 Gm.	4 oz. av. 75 gr.
Glycerin	250 cc.	8 fl. oz.
Alcohol	125 cc.	4 fl. oz.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Pour 200 cc. [6 fl. oz. 192 min.] of cold water upon the pine tar, contained in a mortar, mix them thoroughly, allow the mixture to settle, and pour off the water. Repeat this operation until the washings show only a slightly acid reaction with litmus paper. Now triturate the washed tar with the alcohol, gradually incorporate the magnesium carbonate and glycerin, and add 625 cc. [20 fl. oz.] of water. Pour the mixture upon a filter of loose texture, and, after the liquid portion has passed through, wash the residue on the filter with a mixture of one volume of alcohol and seven volumes of water, sufficient to make the product measure 1000 cc. [2 pints].

Uses—An expectorant.

Average dose—1 fluidrachm (4 cc.).

GLYCERITUM TRAGACANTHÆ. N. F. Glycerite of Tragacanth

[Glycer. Trag.]

	Metric	Alternative
Tragacanth, in fine powder	125 Gm.	4 oz. av. 179 gr.
Glycerin	775 cc.	26 fl. oz. 98 min.
Water	185 cc.	6 fl. oz. 123 min.

Mix the tragacanth and glycerin thoroughly, add the water and stir the mixture until a homogeneous, thick paste results.

Uses—An excellent pill excipient.

GLYCERITUM VITELLI. N. F. Glycerite of Egg Yolk

[Glycer. Vitell.—GLYCONIN]

	Metric	Alternative
Fresh Egg Yolk	45 Gm.	1 oz. av. 350 gr.
Glycerin	55 Gm.	2 oz. av. 88 gr.
To make	100 Gm.	4 oz. av.

Rub the fresh egg yolk in a mortar, with the glycerin, gradually added, until they are thoroughly mixed, and then strain the product.

N. F. Preparation—Emulsum Olei Morrhuæ cum Vitello.

Uses—It offers a permanent form of egg yolk for use as an emulsifying agent.

Table of Some Unofficial Glycerites

Title	*Directions*
Glyceritum Ferri Quininæ et Strychninæ (Phosphatum, U. S. P. VIII)	(Dilute with three volumes of syrup to make syrupus ferri, quininæ et strychninæ, phosphatum U. S. P. VIII.) Dissolve 8 Gm. of soluble ferric phosphate in 20 cc. of hot water, add 20 cc. of phosphoric acid, 0.08 Gm. of strychnine, 10.4 Gm. of quinine and enough water to make 50 cc. Stir until solution is effected and add 50 cc. of glycerin Dose: fifteen minims (1 cc.)
Guaiaci (N. F. IV)	Add 8.5 Gm. of powdered guaiac to 6.5 cc. of solution of potassium hydroxide and macerate during twenty-four hours. Filter, add 60 cc. of glycerin and enough water to make 100 cc. Dose: thirty minims (2 cc.)
Glycerinum Aluminis (Br. 1914) (The British Pharmacopœia (1914) uses the class title Glycerinum for preparations of this character)	Dissolve 20 Gm. of purified alum in 7.5 cc. of distilled water and glycerin enough to make 120 cc., warming slightly if necessary, set aside and pour off the clear liquid
Plumbi Subacetatis (Br. 1914)	Evaporate 50 cc. of strong solution of lead subacetate to dryness on a water bath, add 50 cc. of glycerin, warm gently until dissolved. Cool, add enough distilled water to make the specific gravity 1.48 and filter if necessary
Talbot's Iodoglycerole	Prepared by dissolving 15 parts of zinc iodide and 25 parts of iodine in a mixture of 10 parts of distilled water with 50 parts of glycerin Used by dentists in cleansing gums and mucous membranes before operating. It is diluted with water before use to suit varying conditions

CHAPTER XXVII

ALCOHOLIC SOLUTIONS

Spiritus—*Spirits*

Spirits, from a pharmaceutical point of view, are simply *alcoholic* solutions of volatile substances. They are popularly known as *essences*. Like the medicated waters, the active ingredient may be solid, liquid, or gaseous. None are made by percolation, but there are four different methods represented in the preparation of this official group: 1. By simple solution. 2. By solution with maceration. 3. By chemical reaction. 4. By distillation.

1. **By Simple Solution**—This is the method by which the majority of spirits are prepared; the official preparations of this class are merely solutions of volatile oils in alcohol of appropriate strength. No skill is required to make these, but a great deal of conscientious care must be used in the selection of the volatile oils, that they be of the best quality, and recently distilled. Filtration is usually unnecessary.

2. **By Solution with Maceration**—This method is employed when it is desirable to introduce the coloring matter of the drug into the preparation. This has been done in order to bestow individuality, and in deference to popular feeling in favor of colored preparations. It is very doubtful whether either object is worthy of consideration.

3. **By Chemical Reaction**—There is but *one* spirit in the Pharmacopœia made by chemical reaction, namely, Spirit of Nitrous Ether. As explained elsewhere (page 919), it is the product resulting from a reaction between sodium nitrite, sulphuric acid and alcohol, and the ethyl nitrite so produced is dissolved in alcohol. This spirit is now ordinarily made by simple solution of concentrated ethyl nitrite which is supplied in sealed tubes.

4. **By Distillation**—This method of making spirits is the oldest and in many respects the best in use. When the desirable volatile principles which are present in the finished preparation can be vaporized at the temperature of boiling alcohol or diluted alcohol, distillation is preferred. Two spirits of the U. S. P. are made by distillation. They are Whisky and Brandy.

SPIRITUS ÆTHYLIS NITRITIS. U. S. Spirit of Ethyl Nitrite

[**Sp. Æth. Nitrit.**—Spiritus Ætheris Nitrosi U. S. P. IX, Spirit of Nitrous Ether, Sweet Spirit of Nitre]

Spirit of Ethyl Nitrite is an alcoholic solution of ethyl nitrite containing not less than 3.5 per cent and not more than 4.5 per cent of $C_2H_5NO_2$. (75.06).

The U. S. P. X does not give a method for the preparation of this spirit, but the process of the U. S. P. IX is as follows:

	Metric	Alternative
Sodium Nitrite	**100.0 Gm.**	3 oz. av. 148 gr.
Sulphuric Acid	**40.0 cc.**	1 fl. oz. 134 min.
Monohydrated Sodium Carbonate	**0.6 Gm.**	9 gr.
Potassium Carbonate, completely deprived of water by heating	**3.0 Gm.**	44 gr.
Alcohol,		
Water, each, a sufficient quantity.		

Mix the sulphuric acid with 120 cc. [4 fl. oz.] of water, cool the liquid, add 85 cc. [2 fl. oz. 6 fl. dr.] of alcohol previously diluted with an equal

volume of water, and introduce the solution into a 1000 cc. flask, surrounded by a mixture of ice and water. Dissolve the sodium nitrite in 280 cc. [9 fl. oz.] of water, filter, and, having poured the filtrate into a separatory funnel, allow the liquid to drop slowly into the flask containing the acid mixture. When all has been added and the reaction is complete, allow any crystals which may have formed to settle at the bottom of the flask, and decant the cold mixture of ethyl nitrite and aqueous solution quickly to the previously cooled separatory funnel, and draw off and discard the aqueous liquid. Wash the separated ethyl nitrite, first, with 20 cc. [5 fl. dr. 7 minims] of ice-cold water, and then remove any traces of acid by washing it with 15 cc. [4 fl. dr.] of ice-cold water, in which the monohydrated sodium carbonate has previously been dissolved. Carefully separate the ethyl nitrite from the aqueous liquid, and agitate it in a well-stoppered bottle with the potassium carbonate to remove traces of water. Then cool the liquid, decant and pour the ethyl nitrite immediately into a tared bottle containing 500 Gm. [16 oz. av. 302 grains] of alcohol. Ascertain the weight of the ethyl nitrite poured into the alcohol by noting the increase in weight of the tared bottle and contents, and then add enough alcohol to make the mixture weigh *twenty-two times* the weight of the ethyl nitrite added. Lastly, transfer the product to small, well-stoppered, dark amber-colored bottles, and keep these in a cool place, remote from fire.

(For tests and comments see page 920.)

It is so generally the custom to prepare this Spirit by diluting the concentrated ethyl nitrite that manufacturing processes have been omitted from the U. S. P. Both the distillation method, formerly universally used for its manufacture on the large scale, and the U. S. P. IX method, depending upon its immiscibility with water, have been inserted here.

If the Spirit is to be prepared by diluting the concentrated ethyl nitrite, the latter must be thoroughly chilled in ice-water whether in bulk or in a hermetically sealed tube, before attempting to open or measure it. If in a tube, wrap the tube well with a towel dipped in ice-water before opening, as at times the tube explodes violently, especially if more than six months old. The tubes usually contain the exact volume of ethyl nitrite to make one pint of the official Spirit, but considerable skill is required to avoid loss of the very volatile ester during the mixing. It is preferable to open the tube under the surface of the alcohol, contained in a large graduate or jar, or, if possible, in a bottle.

The 1890 U. S. P. directed ethyl nitrite to be made by a distillation process as follows:

	Metric	Alternative
Sodium Nitrite	**95.0 Gm.**	3 oz. av. 153 gr.
Water	**150.0 cc.**	5 fl. oz. 33 min.
Alcohol	**90.0 cc.**	3 fl. oz. 20 min.

Dissolve the sodium nitrite in the water, in a suitable flask. Add the alcohol. Connect the flask to a condenser and when the joints are tight, the condenser cooled, and a small receiving flask arranged in an ice bath, add the following mixture, in portions and very gradually, through a funnel tube:

	Metric	Alternative
Sulphuric Acid	**45.0 cc.**	1 fl. oz. 250 min.
Water	**150.0 cc.**	5 fl. oz. 33 min.

If necessary toward the end of the reaction, warm the flask gently until all of the ethyl nitrite has been volatilized.

Wash the distillate in the receiving flask, first with 15 cc. [4 fl. dr.] of ice-cold water, to remove any alcohol, then with 15 cc. [4 fl. dr.] of a 4 per cent

solution of sodium carbonate, to remove any acid, and carefully separate the ethyl nitrite from the aqueous liquid.

To prepare Spirit of Ethyl Nitrite from the ethyl nitrite, the ester should be agitated in a well-stoppered bottle with potassium carbonate to remove traces of water. Pour the ethyl nitrite into a tared bottle containing about 500 Gm. [17½ oz. av.] of alcohol. Determine the weight of ethyl nitrite added by noting the increase in weight of the bottle and contents and add enough alcohol to make the mixture weigh 22 times the weight of ethyl nitrite added.

U. S. P. Preparation—Mistura Glycyrrhizæ Composita.
N. F. Preparations—Mistura Copaibæ; Mistura Copaibæ et Opii.

History—The first record of this preparation is found in the writings of Raymond Lully in the thirteenth century. It was also discussed by Basil Valentine in the following century. It was first introduced into medical practice by Doctor Silvius of Leyden, who sold it for a very high price. In the P. L. 1746 it was officially recognized as *Spiritus Nitri Dulcis*, which was changed in 1788 to *Spiritus Aetheris Nitrosi* and in 1809 to *Spiritus Aetheris Nitrici*. It has been made by various formulas and processes.

Uses—Chiefly employed as a diaphoretic in mild fevers and as a diuretic, especially for children. The official directions to keep in small, tightly-stoppered, dark colored bottles should be observed, as it quickly deteriorates when kept in a partially-filled flint bottle on the shelf.

Average dose—30 minims (2 cc.).

SPIRITUS AMMONIÆ AROMATICUS. U.S. Aromatic Spirit of Ammonia
[Sp. Ammon. Arom.]

	Metric	Alternative
Ammonium Carbonate, in translucent pieces	34 Gm.	1 oz. av. 59 gr.
Ammonia Water	90 cc.	2 fl. oz. 7 fl. dr.
Oil of Lemon	10 cc.	2½ fl. dr.
Oil of Lavender	1 cc.	15 min.
Oil of Myristica	1 cc.	15 min.
Alcohol	700 cc.	22 fl. oz. 3 fl. dr.
Distilled Water, a sufficient quantity, To make	1000 cc.	2 pints

Dissolve the ammonium carbonate in the ammonia water and 140 cc. [4½ fl. oz.] of distilled water by gentle agitation, and allow the solution to stand for twelve hours. Dissolve the oils in the alcohol, contained in a 1000 cc. [2 pint] volumetric flask or cylinder, gradually add the ammonium carbonate solution, and enough distilled water to make the product measure 1000 cc. [2 pints]. Set it aside in a cool place for twenty-four hours, occasionally agitating, and filter, using a covered funnel.

(For tests see Part 651.)

The ammonium carbonate in this preparation must be in translucent pieces. The soft, chalky variety is chiefly ammonium bicarbonate, a deteriorated product.

U. S. P. Preparation—Tinctura Valerianæ Ammoniata.
N. F. Preparations—Liquor Sodæ et Menthæ; Tinctura Guaiaci Ammoniata.

History—This first found an official place in the London Pharmacopœia of 1721 under the name *Spiritus Salis Volatilis Oleosus*. The present name was first adopted in the P. L. of 1809. The formula and process have changed repeatedly during the several centuries in which the preparation has been used.

Uses—For hyperacidity of the stomach, especially when accompanied by nausea and sick headache. Also employed for faintness.

Average dose—30 minims (2 cc.).

SPIRITUS ANISI. U.S. Spirit of Anise

[Sp. Anisi]

	Metric	Alternative
Oil of Anise	100 cc.	1 fl. oz.
Alcohol, a sufficient quantity,		
To make	1000 cc.	10 fl. oz.

Mix the oil with sufficient alcohol to make the product measure 1000 cc. [10 fl. oz.].

Alcohol content, by volume, 80 to 87 per cent.

Uses—A stomachic and carminative.

Average dose—30 minims (1 cc.).

SPIRITUS AURANTII COMPOSITUS. U.S. Compound Spirit of Orange

[Sp. Aurant. Co.]

	Metric	Alternative
Oil of Orange	200 cc.	6 fl. oz. 3 fl. dr.
Oil of Lemon	50 cc.	1 fl. oz. 5 fl. dr.
Oil of Coriander	20 cc.	5 fl. dr.
Oil of Anise	5 cc.	77 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the oil with sufficient alcohol to make the product measure 1000 cc. [2 pints].

Preserve in dark amber-colored bottles.
Alcohol content, by volume, 65 to 70 per cent.

U. S. P. Preparation—Elixir Aromaticum.
N. F. Preparations—Elixir Aletridis Compositum; Elixir Calcii Lactophosphatis; Elixir Carnis et Ferri; Elixir Chloridorum; Elixir Ferri, Quininæ et Strychninæ; Elixir Heloniadis Compositus; Elixir Hydrangeæ et Lithii; Elixir Phosphori; Elixir Sabal et Santali Compositus; Elixir Terpini Hydratis et Creosoti Compositus; Elixir Tongæ et Salicylatum; Emulsions.

Uses—A flavor for elixirs. An alcoholic solution of this kind permits the uniform introduction of small proportions of oils and also preserves such oils as orange and lemon from rapid oxidation. These two oils should be bought in small quantities by the retail pharmacist, and this spirit is most satisfactorily made from oils taken from bottles not previously opened. This will insure that delicacy of flavor which should always be characteristic of elixirs.

SPIRITUS CAMPHORÆ. U.S. Spirit of Camphor

[Sp. Camph.]

Spirit of Camphor contains not less than 9.5 Gm. and not more than 10.5 Gm. of camphor in each 100 cc.

	Metric	Alternative
Camphor	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the camphor in about 800 cc. [25½ fl. oz.] of alcohol and add enough alcohol to make the product measure 1000 cc. [2 pints]. Filter if necessary.

Tests for Purity—Specific gravity: from 0.824 to 0.826 at 25° C.
Add 0.05 Gm. of anhydrous potassium carbonate to 5 cc. of Spirit of Camphor: the potassium carbonate does not liquefy or adhere to the bottom of the vessel (*added water*).

Assay—Fill a 200 mm. polariscope tube with the Spirit of Camphor and take the mean of four or more readings of the rotation, setting the instrument at zero each time. The temperature correction for each degree of temperature is half minute, added if above, subtracted if below, 25° C. Evaporate 60 cc. or more of the Spirit of Camphor in a dish, on a water bath, and when the camphor begins to solidify stir it with a glass rod until dry. Then transfer the camphor to a watch glass, cover it with an inverted funnel and place the watch glass on wire gauze 10 cm. above a Bunsen burner having a flame 4 cm. high. When the camphor has all sublimed, dissolve 2.5 Gm. of the sublimate in sufficient alcohol to make exactly 25 cc., and take the mean of four or more polariscope readings in a 200 mm. tube as before. The minutes of rotation of the Spirit of Camphor divided by the minutes of rotation of the control test, and this multiplied by 10, shows the number of Gm. of camphor in 100 cc. of the Spirit of Camphor.

Alcohol content, by volume, 80 to 87 per cent.

N. F. Preparations—Lotio Ammoniacalis Camphorata; Mistura Opii et Chloroformi Composita; Mistura Opii et Rhei Composita; Tinctura Opii et Gambir Composita.

Uses—Used as a sedative and antispasmodic in diarrhea, and also in hysteria, headache and other forms of nervous excitement. A stimulant in small doses.

Average dose—15 minims (1 cc.).

SPIRITUS CHLOROFORMI. U.S. Spirit of Chloroform

[Sp. Chlorof.—Chloric Ether]

	Metric	Alternative
Chloroform	**60 cc.**	1 fl. oz. 7½ fl. dr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the chloroform with sufficient alcohol to make the product measure 1000 cc. [2 pints].

Preserve in dark amber-colored bottles.

Alcohol content, by volume, 85 to 91 per cent.

Uses—A sedative in cough mixtures and in flatulence.

Average dose—30 minims (2 cc.).

SPIRITUS CINNAMOMI. U.S. Spirit of Cinnamon

[Sp. Cinnam.]

	Metric	Alternative
Oil of Cinnamon	**100 cc.**	1 fl. oz.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	10 fl. oz.

Mix the oil with sufficient alcohol to make the product measure 1000 cc. [10 fl. oz.].

Alcohol content, by volume, 80 to 87 per cent.

U. S. P. Preparation—Syrupus Rhei.

N. F. Preparations—Syrupus Ipecacuanhæ et Opii; Tabellæ Phenolphthaleini.

Uses—A pleasantly flavored cordial.

Average dose—15 minims (1 cc.).

SPIRITUS FRUMENTI. U.S. Whisky

Whisky is discussed under alcohol (see page 914).

SPIRITUS GLYCERYLIS NITRATIS. U.S. Spirit of Glyceryl Trinitrate

[Sp. Glyceryl. Nit.—Spirit of Glonoin, Spirit of Nitroglycerin]

Spirit of Glyceryl Trinitrate is an alcoholic solution containing not less than 1 per cent and not more than 1.1 per cent of $C_3H_5(NO_3)_3$(227.08).

Caution—Great care must be exercised in dispensing, handling, packing, transporting, and storing this Spirit, since a dangerous explosion may result if any considerable quantity of it is spilled, and the alcohol wholly or partly lost by evaporation. If, through accident, it is spilled, a solution of potassium or sodium hydroxide must be poured over it at once to effect decomposition.

Description and Physical Properties—A clear, colorless liquid, having the odor of alcohol. *Caution must be exercised in tasting it*, since even a small quantity is liable to produce a violent headache. The same effect is produced when it is applied to the skin.

Tests for Identity and Purity—Specific gravity: 0.814 to 0.820 at 25° C.

It is neutral to litmus paper.

Heat about 10 cc. of Spirit of Glyceryl Trinitrate on a water bath with 1 cc. of potassium hydroxide T.S. until the alcohol is evaporated, and then heat a portion of the residue with about 1.5 Gm. of potassium bisulphate: the pungent odor of acrolein is evolved. Dissolve the remainder of the residue in 2 cc. of distilled water acidulated with diluted sulphuric acid, add a few drops of diphenylamine T.S., and pour the solution upon 2 cc. of sulphuric acid in a test tube so as to form a separate layer: a dark blue color is produced at the zone of contact.

On mixing 10 cc. of the Spirit with 11 cc. of distilled water, both previously cooled to 15° C., a clear solution results. On now adding 2 cc. more of distilled water, the mixture becomes turbid at 15° C.

Assay—Transfer about 5 cc. of the Spirit, accurately weighed, to a tared dish, protect it from dust, allow it to evaporate spontaneously, and dry the residue to constant weight over sulphuric acid. The weight of the residue corresponds to not less than 1 per cent and not more than 1.1 per cent of the weight of Spirit taken.

Preserve in well-stoppered bottles, in a cool, dark place, remote from fire.

Alcohol content, by volume, 88 to 95 per cent.

Uses—Employed in angina pectoris, threatened apoplexy, and other severe circulatory disorders. It is not a heart stimulant but lowers blood pressure.

Average dose—1 minim (0.05 cc.).

SPIRITUS LAVANDULÆ. U.S. Spirit of Lavender

[Sp. Lavand.]

	Metric	Alternative
Oil of Lavender	**50 cc.**	**½ fl. oz.**
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	**10 fl. oz.**

Mix the oil with sufficient alcohol to make the product measure 1000 cc. [10 fl. oz.].

Alcohol content, by volume, 85 to 92 per cent.

Uses—A stimulant and carminative.

Average dose—30 minims (2 cc.).

SPIRITUS MENTHÆ PIPERITÆ. U.S. Spirit of Peppermint

[Sp. Menth. Pip.—Essence of Peppermint]

	Metric	Alternative
Oil of Peppermint	**100 cc.**	**3 fl. oz. 96 min.**
Peppermint, bruised	**10 Gm.**	**146 gr.**
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	**2 pints**

Macerate the peppermint leaves, freed as much as possible from stems, during one hour in 500 cc. [1 pint] of water, and then strongly express them.

Mix 800 cc. [25 fl. oz. 288 min.] of alcohol with the oil, add the moist, macerated leaves, and allow to stand during six hours with frequent agitation. Filter and pass sufficient alcohol through the filter to make the product measure 1000 cc. [2 pints].

Preserve in amber-colored bottles.
Alcohol content, by volume, 79 to 85 per cent.

N. F. Preparations—Elixir Catharticum Compositum; Liquor Phosphori; Mistura Opii et Rhei Composita; Mistura Rhei Alkalina; Mistura Rhei Composita; Syrupus Ficorum Compositus.

Uses—A valuable carminative and gastric stimulant in flatulence, and nausea. The oil is usually employed for flavoring.

Average dose—15 minims (1 cc.).

SPIRITUS MENTHÆ VIRIDIS. U.S. Spirit of Spearmint

[Sp. Menth. Vir.]

	Metric	Alternative
Oil of Spearmint	100 cc.	3 fl. oz. 96 min.
Spearmint, bruised	10 Gm.	146 gr.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Macerate the spearmint leaves, freed as much as possible from stems, during one hour in 500 cc. [1 pint] of water, and then strongly express them. Mix 800 cc. [25 fl. oz. 288 min.] of alcohol with the oil, add the moist macerated leaves, and allow to stand during six hours with frequent agitation. Filter, and pass sufficient alcohol through the filter to make the product measure 1000 cc. [2 pints].

Preserve in amber-colored bottles.
Alcohol content, by volume, 79 to 85 per cent.

N. F. Preparation—Elixir Manacæ Compositus.

Uses—As a carminative.

Average dose—15 minims (1 cc.).

SPIRITUS VINI VITIS. U.S. Brandy

Brandy is discussed under alcohol (see page 916).

SPIRITUS ACIDI FORMICI. N.F. Spirit of Formic Acid

[Sp. Ac. Formic.—Spiritus Formicarum, Spirit of Ants]

	Metric	Alternative
Formic Acid	40 cc.	1 fl. oz. 134 min.
Distilled Water	225 cc.	7 fl. oz. 96 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the formic acid with the distilled water, and add sufficient alcohol to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 70 per cent.

Uses—Externally a counterirritant, internally a diuretic.

Average dose—1 fluidrachm (4 cc.).

SPIRITUS ÆTHERIS. N.F. Spirit of Ether
(U.S.P. IX)

[Sp. Æth.—Hoffmann's Drops]

	Metric	Alternative
Ether	325 cc.	10 fl. oz. 192 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the ether with a sufficient quantity of alcohol to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 63 per cent.

Uses—A carminative in flatulence.

Average dose—1 fluidrachm (4 cc.).

SPIRITUS ÆTHERIS COMPOSITUS. N.F. Compound Spirit of Ether

[Sp. Æth. Co.—Hoffmann's Anodyne]

	Metric	Alternative
Ether	325 cc.	10 fl. oz. 192 min.
Alcohol	650 cc.	20 fl. oz. 384 min.
Ethereal Oil	25 cc.	384 min.
To make about	1000 cc.	2 pints

Mix them.

Approximate alcohol content, by volume, 61 per cent.

History—Compound spirit of ether was based upon a secret preparation of Dr. Friedrich Hoffmann of the early eighteenth century, called *Liquor Anodynus Hoffmannii.*

Uses—A carminative in flatulent colic.

Average dose—1 fluidrachm (4 cc.).

SPIRITUS AMMONIÆ ANISATUS. N.F. Anisated Spirit of Ammonia

[Sp. Ammon. Anis.—Liquor Ammoniæ Anisatus, Anisated Solution of Ammonia]

	Metric	Alternative
Anethol	30 cc.	461 min.
Ammonia Water	200 cc.	6 fl. oz. 192 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the anethol in 770 cc. [24 fl. oz. 307 min.] of alcohol, gradually add the ammonia water and then sufficient alcohol to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 73 per cent.

Uses—A carminative, antacid and stimulant.

Average dose—15 minims (1 cc.).

SPIRITUS AMYGDALÆ AMARÆ. N.F. Spirit of Bitter Almond
[U.S.P. IX]

[Sp. Amygd. Amar.]

	Metric	Alternative
Oil of Bitter Almond	10 cc.	154 min.
Alcohol	800 cc.	25 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the oil in the alcohol, and add enough distilled water to make the product measure 1000 cc. [2 pints].

NOTE—This Spirit is intended for medicinal use; it must not be used for flavoring foods.

Approximate alcohol content, by volume, 75 per cent.

N. F. Preparations—Elixir Anisi; Elixir Terpini Hydratis.

Uses—As a flavoring agent. It contains enough prussic acid to exert a deleterious effect if used too freely.

Average dose—8 minims (0.5 cc.).

SPIRITUS CARDAMOMI COMPOSITUS. N. F. Compound Spirit of Cardamom

[Sp. Card. Co.]

	Metric	Alternative
Oil of Cardamom	20.0 cc.	384 min.
Oil of Orange	20.0 cc.	384 min.
Oil of Cinnamon	2.0 cc.	38 min.
Oil of Clove	1.0 cc.	19 min.
Anethol	1.0 cc.	19 min.
Oil of Caraway	0.1 cc.	2 min.
Alcohol, a sufficient quantity,		
To make	200 cc.	8 fl. oz.

Mix the oils with 150 cc. [4 fl. oz. 384 min.] of alcohol, and add sufficient alcohol to make the product measure 200 cc. [6 fl. oz. 192 min.].

Approximate alcohol content, by volume, 72 per cent.

N. F. Preparations—Elixir Cardamomi Compositum; Elixir Gentianæ; Elixir Gentianæ et Ferri; Elixir Gentianæ et Ferri Phosphatis; Elixir Glycerophosphatum Compositum; Elixir Glycyrrhizæ Aquosum; Liquor Pancreatini.

Uses—The flavor for a vehicle elixir of the same name (also see Spiritus Aurantii Compositus).

SPIRITUS MYRCIÆ COMPOSITUS. N. F. Compound Spirit of Myrcia

[Sp. Myrciæ Co.]

	Metric	Alternative
Oil of Myrcia	8.0 cc.	123 min.
Oil of Orange	0.5 cc.	8 min.
Oil of Pimenta	0.5 cc.	8 min.
Alcohol	610.0 cc.	19 fl. oz. 250 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the oils with the alcohol, and gradually add water until the product measures 1000 cc. [2 pints]. Set the mixture aside, in a well-stoppered bottle, for eight days and then filter it through paper in a covered funnel.

Approximate alcohol content, by volume, 57 per cent.

Uses—Commonly sold for *Bay Rum*. Genuine Bay Rum is a distillation of bay-leaf and Demerara rum. It is used to give perfume to external applications, also as a lotion after shaving and, since unmedicated alcohol is not available, often employed for an alcohol rub.

SPIRITUS ODORATUS. N. F. Perfumed Spirit

[Sp. Odorat.—AQUA COLONIENSIS]

	Metric	Alternative
Oil of Bergamot	15 cc.	230 min.
Oil of Lemon	8 cc.	123 min.
Oil of Rosemary	7 cc.	108 min.
Oil of Lavender	4 cc.	61 min.
Oil of Orange Flowers	4 cc.	61 min.
Acetic Ether	2 cc.	31 min.
Water	120 cc.	3 fl. oz. 403 min.
Alcohol	840 cc.	26 fl. oz. 422 min.
To make about	1000 cc.	2 pints

Dissolve the oils and the acetic ether in the alcohol, and add the water. Set the mixture aside, in a stoppered bottle, during eight days and then filter it through paper in a covered funnel.

Approximate alcohol content, by volume, 78 per cent.

Uses—A refreshing perfume, often employed in the sick room. It is a typical formula for the preparation known as *Cologne Water*.

Genuine Cologne Water (Eau de Cologne) is so called from having been first manufactured in Cologne, Germany. The preparations made by various firms differ considerably in their odor, but the oil of orange flowers or neroli is universally recognized as the dominant odor.

SPIRITUS OLEORUM VOLATILIUM. N.F. Spirits of Volatile Oils

Any spirit of a volatile oil, for which no formula is provided, may be prepared by the following general formula:

	Metric	Alternative
The Volatile Oil	**65 cc.**	2 fl. oz. 38 min.
Alcohol	**935 cc.**	29 fl. oz. 442 min.
To make about	**1000 cc.**	2 pints

Dissolve the volatile oil in the alcohol.

SPIRITUS SINAPIS. N.F. Spirit of Mustard

[Sp. Sinap.]

	Metric	Alternative
Volatile Oil of Mustard	**2 cc.**	38 min.
Alcohol, a sufficient quantity,		
To make	**100 cc.**	4 fl. oz.

Mix them.

Approximate alcohol content, by volume, 92 per cent.

Uses—A counterirritant.

SPIRITUS VANILLINI COMPOSITUS. N.F. Compound Spirit of Vanillin

[Sp. Vanil. Co.]

	Metric	Alternative
Vanillin	**40 Gm.**	1 oz. av. 293 gr.
Oil of Orange	**10 cc.**	192 min.
Oil of Cardamom	**2 cc.**	38 min.
Oil of Cinnamon	**1 cc.**	19 min.
Alcohol, a sufficient quantity,		
To make	**200 cc.**	8 fl. oz.

Dissolve the vanillin and the oils in 150 cc. [6 fl. oz.] of alcohol and add sufficient alcohol to make the product measure 200 cc. [8 fl. oz.].

Preserve the spirit in tightly stoppered, amber-colored bottles, in a cool place.

Approximate alcohol content, by volume, 15 per cent.

N. F. Preparation—Elixir Vanillini Compositum.

Uses—The flavor for a vehicle elixir of the same name. (See also Spiritus Aurantii Compositus.)

Table of Some Unofficial Spirits

Title	*Directions*
Spiritus Ammoniæ (U. S. P. VIII)	Heat 50 cc. of stronger ammonia water, not above 60° C., in a flask, connected by means of a glass condenser, with a well-cooled receiver containing 100 cc. of alcohol, the delivery tube reaching nearly to the bottom of the condenser. When all the ammonia has been distilled, adjust the volume of the spirit to contain 10 per cent by weight, of ammonia gas Dose: fifteen minims (1 cc.)
Ammoniæ Fetidus (Br. 1914)	Macerate 7.5 Gm. of asafetida in 75 cc. of alcohol for twenty-four hours and then distil off the alcohol. Mix the distillate with 10 cc. of strong solution of ammonia (32.5 per cent) and enough alcohol to make 100 cc. Dose: thirty minims (2 cc.)

Table of Some Unofficial Spirits—*Continued*

Title	*Directions*
Spiritus Armoraciæ Compositus (Br. 1914)	Macerate 12.5 Gm. of horseradish root, scraped, 12.5 Gm. of dried bitter orange peel and 0.3 Gm. of nutmeg with 62.5 cc. of alcohol and 75 cc. of distilled water for one hour, and distil 100 cc. Dose: two fluidrachms (8 cc.)
Cajuputi (Br. 1914)	Mix 10 cc. of oil of cajuput with enough alcohol to make 100 cc. Dose: ten minims (0.6 cc.)
Juniperi Compositus (U. S. P. IX)	Dissolve 0.8 cc. of oil of juniper, 0.1 cc. of oil of caraway and 0.1 cc. of oil of fennel in 140 cc. of alcohol and add enough water to make 200 cc. Dose: two and one-half fluidrachms (10 cc.)
Limonis (U. S. P. 1890)	Mix 5 cc. of oil of lemon with 90 cc. of alcohol, add 5 Gm. of freshly grated lemon peel and macerate for twenty-four hours. Filter and add enough alcohol to make 100 cc.
Phosphori (U. S. P. 1890)	Add 0.12 Gm. of phosphorus, carefully weighed, to 100 cc. of dehydrated alcohol contained in a flask, connect with an upright condenser and boil the liquid until the phosphorus is dissolved; then, if necessary, add enough dehydrated alcohol to make 100 cc. and preserve in small, tightly-stoppered bottles
Rosmarini (Br. 1914)	Mix 10 cc. of oil of rosemary with enough alcohol to make 100 cc.

Elixiria—*Elixirs*

Elixirs are aromatic, sweetened, spiritous preparations, frequently used as flavors and adjuvants in prescriptions and sometimes containing active medicinal substances. Although they are largely employed throughout the United States, but two are official in the U. S. P. X. These are intended as vehicles for the administration of active remedies in small doses. The National Formulary, however, has recognized a large number of preparations of this class; in the group are *ten* intended for use as vehicles or adjuvants, and the remainder are medicated. Elixirs, when dispensed, should always be brilliantly clear, filtration through purified talc, or preferably through purified siliceous earth, being resorted to, if necessary. The utmost care should be taken in the selection of the flavoring ingredients. Especially is this necessary with volatile oils, and only those which are of finest quality and entirely free from evidences of deterioration should be employed.

ELIXIR AROMATICUM. U. S. Aromatic Elixir

[Elix. Arom.—Simple Elixir]

	Metric	Alternative
Compound Spirit of Orange	**12 cc.**	184 min.
Syrup	**375 cc.**	12 fl. oz.
Purified Talc	**30 Gm.**	1 oz. av.
Alcohol,		
Distilled Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

To the compound spirit of orange add enough alcohol to make 250 cc. [8 fl. oz.]. To this solution add the syrup in several portions, agitating after each addition, and afterwards add, in the same manner, 375 cc. [12 fl. oz.] of distilled water. Mix the purified talc intimately with the liquid, and filter through a wetted filter, returning the first portions of the filtrate until a clear liquid is obtained. Lastly, wash the filter with a mixture of 1 volume of alcohol and 3 volumes of distilled water until the product measures 1000 cc. [2 pints].

The compound spirit is used to insure a uniform proportion of the several oils (*i.e.* orange, lemon, coriander, and anise), in every lot of the elixir. The alcoholic solution also preserves the delicate flavor of the orange and lemon for a considerable time.

Alcohol content, by volume, 22 to 24 per cent.

U. S. P. Preparations—Elixir Glycyrrhizæ; Liquor Ferri et Ammonii Acetatis.

N. F. Preparations—Elixir Aromaticum Rubrum; also in many medicated elixirs; Liquor Ferri Albuminati.

Uses—A pleasantly flavored vehicle, employed in the preparation of many other elixirs. The chief objection to its extensive use is the high alcohol content (about 22 per cent) which at times counteracts the effect of other medicines. The N.F. offers several vehicle elixirs of low alcoholic strength, among them being the compound elixir of almond (about 5 per cent alcohol), aqueous elixir of glycyrrhiza (about 1 per cent alcohol), and the compound elixirs of cardamom and vanillin (both with about 10 per cent alcohol).

ELIXIR GLYCYRRHIZÆ. U.S. Elixir of Glycyrrhiza

[Elix. Glycyrrh.—Elixir Adjuvans, Elixir of Licorice]

	Metric	Alternative
Fluidextract of Glycyrrhiza	**125 cc.**	4 fl. oz.
Aromatic Elixir	**875 cc.**	28 fl. oz.
To make	**1000 cc.**	2 pints

Mix and filter.

Alcohol content, by volume, 21 to 23 per cent.

Uses—A flavored vehicle and adjuvant.

ELIXIR ALETRIDIS COMPOSITUM. N.F. Compound Elixir of Aletris

[Elix. Aletrid. Co.]

	Metric	Alternative
Fluidextract of Aletris, **Fluidextract of Mitchella,** **Fluidextract of Helonias,** **Fluidextract of Caulophyllum,** each	**65.50 cc.**	2 fl. oz. 46 min.
Fluidextract of Viburnum Opulus	**32.75 cc.**	1 fl. oz. 23 min.
Compound Spirit of Orange	**10.00 cc.**	154 min.
Alcohol	**125.00 cc.**	4 fl. oz.
Syrup	**300.00 cc.**	9 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the compound spirit of orange in the alcohol, add the fluidextracts, then the syrup, and sufficient distilled water to make the product measure 1000 cc. [2 pints]. Filter.

Approximate alcohol content, by volume, 27 per cent.

Uses—In dysmenorrhea.

Average dose—1 fluidrachm (4 cc.).

ELIXIR AMMONII BROMIDI. N.F. Elixir of Ammonium Bromide

[Elix. Ammon. Brom.]

	Metric	Alternative
Ammonium Bromide	**85 Gm.**	2 oz. av. 366 gr.
Syrup	**200 cc.**	6 fl. oz. 192 min.
Distilled Water	**460 cc.**	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the ammonium bromide in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

It will be observed that all elixirs containing bromides are made with only a small percentage of aromatic elixir, water serving as the main solvent. This is for the purpose of reducing the alcohol content which, if present in large amount, would interfere with the action of the bromide.

Approximate alcohol content, by volume, 6 per cent.

Uses—A sedative containing 5 grains of bromide in a fluidrachm.

Average dose—1 fluidrachm (4 cc.).

ELIXIR AMMONII VALERATIS. N.F. Elixir of Ammonium Valerate

[Elix. Ammon. Valer.—Elixir Ammonii Valerianatis]

	Metric	Alternative
Ammonium Valerate	35.0 Gm.	1 oz. av. 74 gr.
Chloroform	1.5 cc.	23 min.
Tincture of Vanilla	16.0 cc.	246 min.
Compound Tincture of Cudbear	16.0 cc.	246 min.
Ammonia Water,		
Aromatic Elixir, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the ammonium valerate in about 65 cc. [2 fl. oz. 38 min.] of aromatic elixir and add ammonia water, in drops, until a faint excess of it is perceptible in the liquid, using litmus paper as an indicator. Then add the chloroform, tincture of vanilla and compound tincture of cudbear, and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

If the ammonia is not in excess, free valeric acid is present and renders the preparation offensive in odor and taste.

Approximate alcohol content, by volume, 21 per cent.

Uses—In nervousness and hysteria.

Average dose—1 fluidrachm (4 cc.).

ELIXIR AMYGDALÆ COMPOSITUM. N.F. Compound Elixir of Almond

[Elix. Amygdal. Co.]

	Metric	Alternative
Oil of Bitter Almond	0.5 cc.	8 min.
Vanillin	1.0 Gm.	15 gr.
Orange Flower Water	150.0 cc.	4 fl. oz. 384 min.
Alcohol	50.0 cc.	1 fl. oz. 288 min.
Syrup	400.0 cc.	12 fl. oz. 384 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the oil of bitter almond and the vanillin in the alcohol, add the syrup, the orange flower water and sufficient distilled water, in several portions, shaking the mixture thoroughly after each addition, to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 4 per cent.

N. F. Preparation—Elixir Trium Bromidorum.

Uses—A vehicle elixir offering low-alcoholic content (about 5 per cent) where such is desired.

ELIXIR ANISI. N.F. Elixir of Anise

[Elix. Anis.]

	Metric	Alternative
Anethol	3.5 cc.	54 min.
Oil of Fennel	0.5 cc.	8 min.
Spirit of Bitter Almond	12.0 cc.	184 min.
Alcohol	50.0 cc.	1 fl. oz. 288 min.
Syrup	625.0 cc.	20 fl. oz.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the anethol, oil of fennel, spirit of bitter almond and alcohol, add the syrup and sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 4 per cent.

Uses—A carminative for infants; also a flavored vehicle.

Average dose—For infants, 15 minims (1 cc.).

ELIXIR AROMATICUM RUBRUM. N.F. Red Aromatic Elixir

[Elix. Arom. Rub.—Red Elixir]

	Metric	Alternative
Cudbear	2 Gm.	29 gr.
Aromatic Elixir	1000 cc.	2 pints
To make	1000 cc.	2 pints

Add the cudbear to the aromatic elixir, allow the mixture to stand for six or more hours with occasional agitation, then filter.

Approximate alcohol content, by volume, 22 per cent.

Uses—A red-colored, flavored vehicle.

ELIXIR AURANTII AMARI. N.F. Elixir of Bitter Orange

[Elixir Curassao]

	Metric	Alternative
Oil of Bitter Orange	4 cc.	60 min.
Tincture of Bitter Orange Peel	20 cc.	307 min.
Alcohol	300 cc.	9 fl. oz. 288 min.
Orange Flower Water	20 cc.	307 min.
Syrup	400 cc.	12 fl. oz. 384 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the oil of bitter orange and the tincture of bitter orange peel with the alcohol, add the syrup, the orange flower water and then sufficient distilled water, in several portions, shaking the mixture after each addition, to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 28 per cent.

History—Under the name *Elixir Aurantii Compositum* the celebrated Dr. Friedrich Hoffmann of the early part of the eighteenth century introduced a similar preparation which he also called *Elixir Viscerale Hoffmannii.*

Uses—A pleasantly flavored vehicle.

ELIXIR BISMUTHI. N.F. Elixir of Bismuth

[Elix. Bism.]

	Metric	Alternative
Glycerite of Bismuth	125 cc.	4 fl. oz.
Glycerin	125 cc.	4 fl. oz.
Distilled Water	250 cc.	8 fl. oz.
Aromatic Elixir, a sufficient quantity		
To make	1000 cc.	2 pints

Mix the ingredients in the order given and filter the product.

Approximate alcohol content, by volume, 11 per cent.

Uses—An intestinal astringent.

Average dose—1 fluidrachm (4 cc.).

ELIXIR BROMIDORUM QUINQUE. N.F. Elixir of Five Bromides

[Elix. Bromid. Quinq.]

	Metric	Alternative
Sodium Bromide	87.5 Gm.	2 oz. av. 403 gr.
Potassium Bromide	70.0 Gm.	2 oz. av. 147 gr.
Calcium Bromide	52.5 Gm.	1 oz. av. 329 gr.
Lithium Bromide	35.0 Gm.	1 oz. av. 74 gr.
Ammonium Bromide	17.5 Gm.	256 gr.
Fluidglycerate of Glycyrrhiza	80.0 cc.	2 fl. oz. 269 min.
Syrup of Raspberry	150.0 cc.	4 fl. oz. 384 min.
Syrup	150.0 cc.	4 fl. oz. 384 min.
Aromatic Elixir	200.0 cc.	6 fl. oz. 192 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the bromides with 250 cc. [8 fl. oz.] of distilled water, add the syrups, the fluidglycerate of glycyrrhiza and the aromatic elixir, and agitate until the bromides are completely dissolved. Then add enough distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 4 per cent.

Uses—A nerve sedative.

Average dose—1 fluidrachm (4 cc.).

ELIXIR BROMIDORUM TRIUM. N.F. Elixir of Three Bromides

[**Elix. Brom. Tri.**—ELIXIR TRIUM BROMIDORUM, N.F. IV]

	Metric	Alternative
Ammonium Bromide	**80 Gm.**	2 oz. av. 293 gr.
Potassium Bromide	**80 Gm.**	2 oz. av. 293 gr.
Sodium Bromide	**80 Gm.**	2 oz. av. 293 gr.
Cudbear	**2 Gm.**	29 gr.
Compound Elixir of Almond, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the bromides in 800 cc. [25 fl. oz.] of compound elixir of almond, add the cudbear and allow the mixture to macerate in a stoppered bottle for six or more hours, with occasional shaking; then add sufficient compound elixir of almond to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 4 per cent.

Uses—A nerve sedative.

Average dose—1 fluidrachm (4 cc.).

ELIXIR BUCHU. N.F. Elixir of Buchu

[**Elix. Buchu**]

	Metric	Alternative
Fluidextract of Buchu	**125 cc.**	4 fl. oz.
Alcohol	**50 cc.**	1 fl. oz. 288 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the fluidextract of buchu with the alcohol, add sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 32 per cent.

N. F. Preparation—Elixir Buchu et Potassii Acetatis.

Uses—A sedative to genito-urinary tract.

Average dose—1 fluidrachm (4 cc.).

ELIXIR BUCHU COMPOSITUM. N.F. Compound Elixir of Buchu

[**Elix. Buchu Co.**]

	Metric	Alternative
Compound Fluidextract of Buchu	**250 cc.**	8 fl. oz.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the compound fluidextract of buchu with sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 31 per cent.

Uses—For chronic inflammations of genito-urinary organs.

Average dose—1 fluidrachm (4 cc.).

ELIXIR BUCHU ET POTASSII ACETATIS. N. F. Elixir of Buchu and Potassium Acetate

[Elix. Buchu et Pot. Acet.]

	Metric	Alternative
Potassium Acetate	**85 Gm.**	2 oz. av. 366 gr.
Elixir of Buchu, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the potassium acetate in sufficient elixir of buchu to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 31 per cent.

Uses—For hyperacidity of urine and irritated bladder.

Average dose—1 fluidrachm (4 cc.).

ELIXIR BUCHU, JUNIPERI ET POTASSII ACETATIS. N. F. Elixir of Buchu, Juniper and Potassium Acetate

[Elix. Buchu, Junip. et Pot. Acet.]

	Metric	Alternative
Fluidextract of Buchu	**150 cc.**	4 fl. oz. 384 min.
Fluidextract of Juniper	**75 cc.**	2 fl. oz. 192 min.
Potassium Acetate	**50 Gm.**	1 oz. av. 293 gr.
Alcohol	**50 cc.**	1 fl. oz. 288 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the fluidextracts with the alcohol, and add 750 cc. [24 fl. oz.] of aromatic elixir in which the potassium acetate has been previously dissolved. Add sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 35 per cent.

Uses—Chronic inflammation of genito-urinary tract and as a diuretic.

Average dose—1 fluidrachm (4 cc.).

ELIXIR CALCII ET SODII GLYCEROPHOSPHATUM. N. F. Elixir of Calcium and Sodium Glycerophosphates

[Elix. Calc. et Sod. Glycerophos.—Elixir Glycerophosphatum]

	Metric	Alternative
Sodium Glycerophosphate	**17.50 Gm.**	256 gr.
Calcium Glycerophosphate	**8.75 Gm.**	128 gr.
Phosphoric Acid	**8.00 cc.**	123 min.
Glycerin	**300.00 cc.**	9 fl. oz. 288 min.
Aromatic Elixir	**300.00 cc.**	9 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the glycerophosphates in the acid and 300 cc. [9 fl. oz. 288 min.] of distilled water, add the glycerin and aromatic elixir, and sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 6 per cent.

Uses—For conditions in which lime and phosphates are indicated, especially diseases of the bones.

Average dose—1 fluidrachm (4 cc.).

ELIXIR CALCII LACTOPHOSPHATIS. N. F. Elixir of Calcium Lactophosphate

[Elix. Calc. Lactophos.]

	Metric	Alternative
Precipitated Calcium Carbonate	**10 Gm.**	146 gr.
Lactic Acid	**30 cc.**	461 min.
Phosphoric Acid	**15 cc.**	230 min.
Compound Spirit of Orange	**10 cc.**	154 min.
Syrup	**350 cc.**	11 fl. oz. 96 min.
Alcohol	**200 cc.**	6 fl. oz. 192 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the precipitated calcium carbonate in the lactic acid, which has been previously mixed with 200 cc. [6 fl. oz. 192 min.] of distilled water, and then add the phosphoric acid, diluted with 50 cc. [1 fl. oz. 288 min.] of distilled water. To this solution add the syrup and then, in divided portions, the mixture of alcohol and compound spirit of orange. Now add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 19 per cent.

Uses—See Syrupus Calcii Lactophosphatis, page 275.

Average dose—2 fluidrachms (8 cc.).

ELIXIR CARDAMOMI COMPOSITUM. N. F. Compound Elixir of Cardamom

[Elix. Card. Co.]

	Metric	Alternative
Compound Spirit of Cardamom	**10 cc.**	154 min.
Alcohol	**90 cc.**	2 fl. oz. 422 min.
Syrup	**400 cc.**	12 fl. oz. 384 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the compound spirit of cardamom with the alcohol, add the syrup and sufficient distilled water, in several portions, shaking the mixture thoroughly after each addition, to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 8 per cent.

Uses—An elixir of pleasant flavor, but of low alcoholic content.

ELIXIR CARNIS ET FERRI. N. F. Elixir of Beef and Iron

(Replacing Vinum Carnis et Ferri N. F. IV)

[Elix. Carn. et Ferr.]

	Metric	Alternative
Extract of Beef	**35.00 Gm.**	1 oz. av. 74 gr
Iron and Ammonium Citrate	**8.75 Gm.**	128 gr.
Alcohol	**200.00 cc.**	6 fl. oz. 192 min.
Compound Spirit of Orange	**5.00 cc.**	77 min.
Syrup	**100.00 cc.**	3 fl. oz. 96 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the iron and ammonium citrate and the extract of beef in 200 cc. [6 fl. oz. 192 min.] of distilled water by the aid of heat. Cool the solution and add 400 cc. [12 fl. oz. 384 min.] of distilled water and the syrup. Gradually add the alcohol in which the compound spirit of orange has been dissolved, then sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 19 per cent.

Preserve it in amber-colored bottles in a cool place.

Uses—Used as a tonic.

Average dose—2 fluidrachms (8 cc.).

ELIXIR CASCARÆ SAGRADÆ. N. F. Elixir of Cascara Sagrada

[Elix. Casc. Sagr.]

	Metric	Alternative
Aromatic Fluidextract of Cascara Sagrada	**500 cc.**	1 pint
Aqueous Elixir of Glycyrrhiza	**500 cc.**	1 pint
To make about	**1000 cc.**	2 pints

Mix them, and filter if necessary.

Approximate alcohol content, by volume, 12 per cent.

Uses—A laxative.

Average dose—1 fluidrachm (4 cc.).

ELIXIR CASCARÆ SAGRADÆ COMPOSITUM. N.F. Compound Elixir of Cascara Sagrada

[Elix. Casc. Sagr. Co.—Elixir Rhamni Purshianæ Compositum, Laxative Elixir]

	Metric	Alternative
Aromatic Fluidextract of Cascara Sagrada	125 cc.	4 fl. oz.
Fluidextract of Senna	75 cc.	2 fl. oz. 192 min.
Fluidextract of Juglans	65 cc.	2 fl. oz. 38 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix them, and filter.

Approximate alcohol content, by volume, 23 per cent.

Uses—A laxative.

Average dose—1 fluidrachm (4 cc.).

ELIXIR CATARIÆ ET FŒNICULI. N.F. Elixir of Catnep and Fennel

[Elix. Catar. et Fœnic.]

	Metric	Alternative
Fluidextract of Catnep	100.0 cc.	3 fl. oz. 96 min.
Sodium Bicarbonate	17.5 Gm.	256 gr.
Oil of Fennel	2.0 cc.	31 min.
Oil of Spearmint	1.0 cc.	15 min.
Alcohol	150.0 cc.	4 fl. oz. 384 min.
Syrup	200.0 cc.	6 fl. oz. 192 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the oils in the alcohol, add the fluidextract and syrup. Dissolve the sodium bicarbonate in 500 cc. [1 pint] of distilled water by very gentle agitation and add this solution to the first mixture. Then add sufficient distilled water to make the product measure 1000 cc. [2 pints], mix well and filter.

Approximate alcohol content, by volume, 17 per cent.

Uses—A carminative.

Average dose—For infants, 8 minims (0.5 cc.).

ELIXIR CATHARTICUM COMPOSITUM. N.F. Compound Cathartic Elixir

[Elix. Cathart. Co.]

	Metric	Alternative
Fluidextract of Frangula	125.0 cc.	4 fl. oz.
Fluidextract of Senna	100.0 cc.	3 fl. oz. 96 min.
Fluidextract of Rhubarb	62.0 cc.	1 fl. oz. 472 min.
Spirit of Peppermint	14.0 cc.	215 min.
Solution of Potassium Hydroxide	4.5 cc.	69 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix 600 cc. [19 fl. oz. 96 min.] of aromatic elixir with the solution of potassium hydroxide; then add the fluidextracts, the spirit of peppermint, and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints]. Allow the mixture to stand twenty-four hours, and filter.

Approximate alcohol content, by volume, 25 per cent.

Uses—A laxative.

Average dose—Aperient, 1 fluidrachm (4 cc.); Cathartic, 3 fluidrachms (12 cc.).

ELIXIR CHLORIDORUM. N. F. Elixir of Chlorides

[Elix. Chlorid.—Elixir of Four Chlorides]

	Metric	Alternative
Corrosive Mercuric Chloride	0.275 Gm.	4 gr.
Solution of Arsenous Acid	16.500 cc.	253 min.
Tincture of Ferric Chloride	83.000 cc.	2 fl. oz. 315 min.
Diluted Hydrochloric Acid	83.000 cc.	2 fl. oz. 315 min.
Compound Spirit of Orange	10.000 cc.	154 min.
Syrup	250.000 cc.	8 fl. oz.
Alcohol	200.000 cc.	6 fl. oz. 192 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the corrosive mercuric chloride in the diluted hydrochloric acid, add the solution of arsenous acid and the tincture of ferric chloride. Mix the compound spirit of orange with the alcohol, add the syrup, the aqueous solution, then sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Preserve the Elixir in dark amber-colored bottles.

Approximate alcohol content, by volume, 24 per cent.

Uses—An alterative.

Average dose—1 fluidrachm (4 cc.).

One average dose contains about:

0.0011 Gm. or 1/54 grain of Corrosive Mercuric Chloride.

0.00065 Gm. or 1/100 grain of Arsenic Trioxide.

ELIXIR CINCHONÆ ALKALOIDORUM. N. F. Elixir of Cinchona Alkaloids

[Elix. Cinchon. Alk.—Elixir Calisaya, Alkaloidal]

	Metric	Alternative
Quinine Sulphate	2 Gm.	29 gr.
Cinchonidine Sulphate	1 Gm.	15 gr.
Cinchonine Sulphate	1 Gm.	15 gr.
Compound Tincture of Cudbear	50 cc.	1 fl. oz. 288 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the alkaloidal salts in 900 cc. [28 fl. oz. 384 min.] of aromatic elixir; add the compound tincture of cudbear and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

This elixir replaces a former elixir of cinchona or calisaya which was made directly from the bark. This formula is preferable because tannin is absent and this permits its admixture with iron preparations without darkening.

Approximate alcohol content, by volume, 23 per cent.

N. F. Preparation—Elixir Cinchonæ Alkaloidorum et Ferri.

Uses —As a bitter tonic intended especially for combining with iron salts.

Average dose—2 fluidrachms (8 cc.).

ELIXIR CINCHONÆ ALKALOIDORUM ET FERRI. N. F. Elixir of Cinchona Alkaloids and Iron

[Elix. Cinchon. et Ferr.—Ferrated Elixir of Calisaya, Alkaloidal]

	Metric	Alternative
Soluble Ferric Phosphate	35 Gm.	1 oz. av. 74 gr.
Distilled Water	60 cc.	1 fl. oz. 442 gr.
Elixir of Cinchona Alkaloids, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the soluble ferric phosphate in the distilled water with the aid of heat, add a sufficient quantity of the elixir to make the product measure 1000 cc. [2 pints], and filter.

Preserve the Elixir in amber-colored bottles.

Approximate alcohol content, by volume, 21 per cent.

N. F. Preparations—Elixir Cinchonæ Alkaloidorum, Ferri et Bismuthi; Elixir Cinchonæ Alkaloidorum, Ferri et Strychninæ.

Uses—A chalybeate tonic.

Average dose—2 fluidrachms (8 cc.).

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI, BISMUTHI ET STRYCHNINÆ. N. F. Elixir of Cinchona Alkaloids, Iron, Bismuth and Strychnine

[**Elix. Cinchon. Ferr. Bism. et Strych.**—Elixir Cinchonæ, Ferri, Bismuthi et Strychninæ; Elixir of Calisaya, Alkaloidal, with Iron, Bismuth and Strychnine]

	Metric	Alternative
Strychnine Sulphate	**0.175 Gm.**	2½ gr.
Distilled Water	**10.000 cc.**	154 min.
Elixir of Cinchona Alkaloids, Iron and Bismuth, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the strychnine sulphate in the distilled water, and add sufficient of the elixir to make the product measure 1000 cc. [2 pints].

Preserve the Elixir in amber-colored bottles.
Approximate alcohol content, by volume, 18 per cent.

Uses—Employed as a tonic.

Average dose—1 fluidrachm (4 cc.).
One average dose contains about:
0.0007 Gm. or 1/100 grain of Strychnine Sulphate.

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI ET BISMUTHI. N. F. Elixir of Cinchona Alkaloids, Iron and Bismuth

[**Elix. Cinchon. Ferr. et Bism.**—Elixir of Calisaya, Alkaloidal, with Iron and Bismuth]

	Metric	Alternative
Glycerite of Bismuth	**65 cc.**	2 fl. oz. 38 min.
Distilled Water	**65 cc.**	2 fl. oz. 38 min.
Elixir of Cinchona Alkaloids and Iron, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dilute the glycerite with the distilled water, add sufficient of the elixir to make the product measure 1000 cc. [2 pints], mix thoroughly and filter.

Preserve the Elixir in dark amber-colored bottles.
Approximate alcohol content, by volume, 18 per cent.

N. F. Preparation—Elixir Cinchonæ Alkaloidorum, Ferri, Bismuthi et Strychninæ.

Uses—Employed as a tonic.

Average dose—2 fluidrachms (8 cc.).

ELIXIR CINCHONÆ ALKALOIDORUM, FERRI ET STRYCHNINÆ. N. F. Elixir of Cinchona Alkaloids, Iron and Strychnine

[**Elix. Cinchon. Ferr. et Strych.**—Elixir of Calisaya, Alkaloidal, with Iron and Strychnine]

	Metric	Alternative
Strychnine Sulphate	**0.175 Gm.**	2½ gr.
Distilled Water	**10.000 cc.**	154 min.
Elixir Cinchona Alkaloids and Iron, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the strychnine sulphate in the distilled water, add sufficient of the elixir to make the product measure 1000 cc. [2 pints], and filter.

Preserve the Elixir in dark amber-colored bottles.
Approximate alcohol content, by volume, 21 per cent.

Uses—Employed as a bitter chalybeate tonic.

Average dose—1 fluidrachm (4 cc.).
One average dose contains about:
0.0007 Gm. or 1/100 grain of Strychnine Sulphate.

ELIXIR CORYDALIS COMPOSITUM. N.F. Compound Elixir of Corydalis

[Elix. Coryd. Co.]

	Metric	Alternative
Fluidextract of Corydalis	60 cc.	1 fl. oz. 442 min.
Fluidextract of Stillingia	60 cc.	1 fl. oz. 442 min.
Fluidextract of Xanthoxylum	30 cc.	461 min.
Fluidextract of Blue Flag	90 cc.	2 fl. oz. 422 min.
Alcohol	125 cc.	4 fl. oz.
Potassium Iodide	50 Gm.	1 oz. av. 293 gr.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the fluidextracts, add the alcohol and dissolve the potassium iodide in the mixture. Then add sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 40 per cent.

Uses—As an alterative; its most important therapeutic ingredient is the potassium iodide.

Average dose—1 fluidrachm (4 cc.).

ELIXIR ERIODICTYI AROMATICUM. N.F. Aromatic Elixir of Eriodictyon

[Elix. Eriodict. Arom.—Aromatic Elixir of Yerba Santa, Elixir Corrigens]

	Metric	Alternative
Fluidextract of Eriodictyon	60 cc.	1 fl. oz. 442 min.
Syrup	500 cc.	1 pint
Pumice, in fine powder	30 Gm.	1 oz. av.
Magnesium Carbonate	10 Gm.	146 gr.
Compound Elixir of Taraxacum	440 cc.	14 fl. oz. 38 min.
To make	1000 cc.	2 pints

Triturate the fluidextract with the pumice and the magnesium carbonate and gradually add the elixir, followed by the syrup. Shake the mixture frequently during two hours, allow it to stand 12 or more hours, and filter.

Approximate alcohol content, by volume, 15 per cent.

Uses—A peculiar but pleasantly flavored vehicle, especially adapted for bitter substances like quinine.

Average dose—1 fluidrachm (4 cc.).

ELIXIR EUPHORBIÆ COMPOSITUM. N.F. Compound Elixir of Euphorbia

[Elix. Euphorb. Co.—Anti-asthmatic Elixir]

	Metric	Alternative
Fluidextract of Euphorbia	52.50 cc.	1 fl. oz. 326 min.
Fluidextract of Lobelia	7.00 cc.	108 min.
Sodium Bromide	35.00 Gm.	1 oz. av. 74 gr.
Sodium Iodide	35.00 Gm.	1 oz. av. 74 gr.
Spirit of Glyceryl Trinitrate	8.75 cc.	134 min.
Compound Tincture of Cardamom	50.00 cc.	1 fl. oz. 288 min.
Oil of Peppermint	1.00 cc.	15 min.
Glycerin	125.00 cc.	4 fl. oz.
Alcohol	200.00 cc.	6 fl. oz. 192 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the spirit of glyceryl trinitrate and oil of peppermint with the alcohol, add the glycerin, then the fluidextracts and compound tincture of cardamom. Dissolve the sodium bromide and sodium iodide in 400 cc. [12 fl. oz. 384 min.] of distilled water and add this gradually to the alcoholic solution. Mix thoroughly and add sufficient distilled water to make the product measure 1000 cc. [2 pints]. Filter if necessary.

Approximate alcohol content, by volume, 24 per cent.

Uses—In chronic bronchitis.

Average dose—1 fluidrachm (4 cc.).

ELIXIR FERRI PYROPHOSPHATIS, QUININÆ ET STRYCHNINÆ. N. F.
Elixir of Ferric Pyrophosphate, Quinine and Strychnine

[Elix. Ferr. Pyrophos. Quin. et Strych.]

	Metric	Alternative
Soluble Ferric Pyrophosphate	**35.00 Gm.**	1 oz. av. 74 gr.
Quinine Sulphate	**8.75 Gm.**	128 gr.
Strychnine	**0.14 Gm.**	2 gr.
Citric Acid	**0.70 Gm.**	10 gr.
Oil of Orange	**0.70 cc.**	10 gr.
Alcohol	**225.00 cc.**	7 fl. oz. 96 min.
Syrup	**375.00 cc.**	12 fl. oz.
Ammonia Water		
Distilled Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the quinine sulphate, strychnine and citric acid together, until minutely divided, then add the alcohol and oil of orange. Warm the syrup to about 65° C., add it to the turbid alcoholic mixture, and stir until it becomes clear. To this add the ferric pyrophosphate, previously dissolved in 320 cc. [10 fl. oz. 115 min.] of distilled water, and then ammonia water, drop by drop, until the liquid is neutral to litmus paper. Finally add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Preserve the Elixir in dark amber-colored bottles.
Approximate alcohol content, by volume, 21 per cent.

Uses—Employed as a tonic. This preparation soon assumes a darker shade of green, becoming brown or almost black.

Average dose—1 fluidrachm (4 cc.).
One average dose contains about:
0.00056 Gm. or $\frac{1}{125}$ grain of Strychnine.

ELIXIR FERRI, QUININÆ ET STRYCHNINÆ. N. F. Elixir of Iron, Quinine and Strychnine

[Elix. Ferr. Quin. et Strych.—Elixir I., Q. & S.]

	Metric	Alternative
Tincture of Ferric Citrochloride	**125.000 cc.**	4 fl. oz.
Quinine Hydrochloride	**8.750 Gm.**	128 gr.
Strychnine Sulphate	**0.175 Gm.**	2½ gr.
Compound Spirit of Orange	**10.000 cc.**	154 min.
Alcohol	**240.000 cc.**	7 fl. oz. 326 min.
Glycerin	**300.000 cc.**	9 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the quinine hydrochloride in the alcohol, add the compound spirit of orange, then the strychnine sulphate previously dissolved in 10 cc. [154 min.] of distilled water. Then add successively the glycerin, the tincture of ferric citrochloride, and sufficient distilled water to make the product measure 1000 cc. [2 pints]. Filter.

Preserve the Elixir in dark amber-colored bottles.

Note—An elixir containing these ingredients as phosphates was formerly official in the Pharmacopœia (see page 338), but because of its lack of stability and absence of therapeutic advantage, as compared with the more stable N. F. Elixir, it has been omitted.

If the solution of ferric chloride from which the tincture of ferric citrochloride is made, is not excessively acid and if the tincture has been allowed to stand a few weeks before filtering, this Elixir is permanent as to color and absence of precipitate.

Approximate alcohol content, by volume, 24 per cent.

Uses—A general tonic.

Average dose—1 fluidrachm (4 cc.).
One average dose contains about:
0.0007 Gm. or $\frac{1}{100}$ grain of Strychnine Sulphate.

ELIXIR GENTIANÆ. N.F. Elixir of Gentian

[Elix. Gent.]

	Metric	Alternative
Fluidextract of Gentian	**35 cc.**	1 fl. oz. 58 min.
Compound Spirit of Cardamom	**15 cc.**	230 min.
Sodium Citrate	**30 Gm.**	1 oz. av.
Glycerin	**50 cc.**	1 fl. oz. 288 min.
Syrup	**250 cc.**	8 fl. oz.
Alcohol	**150 cc.**	4 fl. oz. 384 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the sodium citrate in 350 cc. [11 fl. oz. 96 min.] of distilled water, add this solution to the alcohol with which the compound spirit of cardamom has been mixed, then add the fluidextract of gentian, the syrup, the glycerin, and sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

The presence of sodium citrate in this elixir permits the addition of ferric salts without the production of a black color. In former revisions this preparation was treated with ferric hydroxide to precipitate the tannin-like constituents of the gentian so that the elixir could be mixed with ferric salts, but this treatment was laborious and also removed much of the bitterness of the gentian.

Approximate alcohol content, by volume, 16 per cent.

N. F. Preparations—Elixir Gentianæ et Ferri; Elixir Gentianæ et Ferri Phosphatis.

Uses—A vehicle and bitter tonic adjuvant.

Average dose—1 fluidrachm (4 cc.).

ELIXIR GENTIANÆ ET FERRI. N.F. Elixir of Gentian and Iron

[Elix. Gent. et Ferr.—Elixir of Gentian with Tincture of Ferric Citrochloride]

	Metric	Alternative
Tincture of Ferric Citrochloride	**100 cc.**	3 fl. oz. 96 min.
Elixir of Gentian, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix and filter.

Preserve the Elixir in amber-colored bottles.
Approximate alcohol content, by volume, 16 per cent.

Uses—A bitter tonic.

Average dose—1 fluidrachm (4 cc.).

ELIXIR GENTIANÆ ET FERRI PHOSPHATIS. N.F. Elixir of Gentian and Ferric Phosphate

[Elix. Gent. et Ferr. Phos.—Elixir Gentianæ Ferratum]

	Metric	Alternative
Soluble Ferric Phosphate	**17.5 Gm.**	256 gr.
Distilled Water	**35.0 cc.**	1 fl. oz. 58 min.
Elixir of Gentian, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the soluble ferric phosphate in the distilled water with the aid of heat, and add sufficient elixir of gentian to make the product measure 1000 cc. [2 pints].

Preserve the Elixir in amber-colored bottles.
Approximate alcohol content, by volume, 15 per cent.

Uses—A bitter tonic and chalybeate.

Average dose—1 fluidrachm (4 cc.).

ELIXIR GENTIANÆ GLYCERINATUM. N.F. Glycerinated Elixir of Gentian

[Elix. Gentian. Glycerin.]

	Metric	Alternative
Fluidextract of Gentian	**10.0 cc.**	154 min.
Fluidextract of Taraxacum	**15.0 cc.**	230 min.
Compound Tincture of Cardamom	**60.0 cc.**	1 fl. oz. 442 min.
Syrup of Raspberry	**60.0 cc.**	1 fl. oz. 442 min.
Tincture of Sweet Orange Peel	**15.0 cc.**	230 min.
Phosphoric Acid	**5.0 cc.**	77 min.
Acetic Ether	**0.5 cc.**	8 min.
Glycerin	**400.0 cc.**	12 fl. oz. 384 min.
Sucrose	**200.0 Gm.**	6 oz. av. 296 gr.
Alcohol	**100.0 cc.**	3 fl. oz. 96 min.
Distilled Water, a sufficient quantity		
To make	**1000 cc.**	2 pints

Dissolve the sucrose in 250 cc. [8 fl. oz.] of distilled water, add the glycerin and the tincture of sweet orange peel previously dissolved in the alcohol. Then add the other ingredients and sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 14 per cent.

Uses—Said to be the original formula for the *Glycerin Tonic Compound* of Doctor Gray of Boston, which has been popularized as a tonic by advertising.

Average dose—2 fluidrachms (8 cc.).

ELIXIR GLYCEROPHOSPHATUM COMPOSITUM. N.F. Compound Elixir of Glycerophosphates

[Elix. Glycerophos. Co.—Compound Solution of Glycerophosphates]

	Metric	Alternative
Sodium Glycerophosphate	**35.000 Gm.**	1 oz. av. 74 gr.
Calcium Glycerophosphate	**16.000 Gm.**	234 gr.
Ferric Glycerophosphate	**3.000 Gm.**	44 gr.
Soluble Manganese Glycerophosphate	**2.000 Gm.**	29 gr.
Quinine Hydrochloride	**0.900 Gm.**	13 gr.
Strychnine Nitrate	**0.115 Gm.**	1⅞ gr.
Lactic Acid	**10.000 cc.**	154 min.
Compound Spirit of Cardamom	**2.000 cc.**	31 min.
Alcohol	**125.000 cc.**	4 fl. oz.
Glycerin	**350.000 cc.**	11 fl. oz. 96 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the calcium and sodium glycerophosphates and the quinine and strychnine salts in 400 cc. [12 fl. oz. 384 min.] of distilled water containing the lactic acid, and add the glycerin. Dissolve the ferric and manganese glycerophosphates in 50 cc. [1 fl. oz. 288 min.] of distilled water by aid of heat, and add to the first solution. Mix the compound spirit of cardamom and alcohol and add to the mixture, then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Preserve the Elixir in amber-colored bottles.

Approximate alcohol content, by volume, 11 per cent.

Uses—A general tonic.

Average dose—2 fluidrachms (8 cc.).
One average dose contains about:
0.0009 Gm. or 1/60 grain of Strychnine Nitrate.

ELIXIR GLYCYRRHIZÆ AQUOSUM. N.F. Aqueous Elixir of Glycyrrhiza

[Elix. Glycyrrh. Aq.—Aqueous Elixir of Licorice]

	Metric	Alternative
Fluidextract of Glycyrrhiza	150 cc.	4 fl. oz. 384 min.
Compound Spirit of Cardamom	5 cc.	77 min.
Orange Flower Water	200 cc.	6 fl. oz. 192 min.
Glycerin	150 cc.	4 fl. oz. 384 min.
Syrup	150 cc.	4 fl. oz. 384 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix and filter.

Approximate alcohol content, by volume, 3 per cent.

N. F. Preparation—Elixir Cascaræ Sagradæ.

Uses—A vehicle of low alcoholic strength (about 3 per cent).

Average dose—2 fluidrachms (8 cc.).

ELIXIR GUARANÆ. N.F. Elixir of Guarana

[Elix. Guar.]

	Metric	Alternative
Fluidextract of Guarana	200 cc.	6 fl. oz. 192 min.
Aromatic Elixir	200 cc.	6 fl. oz. 192 min.
Compound Elixir of Taraxacum, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix them and filter.

Approximate alcohol content, by volume, 32 per cent.

Uses—A nerve stimulant, used chiefly for headaches.

Average dose—1 fluidrachm (4 cc.).

ELIXIR GUARANÆ ET APII. N.F. Elixir of Guarana and Celery

[Elix. Guaran. et Apii]

	Metric	Alternative
Fluidextract of Guarana	150 cc.	4 fl. oz. 384 min.
Fluidextract of Celery Fruit	150 cc.	4 fl. oz. 384 min.
Fluidglycerate of Glycyrrhiza	30 cc.	461 min.
Glycerin	60 cc.	1 fl. oz. 442 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the fluidextracts, fluidglycerate and glycerin and add sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 35 per cent.

Uses—In headache.

Average dose—2 fluidrachms (8 cc.).

ELIXIR HELONIADIS COMPOSITUM. N.F. Compound Elixir of Helonias

[Elix. Heloniad. Co.]

	Metric	Alternative
Fluidextract of Helonias	32 cc.	1 fl. oz. 12 min.
Fluidextract of Caulophyllum	32 cc.	1 fl. oz. 12 min.
Fluidextract of Viburnum Opulus	32 cc.	1 fl. oz. 12 min.
Fluidextract of Mitchella	125 cc.	4 fl. oz.
Compound Spirit of Orange	10 cc.	154 min.
Alcohol	125 cc.	4 fl. oz.
Syrup	300 cc.	9 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the compound spirit of orange with the alcohol, add the syrup, then the fluidextracts. Then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 22 per cent.

Uses—In dysmenorrhea.

Average dose—1 fluidrachm (4 cc.).

ELIXIR HYDRANGEÆ ET LITHII, N. F. Elixir of Hydrangea and Lithium

[Elix. Hydrang. et Lith.]

	Metric	Alternative
Hydrangea, in moderately coarse powder	400 Gm.	13 oz. av. 154 gr.
Lithium Benzoate	26 Gm.	380 gr.
Lithium Salicylate	26 Gm.	380 gr.
Compound Spirit of Orange	4 cc.	61 min.
Sucrose	50 Gm.	1 oz. av. 293 gr.
Alcohol,		
Distilled Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the compound spirit of orange in 300 cc. [9 fl. oz. 288 min.] of alcohol and add 600 cc. [19 fl. oz. 96 min.] of distilled water. Moisten the hydrangea with 250 cc. [8 fl. oz.] of this menstruum, and allow it to stand well covered for six hours. Pack it in a percolator, saturate with the menstruum and allow to macerate for twenty-four hours. Then allow percolation to proceed slowly and collect 940 cc. [30 fl. oz.] of percolate, using as the second menstruum a mixture of one volume of alcohol and two volumes of water. Dissolve the sucrose and lithium salts in the percolate and add enough of the menstruum to make the product measure 1000 cc. [2 pints]. Mix well, and filter.

Approximate alcohol content, by volume, 25 per cent.

Uses—In rheumatism.

Average dose—1 fluidrachm (4 cc.).

ELIXIR HYDRASTIS COMPOSITUM. N.F. Compound Elixir of Hydrastis

[Elix. Hydrast. Co.—Alkaline Elixir]

	Metric	Alternative
Fluidextract of Hydrastis	17.50 cc.	269 min.
Fluidextract of Oat	17.50 cc.	269 min.
Fluidextract of Xanthoxylum	17.50 cc.	269 min.
Fluidextract of Gentian	8.75 cc.	134 min.
Fluidextract of Ginger	8.75 cc.	134 min.
Sodium Bicarbonate	8.75 Gm.	128 gr.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the sodium bicarbonate in 250 cc. [8 fl. oz.] of aromatic elixir, add the fluidextracts and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 23 per cent.

Uses—In indigestion.

Average dose—1 fluidrachm (4 cc.)

ELIXIR MANACÆ COMPOSITUM. N. F. Compound Elixir of Manaca

[Elix. Manac. Co.]

	Metric	Alternative
Fluidextract of Manaca	165.0 cc.	5 fl. oz. 134 min.
Sodium Salicylate	140.0 Gm.	4 oz. av. 295 gr.
Lithium Salicylate	17.5 Gm.	256 gr.
Potassium Bicarbonate	39.7 Gm.	1 oz. av. 142 gr.
Salicylic Acid	55.0 Gm.	1 oz. av. 366 gr.
Honey	125.0 cc.	4 fl. oz.
Spirit of Spearmint	15.0 cc.	230 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the fluidextract, spirit of spearmint and honey. Dissolve the salicylates and salicylic acid in 600 cc. [19 fl. oz. 96 min.] of aromatic elixir and add, gradually, the potassium bicarbonate. Then add this gradually with constant shaking, to the previous mixture, and add enough aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 20 per cent.

Uses—An antirheumatic.

Average dose—1 fluidrachm (4 cc.).

ELIXIR PEPSINI. N.F. Elixir of Pepsin

[Elix. Pepsin.]

	Metric	Alternative
Glycerite of Pepsin (see note below)	200 cc.	6 fl. oz. 192 min.
Glycerin	100 cc.	3 fl. oz. 96 min.
Diluted Hydrochloric Acid	4 cc.	61 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the glycerite of pepsin, glycerin and diluted hydrochloric acid with sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], avoiding strong agitation.

Note—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly when at or above normal room temperature. To insure the dispensing of this Elixir at standard strength it is strongly recommended that an excess of 25 to 50 per cent of glycerite of pepsin be used in preparing this Elixir to allow for such loss in activity, and that the Elixir be stored in a cool place.

Approximate alcohol content, by volume, 15 per cent.

Uses—A liquid form of pepsin. It is very doubtful how much of enzymic activity will survive the effect of the alcohol in the Elixir.

Average dose—2 fluidrachms (8 cc.).

ELIXIR PEPSINI, BISMUTHI ET STRYCHNINÆ. N.F. Elixir of Pepsin, Bismuth and Strychnine

[Elix. Pepsin. Bism. et Strych.]

	Metric	Alternative
Strychnine	0.175 Gm.	2½ gr.
Tartaric Acid	0.175 Gm.	2½ gr.
Elixir of Pepsin and Bismuth, a sufficient quantity,		
To make	1000 cc.	2 pints

Triturate the strychnine and tartaric acid with about 30 cc. [460 min.] of the elixir, until dissolved, then add sufficient of the elixir to make the product measure 1000 cc. [2 pints], and mix well.

Preserve the Elixir in a cool place.

Approximate alcohol content, by volume, 10 per cent.

Uses—Proposed for a tonic, but does not comply with modern therapeutic ideas.

Average dose—1 fluidrachm (4 cc.).

One average dose contains about:

0.0007 Gm. or $\frac{1}{100}$ grain of Strychnine.

ELIXIR PEPSINI COMPOSITUM. N.F. Compound Elixir of Pepsin

[Elix. Pepsin. Co.—Compound Digestive Elixir]

	Metric	Alternative
Pepsin (see note below)	17.5 Gm.	256 gr.
Lactic Acid	1.0 cc.	15 min.
Glycerin	250.0 cc.	8 fl. oz.
Alcohol	200.0 cc.	6 fl. oz. 192 min.
Oil of Orange	2.0 cc.	31 min.
Cudbear	1.0 Gm.	15 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the lactic acid with 500 cc. [1 pint] of cold water and dissolve the pepsin in this liquid with very gentle stirring; then add the glycerin. Macerate the cudbear in the alcohol for two hours, add the oil of orange and gradually add this liquid to the pepsin solution with gentle stirring. Add sufficient distilled water to make the product measure 1000 cc. [2 pints], allow to stand twenty-four hours with occasional gentle agitation, and filter.

Note—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly when at or above normal room temperature. To insure the dispensing of this Elixir at standard strength it is strongly recommended that the quantity of pepsin directed in the formula be increased to 25 Gm. [365 gr.] to allow for such loss in activity, and that the Elixir be stored in a cool place.

Approximate alcohol content, by volume, 18 per cent.

Uses—A vehicle for nauseating remedies.

Average dose—2 fluidrachms (8 cc.).

ELIXIR PEPSINI ET BISMUTHI. N. F. Elixir of Pepsin and Bismuth

[Elix. Pepsin. et Bism.]

	Metric	Alternative
Pepsin (see note below)	8.75 Gm.	128 gr.
Glycerite of Bismuth	125.00 cc.	4 fl. oz.
Glycerin	125.00 cc.	4 fl. oz.
Distilled Water	250.00 cc.	8 fl. oz.
Caramel	0.50 cc.	8 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the pepsin in the cold distilled water by very gentle stirring, add the glycerin and glycerite of bismuth, then 490 cc. [15 fl. oz. 326 min.] of aromatic elixir. If the mixture is strongly acid, nearly neutralize it with solution of sodium hydroxide but do not make even faintly alkaline. Lastly add the caramel and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints].

NOTE—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly when at or above normal room temperature. To insure the dispensing of this Elixir at standard strength it is strongly recommended that the quantity of pepsin directed in the formula be increased to 12 Gm. [175 gr.] to allow for such loss in activity, and that the Elixir be stored in a cool place.

Approximate alcohol content, by volume, 10 per cent.

N. F. Preparation—Elixir Pepsini, Bixmuthi et Strychninæ.

Uses—Another irrational combination frequently prescribed by physicians.

Average dose—2 fluidrachms (8 cc.).

ELIXIR PEPSINI ET RENNINI COMPOSITUM. N. F. Compound Elixir of Pepsin and Rennin

[Elix. Pepsin. et Rennin. Co.—ESSENCE OF PEPSIN]

	Metric	Alternative
Pepsin (see note below)	22.5 Gm.	328 gr.
Rennin	17.5 Gm.	256 gr.
Lactic Acid	2.0 cc.	31 min.
Glycerin	150.0 cc.	4 fl. oz. 384 min.
Alcohol	165.0 cc.	5 fl. oz. 134 min.
Tincture of Sweet Orange Peel	50.0 cc.	1 fl. oz. 288 min.
Oil of Myristica	0.1 cc.	1½ min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the lactic acid with 300 cc. [9 fl. oz. 288 min.] of cold distilled water and dissolve the pepsin and rennin in this liquid by very gentle stirring, then add the glycerin. Dissolve the tincture of sweet orange peel and oil of myristica in the alcohol and gradually add to the aqueous solution with gentle stirring. Then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and mix thoroughly. Finally filter.

NOTE—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly when at or above normal room temperature. To insure the dispensing of this Elixir at standard strength it is strongly recommended that the quantity of pepsin directed in the formula be increased to 34 Gm. [1 oz. av. 59 gr.] to allow for such loss in activity, and that the Elixir be stored in a cool place.

Approximate alcohol content, by volume, 19 per cent.

Uses—Chiefly as a vehicle for nauseating drugs.

Average dose—2 fluidrachms (8 cc.).

ELIXIR PHOSPHORI. N. F. Elixir of Phosphorus

[Elix. Phosphor.]

	Metric	Alternative
Phosphorus	0.25 Gm.	4 gr.
Chloroform	5.00 cc.	77 min.
Alcohol	340.00 cc.	10 fl. oz. 422 min.
Glycerin	300.00 cc.	9 fl. oz. 288 min.
Compound Spirit of Orange	10.00 cc.	154 min.
Oil of Anise	2.00 cc.	31 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Weigh the phosphorus in a tared watch-crystal containing water, dry it carefully and quickly with blotting paper, and introduce it into a strong flask or bottle of 100 cc. [3 fl. oz.] capacity containing the chloroform. Stopper the container, warm it on a water bath until the phosphorus melts into a globule and agitate it gently, repeating the operation if necessary, until the phosphorus is all dissolved. Add the chloroform solution to the alcohol, which has been warmed to from 55° to 60° C., in a flask graduated to 1000 cc. [2 pints], shake it thoroughly, add the oil of anise, the compound spirit of orange and the glycerin in divided portions, shaking the mixture after each addition, then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 31 per cent.

N. F. Preparation—Elixir Phosphori et Nucis Vomicæ.

Uses—To overcome nervous exhaustion and stimulate bone development. An excellent form for the administration of phosphorus.

Average dose—1 fluidrachm (4 cc.).

ELIXIR PHOSPHORI ET NUCIS VOMICÆ. N. F. Elixir of Phosphorus and Nux Vomica

[Elix. Phosphor. et Nuc. Vom.]

	Metric	Alternative
Tincture of Nux Vomica	**35 cc.**	1 fl. oz. 58 min.
Elixir of Phosphorus, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix them.

Approximate alcohol content, by volume, 31 per cent.

Uses—Same as Elixir of Phosphorus.

Average dose—1 fluidrachm (4 cc.).

ELIXIR POTASSII BROMIDI. N. F. Elixir of Potassium Bromide

[Elix. Pot. Brom.]

	Metric	Alternative
Potassium Bromide	**175 Gm.**	5 oz. av. 368 gr.
Syrup	**200 cc.**	6 fl. oz. 192 min.
Distilled Water	**460 cc.**	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the potassium bromide in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

NOTE—If a colored elixir is preferred add 15 cc. [230 min.] of compound tincture of cudbear in place of the same quantity of aromatic elixir.

Approximate alcohol content, by volume, 6 per cent.

Uses—A nerve sedative; it contains 10 grains of bromide in each fluidrachm.

Average dose—2 fluidrachms (8 cc.).

ELIXIR SABAL ET SANTALI COMPOSITUM. N. F. Compound Elixir of Sabal and Sandalwood

[Elix. Sabal et Santal. Co.—COMPOUND ELIXIR OF SAW PALMETTO AND SANDALWOOD]

	Metric	Alternative
Sabal, in moderately coarse powder	**260 Gm.**	8 oz. av. 297 gr.
Triticum, in moderately coarse powder	**260 Gm.**	8 oz. av. 297 gr.
Fluidextract of Zea	**260 cc.**	8 fl. oz. 154 min.
Fluidextract of Sandalwood	**65 cc.**	2 fl. oz. 38 min.
Compound Spirit of Orange	**5 cc.**	77 min.
Glycerin	**150 cc.**	4 fl. oz. 384 min.
Alcohol,		
Distilled Water, each, a sufficient quantity,		
To make about	**1000 cc.**	2 pints

Mix 265 cc. [8 fl. oz. 230 min.] of alcohol with 360 cc. [11 fl. oz. 250 min.] of distilled water. Mix the powdered drugs, add the fluidextracts and the compound spirit of orange and enough of the alcohol-water mixture to thoroughly moisten the powder and maintain it in a damp condition for six hours. Pack it in a cylindrical percolator, saturate with the menstruum and macerate for twenty-four hours. Then allow the percolation to proceed slowly adding more menstruum, consisting of a mixture of three volumes of alcohol and four volumes of water, as needed, and collect 850 cc. [27 fl. oz. 96 min.] of percolate. To this add the glycerin and mix well.

Approximate alcohol content, by volume, 30 per cent.

Uses—A urinary antiseptic.

Average dose—1 fluidrachm (4 cc.).

ELIXIR SODII BROMIDI. N.F. Elixir of Sodium Bromide

[Elix. Sod. Brom.]

	Metric	Alternative
Sodium Bromide	175 Gm.	5 oz. av. 368 gr.
Syrup	200 cc.	6 fl. oz. 192 min.
Distilled Water	460 cc.	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the sodium bromide in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 6 per cent.

Uses—A nerve sedative; it contains 10 grains of bromide in each fluidrachm.

Average dose—2 fluidrachms (8 cc.).

ELIXIR SODII SALICYLATIS. N.F. Elixir of Sodium Salicylate

[Elix. Sod. Salicyl.]

	Metric	Alternative
Sodium Salicylate	85 Gm.	2 oz. av. 366 gr.
Syrup	200 cc.	6 fl. oz. 192 min.
Distilled Water	460 cc.	14 fl. oz. 346 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the sodium salicylate in the distilled water, add the syrup and sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 6 per cent.

Uses—In rheumatism.

Average dose—1 fluidrachm (4 cc.).

ELIXIR SODII SALICYLATIS COMPOSITUM. N.F. Compound Elixir of Sodium Salicylate

[Elix. Sod. Salicyl. Co.]

	Metric	Alternative
Sodium Salicylate	80 Gm.	2 oz. av. 293 gr.
Fluidextract of Cimicifuga	32 cc.	1 fl. oz. 12 min.
Fluidextract of Gelsemium	16 cc.	246 min.
Potassium Iodide	15 Gm.	219 gr.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the sodium salicylate and potassium iodide in 800 cc. [25 fl. oz. 288 min.] of aromatic elixir, add the fluidextracts and then sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Preserve the Elixir in dark amber-colored bottles.

Approximate alcohol content, by volume, 22 per cent.

Uses—In chronic forms of rheumatism.

Average dose—1 fluidrachm (4 cc.).

ELIXIR TARAXACI COMPOSITUM. N. F. Compound Elixir of Taraxacum

[Elix. Tarax. Co.]

	Metric	Alternative
Fluidextract of Taraxacum	35 cc.	1 fl. oz. 58 min.
Fluidextract of Wild Cherry	20 cc.	307 min.
Fluidextract of Glycyrrhiza	60 cc.	1 fl. oz. 442 min.
Tincture of Sweet Orange Peel	60 cc.	1 fl. oz. 442 min.
Tincture of Cinnamon	30 cc.	461 min.
Compound Tincture of Cardamom	30 cc.	461 min.
Aromatic Elixir, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the fluidextracts, add the tinctures and then sufficient aromatic elixir to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 27 per cent.

N. F. Preparations—Elixir Eriodictyi Aromaticum; Elixir Guaranæ; Elixir Viburni Opuli Compositum.

Uses—A vehicle, especially useful for disguising bitter substances.

Average dose—2 fluidrachms (8 cc.).

ELIXIR TERPINI HYDRATIS. N. F. Elixir of Terpin Hydrate

[Elix. Terpin. Hyd.]

	Metric	Alternative
Terpin Hydrate	17.5 Gm.	256 gr.
Tincture of Sweet Orange Peel	20.0 cc.	307 min.
Spirit of Bitter Almond	5.0 cc.	77 min.
Alcohol	425.0 cc.	13 fl. oz. 288 min.
Glycerin	400.0 cc.	12 fl. oz. 384 min.
Syrup	100.0 cc.	3 fl. oz. 96 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the terpin hydrate in the alcohol, add successively the tincture, spirit, glycerin, syrup and sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 40 per cent.

The high alcoholic content in this elixir is required for the solution of the terpin hydrate.

N. F. Preparation—Elixir Terpini Hydratis et Codeinæ.

Uses—A stimulant for secretions in bronchitis.

Average dose—1 fluidrachm (4 cc.).

ELIXIR TERPINI HYDRATIS ET CODEINÆ. N. F. Elixir of Terpin Hydrate and Codeine

[Elix. Terpin. Hyd. et Codein.—Elixir Terpini Hydratis cum Codeinæ]

	Metric	Alternative
Codeine	2 Gm.	29 gr.
Elixir of Terpin Hydrate, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the codeine in sufficient of the elixir to measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 40 per cent.

Uses—An expectorant, and to allay excessive cough.

Average dose—1 fluidrachm (4 cc.).
One average dose contains about:
0.008 Gm. or ⅛ grain of Codeine.

ELIXIR TERPINI HYDRATIS ET CREOSOTI COMPOSITUM. N.F. Compound Elixir of Terpin Hydrate and Creosote

[Elix. Terpin. Hyd. et Creosot. Co.]

	Metric	Alternative
Terpin Hydrate	4.4 Gm.	64 gr.
Creosote	4.4 cc.	68 min.
Calcium Glycerophoshate	8.75 Gm.	129 gr.
Sodium Glycerophosphate	8.75 Gm.	129 gr.
Chloroform	2.2 cc.	34 min.
Lactic Acid	6.0 cc.	92 min.
Glycerin	320.0 cc.	10 fl. oz. 115 min.
Alcohol	200.0 cc.	6 fl. oz. 192 min.
Gluside	0.2 Gm.	3 gr.
Acetic Ether	2.0 cc.	31 min.
Compound Spirit of Orange	10.0 cc.	154 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the terpin hydrate, creosote, gluside, chloroform, acetic ether and compound spirit of orange in the alcohol, add the glycerin and mix well. Dissolve the calcium and sodium glycerophosphates and lactic acid in 100 cc. [3 fl. oz. 96 min.] of distilled water, and add 300 cc. [9 fl. oz. 288 min.] of distilled water to this solution. Gradually add the aqueous solution to the first solution, with constant stirring, then add sufficient distilled water to make the product measure 1000 cc. [2 pints]. Filter if necessary.

Approximate alcohol content, by volume, 18 per cent.

Uses—In chronic bronchitis.

Average dose—1 fluidrachm (4 cc.).

ELIXIR TONGÆ ET SALICYLATUM. N.F. Elixir of Tonga and Salicylates

[Elix. Tong. et Salicyl.]

	Metric	Alternative
Tonga, in moderately coarse powder	140.00 Gm.	4 oz. av. 295 gr.
Cimicifuga, in moderately coarse powder	35.00 Gm.	1 oz. av. 74 gr.
Sodium Salicylate	70.00 Gm.	2 oz. av. 147 gr.
Pilocarpine Nitrate	0.175 Gm.	2½ gr.
Colchicine	0.035 Gm.	½ gr.
Compound Spirit of Orange	12.00 cc.	184 min.
Sucrose	325.00 Gm.	10 oz. av. 371 gr.
Glycerin	60.00 cc.	1 fl. oz. 442 min.
Alcohol,		
Distilled Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints.

Mix the powdered drugs with the compound spirit of orange; moisten the mixture with a menstruum composed of two volumes of alcohol and five volumes of water, pack it in a percolator, saturate it with the above menstruum, and macerate twenty-four hours. Then percolate slowly until 700 cc. [22 fl. oz. 192 min.] of percolate are obtained. In this dissolve the sodium salicylate, pilocarpine nitrate, colchicine and sucrose, and add the glycerin. Finally add enough menstruum to make the product measure 1000 cc. [2 pints], and mix well.

Approximate alcohol content, by volume, 16 per cent.

Uses—In neuralgia and as an antirheumatic.

Average dose—1 fluidrachm (4 cc.).

ELIXIR VANILLINI COMPOSITUM. N.F. Compound Elixir of Vanillin

[Elix. Vanillin. Co.]

	Metric	Alternative
Compound Spirit of Vanillin	20 cc.	307 min.
Alcohol	80 cc.	2 fl. oz. 269 min.
Glycerin	25 cc.	384 min.
Syrup	300 cc.	9 fl. oz. 288 min.
Caramel	2 cc.	31 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the compound spirit of vanillin with the alcohol, add the glycerin, the syrup and 570 cc. [18 fl. oz. 115 min.] of distilled water, in several portions, shaking the mixture thoroughly after each addition. Then add the caramel and sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 8 per cent.

Uses—A pleasantly flavored vehicle of low alcoholic content.

ELIXIR VIBURNI OPULI COMPOSITUM. N. F. Compound Elixir of Viburnum Opulus

[Elix. Viburn. Opul. Co.]

	Metric	Alternative
Fluidextract of Viburnum Opulus	**75 cc.**	2 fl. oz. 192 min.
Fluidextract of Trillium	**150 cc.**	4 fl. oz. 384 min.
Fluidextract of Aletris	**75 cc.**	2 fl. oz. 192 min.
Compound Elixir of Taraxacum, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the fluidextracts with the elixir and filter.

Approximate alcohol content, by volume, 33 per cent.

Uses—Employed in dysmenorrhea, but of doubtful value.

Average dose—1 fluidrachm (4 cc.).

ELIXIR VIBURNI PRUNIFOLII. N. F. Elixir of Viburnum Prunifolium

[Elix. Viburn. Prun.—ELIXIR OF BLACK HAW]

	Metric	Alternative
Fluidextract of Viburnum Prunifolium	**125 cc.**	4 fl. oz.
Compound Tincture of Cardamom	**75 cc.**	2 fl. oz. 192 min.
Aromatic Elixir, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix them.

Approximate alcohol content, by volume, 27 per cent.

Uses—Employed in dysmenorrhea, but of doubtful value.

Average dose—1 fluidrachm (4 cc.).

Table of Some Unofficial Elixirs

Title	*Directions*
Elixir Calcii Bromidi (N. F. IV)	Dissolve 8.5 Gm. of calcium bromide in 46 cc. of distilled water to which has been added 0.4 cc. of diluted hydrobromic acid. Add 20 cc. of syrup and enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)
Calcii Hypophosphitis (N. F. IV)	Dissolve 3.5 Gm. of calcium hypophosphite in 75 cc. of aromatic elixir, to which has been added 0.4 cc. of hypophosphorous acid, and add enough aromatic elixir to make 100 cc. Dose: two fluidrachms (8 cc.)
Cinchonæ Alkaloidorum et Hypophosphitum (N. F. IV)	Dissolve 1.75 Gm. of calcium hypophosphite, 1.75 Gm. of sodium hypophosphite in 12.5 cc. of distilled water and 0.8 cc. of hypophosphorous acid and add enough elixir of cinchona alkaloids to make 100 cc. Filter Dose: two fluidrachms (8 cc.)
Cinchonæ Alkaloidorum Ferri et Calcii Lactophosphatis (N. F. IV)	Dissolve 3 Gm. of potassium citrate in 45 cc. of elixir of cinchona alkaloids and iron, add 50 cc. of syrup of calcium lactophosphate and enough elixir of cinchona alkaloids and iron to make 100 cc. Dose: two fluidrachms (8 cc.)
Cinchonæ Alkaloidorum Ferri et Pepsini (N. F. IV)	Mix 20 cc. of glycerite of pepsin with enough elixir of cinchona alkaloids and iron to make 100 cc. Filter Dose: two fluidrachms (8 cc.)
Ferri Hypophosphitis (N. F. IV)	Dissolve 1.65 Gm. of ferric hypophosphite and 2.15 Gm. of potassium citrate in 3.5 cc. of distilled water, with the aid of heat, and then add enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)
Ferri Lactatis (N. F. IV)	Dissolve 1.75 Gm. of ferrous lactate and 5.25 Gm. of potassium citrate in 12 cc. of distilled water, with the aid of heat, and then add enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)
Ferri Phosphatis (N. F. IV)	Dissolve 3.5 Gm. of ferric phosphate in 6 cc. of distilled water, with the aid of heat, and then add enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)

Table of Some Unofficial Elixirs—*Continued*

Title	*Directions*
Elixir Ferri Pyrophosphatis (N. F. IV)	Dissolve 3.5 Gm. of ferric pyrophosphate in 6 cc. of distilled water with the aid of heat and add enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)
Ferri, Quininæ et Strychninæ Phosphatum (U. S. P. VIII)	Dissolve 0.875 Gm. of quinine and 0.027 Gm. of strychnine in 6 cc. of alcohol, add 0.2 cc. of phosphoric acid and 35 cc. of aromatic elixir. Dissolve 0.9 Gm. of ammonium carbonate in 2.865 Gm. of acetic acid, neutralize with ammonia water, and add enough water to make 5 cc. Mix the two solutions just prepared and add enough aromatic elixir to make 85 cc. Dissolve 1.75 Gm. of soluble ferric phosphate in 3 cc. of water with a gentle heat, neutralize to litmus with ammonia water and add enough aromatic elixir to make 15 cc. Finally mix the two solutions and filter Dose: one fluidrachm (4 cc.)
Formatum (N. F. IV)	Dissolve 4.1 Gm. of potassium carbonate and 3.6 Gm. of monohydrated sodium carbonate in 22.5 cc. of formic acid and add enough aromatic elixir to make 100 cc. Dose: two fluidrachms (8 cc.)
Formatum Compositum (N. F. IV)	Dissolve 2.3 Gm. of monohydrated sodium carbonate, 2.0 Gm. of magnesium carbonate, 2.5 Gm. of strontium carbonate, 0.8 Gm. of lithium carbonate and then 0.77 Gm. of quinine in 20 cc. of formic acid mixed with 30 cc. of distilled water. Add a mixture of 30 cc. of glycerin, 10 cc. of alcohol, 0.5 cc. of compound spirit of cardamom, and 0.2 cc. of acetic ether. Mix thoroughly, add enough water to make 100 cc. Incorporate 4 Gm. of purified talc and filter Dose: two fluidrachms (8 cc.)
Glycyrrhizæ Aromaticum (N. F. IV)	Triturate 0.075 cc. of oil of clove, 0.075 cc. of oil of cinnamon and 0.05 cc. of oil of myristica with 4 Gm. of purified talc, gradually add 12.5 cc. of fluidextract of glycyrrhiza and enough distilled water to make 100 cc. Filter after standing twelve hours Dose: two fluidrachms (8 cc.)
Humuli (N. F. IV)	Incorporate 12.5 cc. of fluidextract of hops with 4 Gm. of purified talc, then gradually add 12.5 cc. of compound elixir or taraxacum, 3 cc. of tincture of vanilla and enough aromatic elixir to make 100 cc. Filter after standing twelve hours Dose: two fluidrachms (8 cc.)
Hypophosphitum (N. F. IV)	Dissolve 5.25 Gm. of calcium hypophosphite and 1.75 Gm. of sodium hypophosphite and 1.75 Gm. of potassium hypophosphite in a mixture of 0.4 cc. of hypophosphorous acid and 42 cc. of distilled water, then add 3 cc. of glycerin, 0.06 cc. of compound spirit of cardamom and enough aromatic elixir to make 100 cc. Dose: two fluidrachms (8 cc.)
Hypophosphitum et Ferri (N. F. IV)	Dissolve 0.875 Gm. of ferric hypophosphite and 1.1 Gm. of potassium citrate in 5 cc. of warm distilled water and add 25 cc. of syrup. Dissolve 1.75 Gm. of calcium hypophosphite, 1.75 Gm. of sodium hypophosphite and 0.875 Gm. of potassium hypophosphite in 20 cc. of distilled water and mix the two solutions. Finally add 0.4 cc. of hypophosphorous acid and enough aromatic elixir to make 100 cc. and filter Dose: two fluidrachms (8 cc.)
Lithii Bromidi (N. F. IV)	Dissolve 8.5 Gm. of lithium bromide in 46 cc. of distilled water, add 20 cc. of syrup and enough aromatic elixir to make 100 cc., and filter Dose: two fluidrachms (8 cc.)
Lithii Citratis (N. F. IV)	Dissolve 8.5 Gm. of lithium citrate in enough aromatic elixir to make 100 cc., and filter Dose: two fluidrachms (8 cc.)
Lithii Salicylatis (N. F. IV)	Dissolve 8.5 Gm. of lithium salicylate in enough aromatic elixir to make 100 cc., and filter Dose: two fluidrachms (8 cc.)
Pepsini et Ferri (N. F. IV)	Mix 7.5 cc. of tincture of ferric citrochloride with enough elixir of pepsin to make 100 cc., and filter Dose: two fluidrachms (8 cc.)
Potassii Acetatis (N. F. IV)	Dissolve 8.5 Gm. of potassium acetate in enough aromatic elixir to make 100 cc., and filter Dose: four fluidrachms (15 cc.)
Potassii Acetatis et Juniperi (N. F. IV)	Mix 12.5 cc. of fluidextract of juniper with 75 cc. of aromatic elixir in which 8.5 Gm. of potassium acetate has been dissolved and then add enough aromatic elixir to make 100 cc. Incorporate 4 Gm. of purified talc and filter after standing twelve hours Dose: four fluidrachms (15 cc.)
Quininæ Valeratis et Strychninæ (N. F. IV)	Dissolve 0.0175 Gm. of strychnine sulphate in 0.5 cc. of distilled water; add to 80 cc. of aromatic elixir and dissolve 1.75 Gm. of quinine valerate in the liquid. Then add 1.5 cc. of compound tincture of cudbear and enough aromatic elixir to make 100 cc., and filter Dose: one fluidrachm (4 cc.)
Rubi Compositum (N. F. IV)	Percolate 16 Gm. rubus, 16 Gm. nutgall, 16 Gm. saigon cinnamon, 4 Gm. clove, 2 Gm. mace and 2 Gm. of ginger with diluted alcohol, until the percolate measures 250 cc. Add 750 cc. of syrup of blackberry fruit to the percolate and filter after standing several days Dose: four fluidrachms (15 cc.)
Sodii Hypophosphitis (N. F. IV)	Dissolve 3.5 Gm. of sodium hypophosphite in 82 cc. of aromatic elixir, add 0.4 cc. of hypophosphorous acid and enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)
Sodii Salicylatis Compositum (N. F. IV)	Dissolve 8 Gm. of sodium salicylate and 1.5 Gm. of potassium iodide in 80 cc. of aromatic elixir, add 3.2 cc. of fluidextract of cimicifuga, 1.6 cc. of fluidextract of gelsemium, and enough aromatic elixir to make 100 cc. Incorporate 4 Gm. of purified talc and filter Dose: one fluidrachm (4 cc.)
Strychninæ Valeratis (N. F. IV)	Dissolve 0.0175 Gm. of strychnine valerate in 0.5 cc. of distilled water, with the aid of heat; add 90 cc. of aromatic elixir, then 1.5 cc. tincture of vanilla, 1.5 cc. of compound tincture of cudbear and enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)

Table of Some Unofficial Elixirs—*Continued*

Title	*Directions*
Elixir Terpini Hydratis et Diacetylmorphinæ (N. F. IV)	Dissolve 0.027 Gm. of diacetylmorphine hydrochloride and enough elixir of terpin hydrate to make 100 cc., and filter Dose: one fluidrachm (4 cc.)
Zinci Valeratis (N. F. IV)	Neutralize 5.6 Gm. citric acid with stronger ammonia water and add enough distilled water to make 10 cc. Add 25 cc. of aromatic elixir and 12.5 cc. of alcohol and dissolve 1.75 Gm. of zinc valerate in the mixture. Add 1 cc. of spirit of bitter almond, 15 cc. of compound tincture of cudbear and enough aromatic elixir to make 100 cc. Filter Dose: one fluidrachm (4 cc.)

Cordialia—*Cordials*

Cordials as a class are closely related to the elixirs, being pleasantly flavored preparations intended for internal administration. There is no longer a representative of this class official. The N. F. IV recognized one formula, that for Blackberry Cordial which has been employed for diarrhea, but which may no longer be dispensed, under the Volstead Act, except upon physicians' prescriptions.

Lavationes—*Washes*

A class of preparations under this title were introduced into the N. F. V. As represented officially they include chiefly mouth or nasal washes. The Antiseptic Solution and Alkaline Aromatic Solution of the N. F. have also been included here as they belong to this class.

LAVATIO ORI. N. F. Mouth Wash

[Lavat. Ori]

	Metric	Alternative
Soap, dried and granulated	**60.00 Gm.**	2 oz. av.
Gluside	**2.00 Gm.**	29 gr.
Fuchsin, basic	**0.02 Gm.**	⅓ gr.
Oil of Cinnamon	**5.00 cc.**	77 min.
Oil of Peppermint	**5.00 cc.**	77 min.
Oil of Clove	**10.00 cc.**	154 min.
Alcohol	**750.00 cc.**	24 fl. oz.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the soap and fuchsin in the alcohol by aid of a gentle heat, add the gluside and oils, and then sufficient water to make the product measure 1000 cc. [2 pints].

Allow it to stand in a cool place during twenty-four hours, then filter.

Approximate alcohol content, by volume, 69 per cent.

Uses—A few drops to be used on a moistened tooth brush. It corresponds closely to the commercial liquid dentifrices.

LIQUOR ANTISEPTICUS. N. F. Antiseptic Solution

Replacing N. F. IV

[Liq. Antisept.]

	Metric	Alternative
Boric Acid	**25.0 Gm.**	365 gr.
Thymol	**1.0 Gm.**	15 gr.
Eucalyptol	**5.0 cc.**	77 min.
Methyl Salicylate	**1.2 cc.**	18.5 min.
Oil of Thyme	**0.3 cc.**	4.5 min.
Menthol	**1.0 Gm.**	15 gr.
Alcohol	**300.0 cc.**	9 fl. oz. 288 min.
Purified Talc	**20.0 Gm.**	292 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the boric acid in 600 cc. [19 fl. oz. 96 min.] of water and the other ingredients in 200 cc. [6 fl. oz. 192 min.] of alcohol. Pour the aqueous solution into the alcoholic solution, add the talc and allow the mixture to stand, with occasional agitation, during forty-eight hours. Then filter, returning the first portions of the filtrate until it passes through clear. Add 100 cc. [3 fl. oz. 96 min.] of alcohol to the filtrate and then sufficient water to make the product measure 1000 cc. [2 pints].

NOTE—The final addition of alcohol is for the purpose of increasing the alcoholic per cent of the finished product. The filtrate, before this addition, is saturated, and if the alcoholic per cent were not increased, the solution, if cooled below the temperature at which it was filtered, would precipitate or become cloudy, chiefly due to the separation of thymol.

Description and Physical Properties—Antiseptic solution is a clear, colorless liquid, having a characteristic taste and an aromatic odor. It is acid to litmus.

Specific gravity: about 0.976 at 25° C.

Tests for Identity and Purity—Evaporate 10 cc. of the solution at a temperature not exceeding 100° C.: it leaves not more than 0.184 Gm. of a white crystalline residue.

Incinerate the residue from 10 cc. of the solution; it leaves not more than 0.42 Gm. of ash.

Ten cc. of alcohol added to the residue and ignited, exhibits a flame enveloped with a green mantle.

Approximate alcohol content, by volume, 28 per cent.

Uses—This is used chiefly as a mouth wash and for halitosis.

Average dose—1 fluidrachm (4 cc.).

LIQUOR AROMATICUS ALKALINUS. N. F. Alkaline Aromatic Solution

[**Liq. Aromat. Alk.**—LIQUOR ANTISEPTICUS ALKALINUS N. F. IV, ALKALINE ANTISEPTIC SOLUTION]

	Metric	Alternative
Potassium Bicarbonate	**20.0 Gm.**	292 gr.
Sodium Borate	**20.0 Gm.**	292 gr.
Thymol	**0.5 Gm.**	7 gr.
Eucalyptol	**1.0 cc.**	15 min.
Methyl Salicylate	**0.5 cc.**	8 min.
Cudbear	**2.0 Gm.**	29 gr.
Alcohol	**50.0 cc.**	1 fl. oz. 288 min.
Glycerin	**100.0 cc.**	3 fl. oz. 96 min.
Magnesium Carbonate	**10.0 Gm.**	146 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the potassium bicarbonate and sodium borate with 100 cc. [3 fl. oz. 96 min.] of water, add the glycerin, and when the effervescence has ceased add the mixture to 500 cc. [1 pint] of water. Dissolve the thymol, eucalyptol, and methyl salicylate in the alcohol, add the solution of the salts, the cudbear, and sufficient water to make the product measure 1000 cc. [2 pints]. Incorporate the magnesium carbonate and allow the mixture to stand with occasional shaking during three days. Then filter the solution, returning the first portions until the filtrate passes through clear.

Description and Physical Properties—Alkaline Aromatic Solution is a clear bright red liquid, with an aromatic odor and taste. It is alkaline to litmus.

Specific gravity: about 1.0519 at 25° C.

Tests for Identity and Purity—Evaporate 10 cc. of the solution at a temperature not exceeding 100° C.; it leaves a viscous residue, not exceeding 1.82 Gm.

Incinerate the residue from 10 cc. of the solution; it leaves not more than 0.179 Gm. of ash.

Barium chloride T.S. produces a white precipitate soluble in acids.

Approximate alcohol content, by volume, 4 per cent.

Uses—The name of this solution has been changed. It was formerly known as Alkaline Antiseptic Solution but this was inappropriate. Its chief value lies in the fact that it is approximately isotonic with the body fluids and is therefore not irritant to mucous membranes. The Alkaline Aromatic Solution is extensively used as a nasal douche and throat gargle.

In addition to the official preparations mentioned above there are a number of unofficial groups, employed in medicine, as special washes. These are briefly listed on the following page:

Title	*Directions*
Balneum Bath	The British Pharmaceutical Codex (B. P. C.) offers suggestions for a number of baths. About 30 gallons of liquid is required. A *cold bath* is to begin at 35° C. and be lowered to 15° C. by the addition of ice; a *tepid bath* is to be from 30° to 35° C.; a *hot bath* from 37° to 43° C.; a *mustard bath* is to contain 12 ozs. of mustard to 30 gallons; a *salt bath* is to contain 12 ozs. of sea salt to 30 gallons; a *sulphur bath* is to be made from 5 ozs. of sodium sulphate and 5 ozs. of sodium thiosulphate in 30 gallons of water. Other formulas are also given
Collunarium A nasal wash	The official alkaline aromatic solution, properly diluted, and Dobell's solution are typical representatives of this class
Collutorium A mouth wash	Antiseptic solution and alkaline aromatic solution, when properly diluted, are typical preparations. *Hydrogen dioxide* and *formaldehyde mouth washes* are English preparations
Collyrium An eye wash	In the B. P. C. are found formulas for a number of eye washes including *boric acid eye wash* (2 per cent); *boric acid* (1 per cent) and *zinc sulphate* (0.1 per cent) *eye wash*; *borax eye wash* (2 per cent); *zinc sulphate eye wash* (0.2 per cent) and many others
Enemata Enema	Rectal injections employed to evacuate the bowel, or to influence the general system by absorption or to effect locally the seat of disease. They are usually given at body temperature in quantities of from 1 to 2 pints injected slowly with a syringe. Enemas to be retained in the intestine should not be used in larger quantities than 5 fl. oz. for an adult. The B. P. C. gives a number of formulas including *magnesium sulphate enema* (½ to 2 ozs. to the pint); *compound peptone enema* (beef peptone and extract of malt, each 12.5 Gm., brandy 25 cc., beef tea to make 100 cc.). Many other formulas are given in the Codex
Guttæ Eye drops	These are made by dissolving the medicament in freshly sterilized and cooled distilled water. In the B. P. C. will be found many formulas including *silver nitrate eye drops* (0.5 per cent); *atropine eye drops* (1 per cent atropine sulphate); *cocaine eye drops* (2 per cent); *copper sulphate eye drops* (0.5 per cent; *homatropine eye drops* (1 per cent homatropine hydrobromide); *physostigmine eye drops* (1 per cent physostigmine sulphate), and others
Irrigatio An irrigation	A preparation to be applied continuously by means of a special device for the purpose as in the treatment of wounds with Dakin's solution

Dentilinimenta—*Dental Liniments*

This is a new class of preparations in the N. F. V. As the ingredients were the same as those already used in well-known liniments, but in a much higher proportion, it was considered necessary to give them a distinctive title, hence "Dentilinimentum". These are very poisonous liniments and should only be used under the direction of a dentist.

DENTILINIMENTUM ACONITI COMPOSITUM. N. F. Compound Dental Liniment of Aconite

[Dentilin. Aconit. Co.]

	Metric	Alternative
Menthol	**36.0 Gm.**	1 oz. av. 219 gr.
Chloroform	**13.5 cc.**	259 min.
Tincture of Aconite, a sufficient quantity, To make	**100 cc.**	4 fl. oz.

Dissolve the menthol in the chloroform and add sufficient tincture of aconite to make the product measure 100 cc. [4 fl. oz.]. Preserve the Liniment in tightly stoppered, amber-colored bottles.

Approximate alcohol content, by volume, 45 per cent.

Uses—For dental treatment.

DENTILINIMENTUM ACONITI ET IODI COMPOSITUM. N. F. Compound Dental Liniment of Aconite and Iodine

[Dentilin. Aconit. et Iod. Co.—Refrigerant Counterirritant]

	Metric	Alternative
Menthol	**2.2 Gm.**	40 gr.
Iodine	**2.2 Gm.**	40 gr.
Chloroform	**16.5 cc.**	317 min.
Tincture of Aconite, a sufficient quantity, To make	**100 cc.**	4 fl. oz.

Dissolve the menthol and iodine in the chloroform, and add sufficient tincture of aconite to make the product measure 100 cc. [4 fl. oz.]. Preserve the Liniment in amber-colored, tightly stoppered bottles.

Approximate alcohol content, by volume, 54 per cent.

Uses—For dental treatment.

CHAPTER XXVIII

CHLOROFORM SOLUTIONS

Solutiones Chloroformicæ—*Chloroformic Solutions*

THIS is a new class of preparations added to the N. F. V. They are varnishes used in dental work to protect a surface from contact with aqueous liquids.

SOLUTIO MASTICHES CHLOROFORMICA COMPOSITA. N. F. Compound Chloroformic Solution of Mastic

[Sol. Mastic. Chlorof. Co.—PULP CAPPING VARNISH]

	Metric	Alternative
Mastic	**30 Gm.**	1 oz. av. 110 gr.
Balsam of Peru	**30 cc.**	1 fl. oz. 96 min.
Chloroform, a sufficient quantity,		
To make	**100 cc.**	4 fl. oz.

Dissolve the mastic and Peru balsam in about 50 cc. [2 fl. oz.] of chloroform, and add sufficient chloroform to make the product measure 100 cc. [4 fl. oz.].

Preserve the Solution in small, well-stoppered bottles.

Uses—A protective coating in dental work.

SOLUTIO RESINÆ CHLOROFORMICA. N. F. Chloroformic Solution of Rosin

[Sol. Resin. Chlorof.]

	Metric	Alternative
Rosin	**20 Gm.**	309 gr.
Chloroform	**100 cc.**	3 fl. oz. 183 min.

Dissolve the rosin in the chloroform, and filter the solution.

Preserve in amber-colored, cork-stoppered bottles.

Uses—A protective coating in dental work.

CHAPTER XXIX

ETHEREAL SOLUTIONS

Collodia—*Collodions*

Collodions are liquid preparations intended for external use, having for their base a solution of pyroxylin, or gun-cotton, in a mixture of ether and alcohol. (For a description of the properties of pyroxylin see Part IV.) Collodions are applied to the skin by means of a soft brush, and when the ether and alcohol evaporate, a film is left on the surface, which either acts simply as a protection or, in some instances, brings a medicating agent into contact with the epidermis.

COLLODIUM. U. S. Collodion

[Collod.]

	Metric	Alternative
Pyroxylin	**40 Gm.**	1 oz. av. 147 gr.
Ether	**750 cc.**	24 fl. oz.
Alcohol	**250 cc.**	8 fl. oz.
To make about	**1000 cc.**	2 pints

Add the alcohol to the pyroxylin, contained in a suitable bottle, shake the mixture thoroughly, add the ether, and again shake the mixture until the pyroxylin is dissolved. Cork the bottle well, and set it aside until the liquid becomes clear. Fina ly decant the clear portion from any sediment which may have deposited, and transfer it to containers which must be well closed.

Description and Physical Properties—A clear, or slightly opalescent, syrupy liquid. It is colorless, or slightly yellowish and has the odor of ether. *It is highly inflammable.*

Tests for Identity and Purity—Specific gravity: 0.765 to 0.775 at 25° C.

When exposed to the air in a thin layer, it leaves a transparent, tenacious film. When mixed with an equal volume of distilled water, a viscid, stringy mass of pyroxylin separates. The aqueous liquid is not acid to litmus paper.

Assay—Pour quickly about 10 cc. of Collodion into a tared flask, stopper, and weigh accurately, then warm it on a water bath, and add 10 cc. of distilled water, drop by drop, with constant stirring. Evaporate the mixture on a water bath, and dry the residue to constant weight at 110° C. The pyroxylin so obtained corresponds to not less than 5.1 per cent of the Collodion taken, corresponding to about 4 Gm. of pyroxylin in 100 cc. of Collodion at 25° C. The pyroxylin obtained burns rapidly, with a yellow flame.

Preserve in well-closed containers, in a cool place, remote from fire.

Alcohol content, by volume, 22 to 24 per cent.

U. S. P. Preparation—Collodium Flexile.

History—In 1847 a German chemist named Schönbein discovered pyroxylin and within a year or two thereafter an American medical student at Boston, Mass., showed how a solution of the substance in ether and alcohol could be utilized in surgery, and the collodions came into use soon thereafter.

Uses—Chiefly employed to seal small wounds or for the preparation of medicated collodions.

COLLODIUM FLEXILE. U. S. Flexible Collodion

[Collod. Flex.]

	Metric	Alternative
Camphor	**20 Gm.**	292 gr.
Castor Oil	**30 Gm.**	1 oz. av.
Collodion, a sufficient quantity,		
To make	**1000 Gm.**	33 oz. av. 167 gr.

Weigh the ingredients, successively, into a dry, tared bottle, stopper, and shake the mixture until the camphor is dissolved. Keep the product in well-closed containers, in a cool place, remote from fire.

Alcohol content, by volume, 21 to 23 per cent.

N. F. Preparations—Collodium Bituminis Sulphonati; Collodium Salicylicum Compositum; Collodium Stypticum.

Uses—Applied externally as a covering to cuts and small burns. Its application is accompanied by considerable pain, but is effective as an antiseptic and for excluding air from open wounds.

COLLODIUM BITUMINIS SULPHONATI. N. F. Collodion of Sulphonated Bitumen

[Collod. Bitum. Sulphon.]

	Metric	Alternative
Sulphonated Bitumen	10 Gm.	183 gr.
Flexible Collodion, a sufficient quantity,		
To make	100 cc.	4 fl. oz.

Dissolve the sulphonated bitumen in the flexible collodion.

Preserve in tightly-closed containers, in a cool place.

Uses—Sulphonated Bitumen is the N. F. title for preparations of the ichthyol type (see page 866).

COLLODIUM SALICYLICUM COMPOSITUM. N. F. Compound Salicylic Collodion

[Collod. Salicyl. Co.]

	Metric	Alternative
Salicylic Acid	10 Gm.	183 gr.
Fluidextract of Cannabis	10 cc.	192 min.
Flexible Collodion, a sufficient quantity,		
To make	100 cc.	4 fl. oz.

Dissolve the salicylic acid in about 75 cc. [3 fl. oz.] of flexible collodion, add the fluidextract of cannabis and sufficient flexible collodion to make the product measure 100 cc. [4 fl. oz.].

Preserve the Collodion in tightly-stoppered bottles, in a cool place.

Uses—For the removal of corns.

COLLODIUM STYPTICUM. N. F. Styptic Collodion

[Collod. Stypt.]

	Metric	Alternative
Tannic Acid	16 Gm.	293 gr.
Flexible Collodion, a sufficient quantity,		
To make	100 cc.	4 fl. oz.

Dissolve the tannic acid in about 80 cc. [3¼ fl. oz.] of flexible collodion and add sufficient flexible collodion to make the product measure 100 cc. [4 fl. oz.].

Preserve the Collodion in tightly-stoppered bottles, in a cool place.

Uses—A styptic for small cuts.

Table of Some Unofficial Collodions

Title	*Directions*
Collodium Cantharidatum (U. S. P. IX)	Macerate 60 Gm. of powdered cantharides with 55 cc. of acetone and 5 cc. of glacial acetic acid during twenty-four hours, in a closely covered container. Then percolate with acetone to exhaustion, evaporate the percolate on a water bath to 15 Gm. and mix with 85 Gm. of flexible collodion. Decant the clear liquid after the sediment has deposited
Iodi (N. F. IV)	Dissolve 5 Gm. of iodine in 95 Gm. of flexible collodion, in a bottle, by agitation
Iodoformi (N. F. IV)	Dissolve 5 Gm. of iodoform in 95 Gm. of flexible collodion, in a bottle, by agitation
Tiglii (N. F. IV)	Mix 10 Gm. of croton oil with 90 Gm. of flexible collodion

CHAPTER XXX

OLEAGINOUS SOLUTIONS OR EXTERNAL APPLICATIONS

Linimenta—*Liniments*

THESE are solutions or mixtures of various substances in oily or alcoholic liquids, intended for external application, and usually applied with friction and rubbing of the skin. They are sometimes spoken of as *embrocations*. The official liniments are as follows:

LINIMENTUM CALCIS. U.S. Lime Liniment

[Lin. Calc.—CARRON OIL]

	Metric	Alternative
Solution of Calcium Hydroxide	500 cc.	1 pint
Linseed Oil	500 cc.	1 pint
To make	1000 cc.	2 pints

Mix them by agitation.

Uses—A useful application to fresh burns and scalds. It restores the alkalinity to the burned area and excludes air, thus relieving the pain.

LINIMENTUM CAMPHORÆ. U.S. Camphor Liniment

[Lin. Camph.—CAMPHORATED OIL]

Camphor Liniment yields not less than 19 per cent and not more than 21 per cent of camphor.

Caution—This preparation is not intended for hypodermic use.

	Metric	Alternative
Camphor, in coarse powder	200 Gm.	2 oz. av.
Cottonseed Oil	800 Gm.	8 oz. av.
To make	1000 Gm.	10 oz. av.

Pour the cottonseed oil into a suitable dry flask or bottle, heat it on a water bath, introduce the camphor, and stopper the container securely. Dissolve the camphor by agitation without the further application of heat.

This liniment should never be made in an open dish, as much of the camphor will be volatilized. The assay is based upon this principle.

Assay—Place 5 cc. of Camphor Liniment in a tared porcelain dish, having a diameter of about 75 mm., weigh accurately, heat at about 110° C. for ninety minutes, or until the odor of camphor is no longer discernible, cool, and weigh: the loss in weight is not less than 19 per cent and not more than 21 per cent.

N. F. Preparation—Ceratum Camphoræ.

Uses—A mild counterirritant for inflamed joints, sprains, rheumatism and in other inflamed conditions, such as colds in throat and chest, in infants and children.

Although the synonym "camphorated oil" is often applied to this liniment, the term is also frequently used by physicians to indicate a sterile, ten per cent solution of camphor in olive or other fixed oil. (See Ampullæ Camphoræ, Part XI.) This is used hypodermatically as a stimulant. The two products must not be confused.

LINIMENTUM CHLOROFORMI. U.S. Chloroform Liniment
[Lin. Chlorof.]

	Metric	Alternative
Chloroform	300 cc.	9½ fl. oz.
Soap Liniment	700 cc.	22½ fl. oz.
To make	1000 cc.	2 pints

Mix them by agitation.

Alcohol content, by volume, 43 to 47 per cent.

Uses—A stimulating liniment for sore and stiff muscles, and a local anesthetic in neuralgia.

LINIMENTUM SAPONIS. U.S. Soap Liniment
[Lin. Sapon.—Liquid Opodeldoc]

	Metric	Alternative
Soap, dried and granulated, or powdered	60 Gm.	2 oz. av.
Camphor, in small pieces	45 Gm.	1 oz. av. 220 gr.
Oil of Rosemary	10 cc.	154 min.
Alcohol	700 cc.	22½ fl. oz.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the camphor and the oil of rosemary in the alcohol, add the soap, and then sufficient water to make the product measure 1000 cc. [2 pints]. Agitate the mixture until the soap is dissolved, set it aside in a cool place for twenty-four hours, and filter.

Only the official Castile soap should be used; soaps made from animal oils will cause gelatinization. If soap shavings from bar soap are used, dry thoroughly and then run through a mill or grater, if the U. S. P. process is to be followed.

Alcohol content, by volume, 62 to 66 per cent.

U. S. P. Preparation—Linimentum Chloroformi.
N. F. Preparation—Linimentum Aconiti et Chloroformi.

History—The term *opodeldoc* sometimes applied to this preparation was first used by Paracelsus in connection with a plaster which had no connection with soap whatever. In the Edinburgh Pharmacopœia of 1722 was a formula for an *Unguentum Opodeldoch* which contained soap in addition to a large number of other ingredients. This was undoubtedly the basis for Steer's Opodeldoc which was a solid preparation of soap, the *Linimentum Saponato-camphoratum* of the N. F.

Uses—An anodyne and mild rubefacient, for sprains, bruises, and rheumatism. It also forms the basis for other liniments.

LINIMENTUM SAPONIS MOLLIS. U.S. Liniment of Soft Soap
[Lin. Sapon. Moll.—Tincture of Green Soap]

	Metric	Alternative
Soft Soap	650 Gm.	21½ oz. av.
Oil of Lavender	20 cc.	5 fl. dr.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the oil of lavender with 300 cc. [9½ fl. oz.] of alcohol, dissolve in this the soft soap by stirring or by agitation, and set the solution aside for twenty-four hours. Then filter it through paper, adding sufficient alcohol to make the product measure 1000 cc. [2 pints].

Alcohol content, by volume, 28 to 32 per cent.

Uses—Used largely as a soap for cleansing the area for an operation, also for washing the surgeon's hands, for washing the scalp, and for other detergent purposes.

The limit of free alkali should be carefully maintained, a small amount being helpful for antiseptic and cleansing purposes, but an excess rendering the soap caustic.

LINIMENTUM ACONITI ET CHLOROFORMI. N. F. Liniment of Aconite and Chloroform

[Lin. Aconit. et Chlorof.]

	Metric	Alternative
Fluidextract of Aconite	45 cc.	1 fl. oz. 211 min.
Alcohol	80 cc.	2 fl. oz. 269 min.
Chloroform	125 cc.	4 fl. oz.
Soap Liniment	750 cc.	24 fl. oz.
To make	1000 cc.	2 pints

Mix them.

Approximate alcohol content, by volume, 59 per cent.

Uses—Externally to relieve pain.

LINIMENTUM AMMONIÆ. N. F. Ammonia Liniment

(U. S. P. IX)

[Lin. Ammon.—Volatile Liniment, Hartshorn Liniment]

	Metric	Alternative
Ammonia Water	250 cc.	8 fl. oz.
Sesame Oil	750 cc.	24 fl. oz.
To make about	1000 cc.	2 pints

Agitate the ammonia water with the sesame oil until a uniform mixture is obtained.

LINIMENTUM BELLADONNÆ. N. F. Belladonna Liniment

(U. S. P. IX)

[Lin. Bellad.]

	Metric	Alternative
Camphor	50 Gm.	1 oz. av. 293 gr.
Fluidextract of Belladona Root, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the camphor in about 800 cc. [25½ fl. oz.] of the fluidextract, and then add enough of the latter to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Approximate alcohol content, by volume, 68 per cent.

Uses—An external counterirritant.

LINIMENTUM CALAMINÆ. N. F. Calamine Liniment

[Lin. Calam.]

	Metric	Alternative
Prepared Calamine, in very fine powder	80 Gm.	2 oz. av. 293 gr.
Zinc Oxide, in very fine powder	80 Gm.	2 oz. av. 293 gr.
Olive Oil	500 cc.	1 pint
Solution of Calcium Hydroxide, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the prepared calamine and zinc oxide with the olive oil and gradually add the solution of calcium hydroxide, with constant agitation.

Shake the Liniment thoroughly before dispensing.

Uses—In skin diseases.

LINIMENTUM OPII COMPOSITUM. N. F. Compound Liniment of Opium

[Lin. Opii. Co.—Canada Liniment]

	Metric	Alternative
Tincture of Opium	100.0 cc.	3 fl. oz. 96 min.
Camphor	17.5 Gm.	256 gr.
Oil of Peppermint	25.0 cc.	384 min.
Alcohol	250.0 cc.	8 fl. oz.
Fresh Egg Albumen	50.0 cc.	1 fl. oz. 288 min.
Ammonia Water	350.0 cc.	11 fl. oz. 96 min.
Oil of Turpentine	220.0 cc.	7 fl. oz. 19 min.
To make about	1000 cc.	2 pints

Mix the albumen with the ammonia water and gradually add the oil of turpentine. Shake it thoroughly and add the camphor and oil of peppermint previously dissolved in the alcohol, then the tincture of opium.

Shake the Liniment well before dispensing.

Approximate alcohol content, by volume, 25 per cent.

Uses—A stimulating anodyne.

LINIMENTUM SAPONATO-CAMPHORATUM. N. F. Camphorated Soap Liniment

[Lin. Sapon. Camph.—Solid Opodeldoc, Steer's Opodeldoc]

	Metric	Alternative
Monohydrated Sodium Carbonate	10 Gm.	146 gr.
Stearic Acid	50 Gm.	1 oz. av. 293 gr.
Water	100 cc.	3 fl. oz. 96 min.
Camphor, in coarse powder,	25 Gm.	365 gr.
Oil of Thyme	3 cc.	46 min.
Oil of Rosemary	6 cc.	92 min.
Ammonia Water	50 cc.	1 fl. oz. 288 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the monohydrated sodium carbonate in the water with the aid of heat, add 200 cc. [6 fl. oz. 192 min.] of alcohol and the stearic acid and warm the mixture until effervescence has ceased and solution results. Add the oils and camphor, dissolved in 500 cc. [1 pint] of alcohol, then the ammonia water and sufficient alcohol to make the product measure 1000 cc. [2 pints]. Filter the liniment while hot.

Pour the filtered liquid into dry, wide-mouthed bottles, stopper these and set them aside to cool.

Approximate alcohol content, by volume, 73 per cent.

Uses—A mild stimulating liniment.

LINIMENTUM SAPONIS MOLLIS COMPOSITUM. N. F. Compound Liniment of Soft Soap

[Lin. Sapon. Mol. Co.—Tinctura Saponis Viridis Composita]

	Metric	Alternative
Soft Soap	150 Gm.	5 oz. av. 3 gr.
Oil of Cade	20 cc.	307 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Soften the soap by warming it in a dish on a water bath; remove it from the heat, mix it with 750 cc. [24 fl. oz.] of alcohol, and, when it has dissolved, add the oil of cade. Then filter the liquid, and wash the filter with sufficient alcohol to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 78 per cent.

Uses—Employed in treating skin and scalp diseases.

LINIMENTUM SINAPIS COMPOSITUM. N. F. Compound Liniment of Mustard

[Lin. Sinap. Co.]

	Metric	Alternative
Volatile Oil of Mustard	**30 cc.**	461 min.
Fluidextract of Mezereum	**200 cc.**	6 fl. oz. 192 min.
Camphor	**60 Gm.**	2 oz. av.
Menthol	**20 Gm.**	292 gr.
Castor Oil	**150 cc.**	4 fl. oz. 384 min.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the camphor and menthol in 500 cc. [1 pint] of alcohol, add the fluidextract of mezereum, then the oil of mustard and castor oil, and sufficient alcohol to make the product measure 1000 cc. [2 pints]. Mix thoroughly.

Approximate alcohol content, by volume, 65 per cent.

Uses—An active rubefacient.

LINIMENTUM TEREBINTHINÆ. N. F. Turpentine Liniment

(U. S. P. IX)

[Lin. Terebinth.—Kentish Ointment]

	Metric	Alternative
Rosin Cerate	**650 Gm.**	13 oz. av.
Oil of Turpentine	**350 Gm.**	7 oz. av.
To make	**1000 Gm.**	20 oz. av.

Dissolve the rosin cerate, previously melted in a dish on a water bath, in the oil of turpentine, and mix them thoroughly.

Uses—An application for burns. It should be applied as soon after the accident as possible, but discontinued when the pain has been relieved. Sometimes used as a stimulant application in erysipelas.

LINIMENTUM TEREBINTHINÆ ACETICUM. N. F. Acetic Turpentine Liniment

[Lin. Terebinth. Acet.—Linimentum Album, Stokes' Liniment, St. John Long's Liniment]

	Metric	Alternative
Oil of Turpentine	**400 cc.**	12 fl. oz. 384 min.
Oil of Lemon	**16 cc.**	246 min.
Acetic Acid	**80 cc.**	2 fl. oz. 269 min.
Fresh Eggs,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the contents of two fresh eggs and the yolks of two others with the oil of turpentine and the oil of lemon in a mortar until they are thoroughly mixed. Then incorporate the acetic acid and sufficient water to make the product measure 1000 cc. [2 pints].

Shake the Liniment before dispensing.

History—John St. John Long, an Irish physician of prominence in London about a century ago used this preparation as a secret remedy in his very extensive practice and at his death the rights to its manufacture were sold for $50,000 and the preparation was continued as a proprietary remedy. The formula now in use is based upon one devised by Doctor Fownes, the famous English chemist.

Uses—A strong counterirritant.

Table of Some Unofficial Liniments

Title	*Directions*
Linimentum Aconiti (Br. 1914)	100 cc. contains 0.2 Gm. of ether-soluble alkaloids of aconite root and 3 Gm. of camphor. Percolate 50 Gm. of aconite root with 90 per cent alcohol until exhausted. Reserve the first 75 cc. of percolate, evaporate the remainder, dissolve the evaporated portion in the reserve and assay. Then add sufficient camphor and alcohol to produce a liniment of the required standard
Ammonii Iodidi (N. F. IV)	Dissolve 0.4 Gm. of iodine, 1.5 cc. of oil of rosemary, 1.5 cc. of oil of lavender and 3.2 Gm. of camphor in 75 cc. of alcohol. Add 11 cc. of ammonia water and enough alcohol to make 100 cc. Filter

Table of Some Unofficial Liniments—*Continued*

Title	*Directions*
Linimentum Camphoræ Ammoniatum (Br. 1914)	Dissolve 12.5 Gm. of camphor and 0.5 cc. of oil of lavender in 60 cc. of alcohol; gradually add 25 cc. of strong solution of ammonia (32.5 per cent) and enough alcohol to make 100 cc. Shake until a clear solution is formed
Hydrargyri (Br. 1914)	Add 40 cc. of solution of ammonia to 80 cc. of liniment of camphor and then triturate 50 Gm. of ointment of mercury with the mixture
Opii (Br. 1914)	Mix 50 cc. of tincture of opium with 50 cc. of soap liniment. Set aside for a few days and filter
Potassii Iodidi cum Saponis (Br. 1914)	Dissolve 20 Gm. of curd soap with the aid of a gentle heat in 10 cc. of glycerin and 100 cc. of distilled water, restoring any water lost through evaporation; add the solution to 15 Gm. of powdered potassium iodide in a mortar and triturate until cold. Set aside for an hour and then incorporate 1 cc. of oil of lemon
Tiglii (N. F. IV)	Mix 13 cc. of croton oil and 43 cc. of oil of cajuput with 44 cc. of alcohol
Tiglii Compositum (N. F. IV)	Mix together 20 cc. of croton oil, 20 cc. of oil of sassafras, 20 cc. of oil of turpentine and 40 cc. of olive oil

Linimentum Exsiccans—*Drying Liniment*

This is a class of preparations which, when smeared on the skin, will dry, forming a medicated film removable by washing with water. A typical formula is as follows:

Tragacanth, 5 parts, glycerin, 2 parts, distilled water, 93 parts. To this base may be added such substances as the following: ichthyol, 30 per cent; boric acid, 10 per cent; chrysarobin, 5 per cent; betanaphthol, 5 per cent; resorcinol, 30 per cent; salicylic acid, 5 per cent.

Oleata—*Oleates*

The official oleates are mainly liquid preparations made by dissolving alkaloids in oleic acid; however, oleate of mercury, the only oleate retained in the U. S. P., is prepared by dissolving mercuric oxide in oleic acid to form a product of ointment-like consistence.

The N. F. oleates are solutions of alkaloids, which are not intended to be definite chemical compounds; the oleic acid is present in large excess and they must be regarded as solutions of the medicating agent in oleic acid, the latter having special advantages as a basis for administering external remedies, being more readily absorbed than most of the fatty substances used in making ointments.

OLEATUM HYDRARGYRI. U. S. Oleate of Mercury

[Oleat. Hydrarg.]

	Metric	Alternative
Yellow Mercuric Oxide, in very fine powder	**25 Gm.**	1 oz. av.
Oleic Acid, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Mix the yellow mercuric oxide with 75 Gm. [3 oz. av.] of oleic acid, warm the mixture to a temperature not exceeding 50° C., stir constantly for five minutes, and then continue the heat, stirring frequently, until the mercuric oxide is dissolved. Add sufficient oleic acid to make the product weigh 100 Gm. [4 oz. av.] and mix thoroughly. In the preparation of this Oleate avoid all contact with metallic utensils.

Preserve Oleate of Mercury in tightly-closed containers, protected from strong light, and do not dispense it if globules of mercury are visible at the bottom of the container.

U. S. P. Preparation—Massa Hydrargyri, Unguentum Hydrargyri Fortius.

Uses—Chiefly for preparation of mass and ointment of mercury. Occasionally as a parasiticide application to the skin.

OLEATUM QUININÆ. N. F. Oleate of Quinine

[Oleat. Quin.]

	Metric	Alternative
Quinine	**25 Gm.**	1 oz. av.
Oleic Acid	**75 Gm.**	3 oz. av.
To make	**100 Gm.**	4 oz. av.

Triturate the quinine in a warm mortar with a small quantity of the oleic acid to a smooth paste. Add the remainder of the oleic acid, previously warmed, and stir frequently until the quinine is dissolved.

Uses—A local anesthetic.

OLEATUM VERATRINÆ. N. F. Oleate of Veratrine

[Oleat. Veratrin.]

	Metric	Alternative
Veratrine	**2 Gm.**	35 gr.
Oleic Acid	**50 Gm.**	2 oz. av.
Olive Oil, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Triturate the veratrine in a tared mortar with about 5 Gm. [87 gr.] of olive oil, and, after warming the mortar, add the oleic acid, and continue stirring until the veratrine is dissolved; then add sufficient olive oil to make the product weigh 100 Gm. [4 oz. av.].

Uses—An anodyne over neuralgic nerves and a rubefacient in rheumatic conditions in joints and muscles. Must be used with great caution as it is highly poisonous.

Table of Some Unofficial Oleates

Title	*Directions*
Oleatum Aconitinæ (N. F. IV)	Triturate 2 Gm. of aconitine in a mortar with 50 Gm. of oleic acid, added slowly until dissolved, and add enough olive oil to make 100 Gm.
Atropinæ (N. F. IV)	Triturate 2 Gm. of atropine in a tared mortar with 2 cc. of alcohol, add an equal volume of oleic acid, warm the mortar and stir until the alcohol evaporates. Then add 48 Gm. of oleic acid, stir until the alcohol dissolves and add enough olive oil to make 100 Gm.
Cocainæ (N. F. IV)	Prepare as directed for oleatum atropinæ, using 5 Gm. of cocaine, 5 cc. of alcohol, 50 Gm. of oleic acid and olive oil to make 100 Gm.
Zinci (U. S. P. 1890)	Mix 50 Gm. of zinc oxide with 950 Gm. of oleic acid in a porcelain dish, set aside for three hours, then heat on a water bath, frequently stirring, until dissolved

Petroxolina—*Petroxolins*

These preparations are intended for external application, and the value of liquid petroxolin depends upon its being an excellent solvent for many substances used externally, combined with its ready absorption through the skin. The British Pharmaceutical Codex title for this class of preparations is *Parogenum* (*Parogen*).

PETROXOLINUM HYDRARGYRI. N. F. Mercury Petroxolin

[Petrox. Hydrarg.—Mercury Petrox]

	Metric	Alternative
Mercury	**30 Gm.**	1 oz. av. 87½ gr.
Hydrous Wool Fat	**13 Gm.**	227½ gr.
Oleic Acid	**2 Gm.**	35 gr.
Solid Petroxolin	**55 Gm.**	2 oz. av. 87½ gr.
To make	**100 Gm.**	4 oz. av.

Triturate the mercury with the mixture of hydrous wool fat and oleic acid until globules of mercury are no longer visible when examined with a lens magnifying ten diameters; then add the solid petroxolin and mix thoroughly.

Uses—An antiparasitic and antisyphilitic.

PETROXOLINUM LIQUIDUM. N. F. Liquid Petroxolin

[Petrox. Liq.—Petrolatum Saponatum Liquidum, Liquid Petrox]

	Metric	Alternative
Light Liquid Petrolatum	580 cc.	18 fl. oz. 269 min.
Oleic Acid	300 cc.	9 fl. oz. 288 min.
Stronger Ammonia Water	50 cc.	1 fl. oz. 288 min.
Oil of Lavender	5 cc.	77 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the light liquid petrolatum and oleic acid, add the stronger ammonia water and 60 cc. [1 fl. oz. 442 min.] of alcohol, previously mixed, and agitate the mixture frequently until a clear liquid results. Then add the oil of lavender and sufficient alcohol to make the product measure 1000 cc. [2 pints].

Note—Difficulty is sometimes experienced in obtaining a clear solution and this is usually remedied by the further addition of a few drops of oleic acid.

A clear, dark amber-colored liquid, having a specific gravity of about 0.870 at 25° C.

It is miscible with ether, chloroform, acetone, and petroleum benzin, and forms an emulsion-like mixture when added to twice its volume of water.

Approximate alcohol content, by volume, 5 per cent.

N. F. Preparations—Petroxolina Medicata.

Uses—As a vehicle for the liquid petroxolins.

PETROXOLINA MEDICATA. Medicated Petroxolins

The following Medicated Liquid Petroxolins are prepared by dissolving the active medicinal substance in a sufficient quantity of Liquid Petroxolin to make the product measure 100 cc. [4 fl. oz.]:

PETROXOLINUM BETANAPHTHOLIS. N. F. Betanaphthol Petroxolin

Betanaphthol 10 Gm. [182 gr.] in 100 cc. [4 fl. oz.] of product.

Uses—An antiseptic used in skin diseases.

PETROXOLINUM BITUMENIS SULPHONATI. N. F. Sulphonated Bitumen Petroxolin

Sulphonated Bitumen 10 Gm. [182 gr.] in 100 cc. [4 fl. oz.] of product.

Uses—In skin diseases.

PETROXOLINUM CADINUM. N. F. Cade Petroxolin

Oil of Cade 25 cc. [1 fl. oz.] in 100 cc. [4 fl. oz.] of product.

Uses—Employed in skin diseases as an antiparasitic.

PETROXOLINUM CHLOROFORMI CAMPHORATUM. N. F. Camphorated Chloroform Petroxolin

Chloroform 20 cc. [384 min.] and Camphor 20 Gm. [182 gr.] in 100 cc. [4 fl. oz.] of product.

Uses—An anodyne and rubefacient.

PETROXOLINUM EUCALYPTOLIS. N. F. Eucalyptol Petroxolin

Eucalyptol 20 cc. [384 min.] in 100 cc. [4 fl. oz.] of product.

Uses—An antiseptic and rubefacient.

PETROXOLINUM GUAIACOLIS. N. F. Guaiacol Petroxolin

Guaiacol 20 Gm. [182 gr.] and Oleic Acid 5 cc. [96 min.] in 100 cc. [4 fl. oz.] of product.

Uses—An antipyretic when applied in neuralgia and in sciatica.

PETROXOLINUM IODI. N. F. Iodine Petroxolin

Iodine 10 Gm. [182 gr.] in 100 cc. [4 fl. oz.] of product.

Uses—A counterirritant and discutient. Also used for endermic absorption of iodine.

PETROXOLINUM IODI DILUTUM. N. F. Diluted Iodine Petroxolin

Iodine 5 Gm. [91 gr.] in 100 cc. [4 fl. oz] of product.

Uses—A counterirritant and discutient.

PETROXOLINUM MENTHOLIS. N. F. Menthol Petroxolin

Menthol 10 Gm. [182 gr.] in 100 cc. [4 fl. oz.] of product.

Uses—A local anesthetic.

PETROXOLINUM METHYLIS SALICYLATIS. N. F. Methyl Salicylate Petroxolin

Methyl Salicylate 20 cc. [384 min.] in 100 cc. [4 fl. oz.] of product.

Uses—Applied locally for rheumatism.

PETROXOLINUM PHENOLIS. N. F. Phenol Petroxolin

Phenol 5 Gm. [91 gr.] in 100 cc. [4 fl. oz.] of product.

Uses—An antiseptic and local anesthetic.

PETROXOLINUM PHENOLIS CAMPHORATUM. N. F. Camphorated Phenol Petroxolin

Phenol 12.5 Gm. [228 gr.] and Camphor 37. 5 Gm. [1 oz. av. 246½ gr.] in 100 cc. [4 fl. oz.] of product.

Uses—An analgesic.

PETROXOLINUM SULPHURATUM. N. F. Sulphurated Petroxolin

Sublimed Sulphur 3 Gm. [55 gr.], Linseed Oil 37 cc. [1 fl. oz. 230 min.], and Oleic Acid 30 cc. [1 fl. oz. 96 min.] in 100 cc. [4 fl. oz.] of product. Dissolve the sulphur in the linseed oil and oleic acid by the aid of heat before mixing with the liquid petroxolin.

N. F. Preparation—Petroxolinum Sulphuratum Compositum.

Uses—A parasiticide.

PETROXOLINUM SULPHURATUM COMPOSITUM. N. F. Compound Sulphurated Petroxolin

Sulphurated Petroxolin 10 cc. [192 min.], Oil of Cade 10 cc. [192 min.], Thymol 0.3 Gm. [5½ gr.], Eucalyptol 3 cc. [57 min.], and Oil of Turpentine 30 cc. [1 fl. oz. 96 min.] in 100 cc. [4 fl. oz.] of product.

Uses—A parasiticide.

PETROXOLINUM SPISSUM. N. F. Solid Petroxolin

[**Petrox. Spiss.**—Petrolatum Saponatum Spissum, Solid Petrox]

	Metric	Alternative
White Wax	**35 Gm.**	1 oz. av. 175 gr.
Light Liquid Petrolatum	**20 Gm.**	350 gr.
Oleic Acid	**32 Gm.**	1 oz. av. 122½ gr.
Oil of Lavender	**3 Gm.**	52½ gr.
Alcohol	**5 Gm.**	87½ gr.
Stronger Ammonia Water	**5 Gm.**	87½ gr.
To make	**100 Gm.**	4 oz. av.

Melt the white wax with the liquid petrolatum on a water bath, add the oleic acid and transfer the mixture at once to a warm mortar; immediately add the mixed alcohol and stronger ammonia water and stir continuously until cool. Finally add the oil of lavender.

N. F. Preparation—Petroxolinum Hydrargyri.

Approximate alcohol content, by volume, 5 per cent.

Uses—Used as a vehicle in the solid petroxolins.

Nebulæ—*Sprays*

These consist of liquids intended for spraying from an atomizer or nebulizer and may be aqueous or oily in character. Light Liquid Petrolatum is usually employed as the vehicle for oily sprays.

NEBULA AROMATICA. N.F. Aromatic Oil Spray

[**Nebul. Arom.**—AROMATOL]

	Metric	Alternative
Phenol	0.2 Gm.	29 gr.
Menthol	0.2 Gm.	29 gr.
Thymol	0.1 Gm.	15 gr.
Camphor	0.3 Gm.	44 gr.
Benzoic Acid	0.3 Gm.	44 gr.
Eucalyptol	0.2 cc.	31 min.
Oil of Cinnamon	0.2 cc.	31 min.
Oil of Clove	0.2 cc.	31 min.
Methyl Salicylate	0.5 cc.	77 min.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 cc.	2 pints

Mix the phenol, menthol, thymol and camphor in a flask and warm on a water bath until liquefied, then add the aromatic oils, eucalyptol, methyl salicylate, and benzoic acid and thoroughly mix with sufficient light liquid petrolatum to make the product measure 100 cc. [2 pints]. Filter if necessary.

Uses—An antiseptic and soothing inhalant, for catarrh of the nose and throat.

NEBULA EUCALYPTOLIS. N.F. Eucalyptol Spray

[**Nebul. Eucalyptol.**]

	Metric	Alternative
Eucalyptol	5 cc.	1 fl. oz. 288 min.
Light Liquid Petrolatum	95 cc.	30 fl. oz. 192 min.
To make	100 cc.	2 pints

Mix them.

Uses—A mildly antiseptic inhalant.

NEBULA MENTHOLIS. N.F. Menthol Spray

[**Nebul. Menthol.**]

	Metric	Alternative
Menthol	2 Gm.	292 gr.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 cc.	2 pints

Dissolve the menthol in the light liquid petrolatum which has been warmed to about 70° C., and filter if necessary.

Uses—A soothing inhalant for catarrh of nose and throat.

NEBULA MENTHOLIS COMPOSITA. N.F. Compound Menthol Spray

[Nebul. Menthol. Co.]

	Metric	Alternative
Menthol	1.0 Gm.	146 gr.
Camphor	1.0 Gm.	146 gr.
Methyl Salicylate	0.5 cc.	77 min.
Eucalyptol	0.2 cc.	31 min.
Oil of Cinnamon	0.2 cc.	31 min.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 cc.	2 pints

Triturate the menthol, camphor, eucalyptol, methyl salicylate and oil together in a dry mortar, add 75 cc. [24 fl. oz.] of light liquid petrolatum and continue trituration until solution is effected. Then add sufficient light liquid petrolatum to make the product measure 100 cc. [2 pints], and filter if necessary.

Uses—An antiseptic inhalant.

NEBULA THYMOLIS. N.F. Thymol Spray

[Nebul. Thymol.]

	Metric	Alternative
Thymol	1 Gm.	146 gr.
Light Liquid Petrolatum, a sufficient quantity,		
To make	100 cc.	2 pints

Dissolve the thymol in the light liquid petrolatum.

Uses—An antiseptic, stimulating inhalant.

Medicated Oils

Three preparations of the National Formulary belong to this class. They consist in two instances of a bland, fixed oil, to which an active medicinal substance has been added, and in the third preparation, of an active oil, castor oil, which is rendered palatable by the addition of aromatics.

OLEUM PHENOLATUM. N.F. Phenolated Oil

[Ol. Phenol.—Oleum Carbolatum, Carbolized Oil]

	Metric	Alternative
Phenol	5 Gm.	87½ gr.
Olive Oil	95 Gm.	3 oz. av. 350 gr.
To make	100 Gm.	4 oz. av.

Melt the phenol with a gentle heat, and mix it with the olive oil.

Uses—An antiseptic oil for external use.

OLEUM PHOSPHORATUM. N.F. Phosphorated Oil

[Ol. Phosphorat.]

	Metric	Alternative
Phosphorus	1 Gm.	17½ gr.
Expressed Oil of Almond,		
Ether, each, a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Pour a sufficient quantity of expressed oil of almond into a flask, heat it on a sand bath to 250° C. and keep it at that temperature for fifteen minutes. Then allow it to cool, and filter it. Introduce 90 Gm. [3 oz. av. 262 gr.] of the filtered oil together with the phosphorus, previously well dried, into a dried, tared bottle of about 120 cc. [4 fl. oz.] capacity, insert the

stopper and heat the bottle in a water bath until the phosphorus melts. Agitate it until the phosphorus is dissolved, allow the oil to cool before opening the bottle, add sufficient ether to make the mixture weigh 100 Gm. [4 oz. av.] and agitate it again. Lastly, transfer the solution to small, glass-stoppered bottles, which should be completely filled, and kept in a cool, dark place.

A clear, yellowish liquid, having the odor of phosphorus and of ether, and free from undissolved particles.

Uses—For the internal administration of phosphorus.

Average dose—1 minim (0.05 cc.).

OLEUM RICINI AROMATICUM. N.F. Aromatic Castor Oil

[**Ol. Ricin. Arom.**]

	Metric	Alternative
Gluside	**0.5 Gm.**	7 gr.
Oil of Cinnamon	**3.0 cc.**	46 min.
Oil of Clove	**1.0 cc.**	15 min.
Vanillin	**1.0 Gm.**	15 gr.
Coumarin	**0.1 Gm.**	1½ gr.
Alcohol	**30.0 cc.**	461 min
Castor Oil, a sufficient quantity,		
To make about	**1000 cc.**	2 pints

Dissolve the volatile oils and the solids in the alcohol, add the castor oil and mix thoroughly.

Approximate alcohol content, by volume, 2 per cent.

Uses—A cathartic. The aromatics assist in its administration by covering the disagreeable taste of the castor oil.

Average dose—4 fluidrachms (15 cc.).

Toothache Drops

Temporary relief is often obtained when toothache is due to cavities, by the application of an aromatic oil or a mixture of oils and phenol. Oil of clove, usually applied on absorbent cotton, is probably the most frequently used toothache remedy, although mixtures of phenol with camphor or creosote are often employed. When phenol, creosote or volatile oils are dissolved in paraffin, a few filaments of cotton added and the mixture moulded into sticks, it constitutes what is known as *dental wax.*

The National Formulary has introduced the following formula for toothache drops:

ODONTALGICUM. U.S. Toothache Remedy

[**Odontalg.**]

Oil of Cinnamon	**10 cc.**
Phenol	**20 Gm.**
Methyl Salicylate	**30 cc.**

Dissolve the phenol in the oils.

CHAPTER XXXI

AQUEOUS LIQUIDS MADE BY PERCOLATION OR MACERATION

Infusa—*Infusions*

Infusions are liquid preparations made by treating vegetable substances with either hot or cold water. *The drug is not subjected to the boiling process,* although it is common to pour boiling water over it; the mixture is allowed to stand in a closed vessel until cold. While the use of hot water has the advantage of saving time in some cases, it is often objectionable because the *inert* principles in the drug are dissolved by the hot water, and as the infusion cools, they are precipitated in such a very finely divided condition that they cannot be readily separated by colation or filtration. Cold water should be selected as the menstruum when the drug contains a valuable volatile principle, when the active agent is injured by heat, or when the desirable principles are readily soluble in water of ordinary temperature. The time required to make the infusion must also be considered, for in warm weather it is quite possible for an infusion to ferment or decompose before it is finished.

Pure water should be used in making infusions, and they should not be made in large quantities unless demanded for immediate use, as, without special precautions to preserve them, they soon decompose.

Of the inert principles found in plants, starch is extracted by hot water and albumen by cold water, while gum, sugar, and extractive are dissolved by both.

In making infusions the drug is usually coarsely comminuted, sliced, or bruised. Very fine powders should be avoided because it is difficult to separate the fine particles from the infusion and if percolation is resorted to, so much time is consumed in the operation, owing to the swelling of the powder, that decomposition may set in before the preparation is finished. Infusions are usually made by one of the following methods: 1. By maceration. 2. By digestion. 3. By percolation. 4. By diluting concentrated preparations.

1. **By Maceration**—This is the process which is most frequently used. The general formula of the U. S. Pharmacopœia, which is here appended, furnishes a model.

Official General Process for Infusions

Infusions must be freshly made, and, when their strength is not otherwise directed, they are to be prepared by the following general formula:

	Metric	Alternative
The Drug, coarsely comminuted	**50 Gm.**	365 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	1 pint

Introduce the drug into a suitable vessel provided with a cover, pour upon it 1000 cc. [1 pint] of boiling water, cover the vessel tightly, and allow it to stand for half an hour. Then strain with pressure, and pass enough water through the strainer to make the Infusion measure 1000 cc. [1 pint]. If the activity of the Infusion is affected by heat, cold water only should be used.

Caution—The strength of infusions of energetic or powerful drugs should be specially directed by the physician.

It will be found most convenient to provide special apparatus for making infusions by maceration. One of the oldest and most efficient forms is known as *Alsop's Infusion Jar*. It consists of an earthen-ware mug, illustrated by Fig. 417. The material to be submitted to infusion is placed on the perforated plate, and the hot water poured in so as to cover it, the vessel having been previously warmed so as not to chill the liquid. As the water becomes impregnated, the liquid acquires an increased specific gravity, and sinks to the bottom, its place being supplied by the unsaturated portion; and this circulation goes on until the whole of the soluble matter is extracted.

Tinned iron or metallic vessels are unsuited for infusions; they are particularly objectionable when the drug used for making the preparation contains tannin, gallic acid, or an astringent substance.

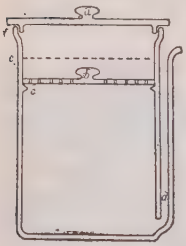
Squire's Infusion Mug differs from the preceding in having a colander of queen's-ware, which is closely covered with a lid, and descends into the jar so as to form a diaphragm for the support of the substance to be infused (see Fig. 418).

A very convenient and quite inexpensive apparatus may be made by the pharmacist, by selecting a queen's-ware or porcelain tea- or coffee-pot, as in Fig. 419, and if a hole is drilled through the top, close to the handle, a copper wire may be passed

Fig. 419

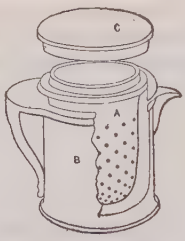
Infusion mug (home-made)

Fig. 417



Alsop's infusion jar

Fig. 418



Squire's infusion mug

through the hole and around the handle, and made to terminate in a hook. The material to be infused is loosely tied up in a square piece of cheesecloth (coarse, thin muslin) and suspended from the hook; the hot water dissolves out the soluble principles by circulatory displacement. This method has the great advantage that no further straining is needed, as the bag retains the marc. The bag may be pressed and the contents then thrown away.

Some drugs are now supplied in accurately weighed amounts in muslin bags ready for the making of specific amounts of infusion. This is especially applied to digitalis and also to the preparation of tea as a beverage.

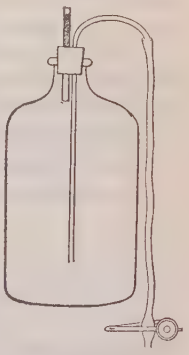
2. **By Digestion**—The process of *digestion* consists in subjecting the substance to the continued action of moderate heat below the boiling temperature. In making infusions, digestion is often very useful, although it may not be directed in the formula. It generally suffices to place the infusion vessel upon a moderately hot portion of the stove plate, or near some other source of heat.

3. **By Percolation**—This method of making infusions is by far the most satisfactory, and should be used whenever possible. It should be selected when the desirable principles are easily dissolved in water, and when the amount of menstruum is amply sufficient to exhaust the drug thoroughly. Percolation presents the advantages of furnishing a finished preparation, straining being

unnecessary. Again, precipitation from the deposition of inert principles after the infusion has been strained, due to the principles being soluble in hot water but insoluble in cold water, is avoided. The chief drawback to the adoption of percolation in making infusions is the difficulty of maintaining heat when that is desirable and length of time required to exhaust the drug with water. Infusions are generally extemporaneous preparations, and they are frequently desired quickly; hence the process of maceration is often selected in preference.

4. **Infusions from Concentrated Preparations**—The habit of making infusions from concentrated alcoholic tinctures or fluidextracts is improper and unjustifiable, except in those few cases in which the active and desirable principles of the drug are equally soluble in alcohol and in water, or in the menstrua used for both fluidextract and infusion. This is well illustrated in those preparations in which the activity of the drug is due to resinous bodies. Alcoholic menstrua here are necessary to dissolve the resins, and if such a fluidextract is added to water, precipitation takes place and the filtered infusion is worthless. If the precipitate is inert or does not carry down with it any portion of the active principle, and is readily separated, the only objection to the infusion is the presence of the alcohol, which may or may not seriously interfere with the therapeutic action, according as the quantity present is large or small. The saving in time and labor by making infusions in this way is the cause of the frequent employment of this method, but it should never be used if the therapeutic action of the drug is weakened thereby. The substitution of a fluidextract-made infusion in a prescription for one directed to be made by an official process is reprehensible and inexcusable.

FIG. 420



Infusion bottle

Preservation of Infusions—The difficulty in preserving infusions arises from the decomposition of fermentable principles which are extracted and retained in the preparation. If sufficient alcohol is added to prevent decomposition, the therapeutic action of the infusion is usually interfered with owing to the comparatively large proportion of spirit contained in the dose. Alcohol is successfully used in preparations like infusion of gentian, orange peel, etc., or simple tonics. If an antiseptic, like boric acid, salicylic acid, sodium benzoate, or phenol is used, the same objection exists—the interference due to the therapeutic action of the ant septic.

It has been proved that infusions may be preserved for a long time if they are protected from the microscopic organisms which float in the air (see chapter on Sterilization). A simple method is to heat the infusion gradually, in a flask of hard glass, to the boiling point in order to destroy any organisms that may be present, and then to transfer it at once, under proper precautions, to small bottles, which have been sterilized, filling them to the brim; the sterilized stoppers are then forced in and tied over, and the stoppers, lip, and neck of each bottle dipped into hot paraffin or sealing wax. A useful modification of Almen's method consists in heating the infusion to the boiling point in a bottle, on a water bath. The rubber stopper of the bottle is perforated so as to admit a long bent tube and a short tube; the short tube is loosely filled with cotton, the long limb of the bent tube is passed through the cork, and a rubber tube with a pinchcock attached, as shown in Fig. 420. The cotton permits the admission of air into the bottle, but excludes organisms, spores, and dust. The infusion may be drawn from the bottle as wanted by the rubber tube and syphon, the flow being controlled by the pinchcock.

INFUSUM DIGITALIS. U.S. Infusion of Digitalis

[Inf. Digit.—Withering's Infusion]

	Metric	Alternative
Digitalis, in fine powder	**15 Gm.**	½ oz. av.
Alcohol	**100 cc.**	3 fl. oz. 96 min.
Cinnamon Water	**150 cc.**	4 fl. oz. 384 min.
Boiling Water	**700 cc.**	22½ fl. oz.
Cold Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Upon the digitalis, contained in a suitable vessel, pour the boiling water, tightly cover, and allow it to macerate for one hour. Filter, add the alcohol and cinnamon water to the filtrate, and pass enough cold water through the residue on the filter to make the product measure 1000 cc. [2 pints]. Mix well.

The U.S.P. X directs a fine powder corresponding to about a No. 60, for the digitalis, instead of the "bruised leaves", since so often the stems or midribs constituted the larger part of the drug, due to the softer parts of the leaf having broken away and sifted to the bottom of the container. Very fine powder must not be employed, however, or filtration is greatly retarded. Alcohol has again been added as a preservative. The infusion is not to be made up for stock, however, but should be freshly prepared from the assayed leaves and should never be made from the fluidextract or tincture.

It is very important to use a vessel for the infusion which will not quickly lose the heat, and to macerate for the full hour, otherwise the drug will not be completely extracted.

Alcohol content, by volume, 8.5 to 9.5 per cent.

Uses—In various heart and kidney diseases.

Average dose—1½ fluidrachms (6 cc.).

INFUSUM BRAYERÆ. N.F. Infusion of Brayera

[Inf. Brayer.]

	Metric	Alternative
Brayera, in coarse powder	**60 Gm.**	2 oz. av.
Boiling Water	**1000 cc.**	2 pints

Pour the boiling water upon the brayera, and allow it to macerate in a covered vessel until cool.

Dispense this Infusion without straining, and only when recently prepared.

Uses—A vermifuge, especially used against tape worm.

Average dose—8 fluidounces (250 cc.).

INFUSUM GENTIANÆ COMPOSITUM. N.F. Compound Infusion of Gentian

[Inf. Gentian. Co.]

	Metric	Alternative
Gentian, in moderately coarse powder	**30 Gm.**	1 oz. av.
Coriander, in moderately coarse powder	**8 Gm.**	117 gr.
Bitter Orange Peel, in moderately coarse powder	**8 Gm.**	117 gr.
Diluted Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Moisten the powdered drugs with diluted alcohol, pack in a percolator, and percolate with diluted alcohol until the product measures 250 cc. [8 fl. oz.]. To this add sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 11 per cent.

Uses—A bitter tonic and vehicle.

Average dose—4 fluidrachms (15 cc.).

INFUSUM ROSÆ COMPOSITUM. N. F. Compound Infusion of Rose

[Inf. Ros. Co.]

	Metric	Alternative
Rose	13 Gm.	190 gr.
Diluted Sulphuric Acid	9 cc.	138 min.
Sucrose	40 Gm.	1 oz. av. 147 gr.
Boiling Water	1000 cc.	2 pints

Pour the boiling water upon the rose in a glass or porcelain vessel, add the acid, cover the vessel; and digest the drug during one hour. Then dissolve the sucrose in the liquid and strain the infusion.

Uses—A mild astringent.

Average dose—3 fluidounces (100 cc.).

INFUSUM SENNÆ COMPOSITUM. N. F. Compound Infusion of Senna

(U. S. P. IX)

[Inf. Senn. Co.]

	Metric	Alternative
Senna	60 Gm.	2 oz. av.
Manna	120 Gm.	4 oz. av.
Magnesium Sulphate	120 Gm.	4 oz. av.
Fennel, bruised	20 Gm.	292 gr.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Pour 800 cc. [25½ fl. oz.] of boiling water upon the senna, manna, and fennel contained in a suitable vessel, and allow the mixture to macerate for half an hour. Then strain, express, and dissolve the magnesium sulphate in the infusion and again strain. Lastly, add sufficient water through the strainer to make the Infusion measure 1000 cc. [2 pints].

This preparation must not be dispensed unless it has been recently prepared.

History—*Black Draught* as this preparation is commonly called in some sections and which name has been confused with serious results, with *"black drop"* which is *vinegar of opium* or *Quaker Laudanum*, originated in a preparation devised by an Italian physician in 1600 at the court of Emperor Rudolph II of Germany. The original preparation was known variously as *Aqua, Potio* or *Elixir Laxativa Viennensis* and was popularly known as *"Wiener trank"*. The formula of the earlier preparation was more complicated than the present one.

Uses—A laxative.

Average dose—4 fluidounces (120 cc.).

Table of Some Unofficial Infusions

Unless otherwise stated use the following directions for the unofficial infusions listed below. Infuse the drug for fifteen minutes with 100 cc. of boiling distilled water in a covered vessel and strain.

Title	*Directions*
Infusum Alstoniæ (Br. 1914)	5 Gm. alstonia, bruised. Infuse for thirty minutes Dose: four fluidrachms (15 cc.)
Aurantii (Br. 1914)	5 Gm. of dried, bitter orange peel Dose: four fluidrachms (15 cc.)
Aurantii Compositum (Br. 1914)	2.5 Gm. dried, bitter orange peel, 1 Gm. lemon peel, 0.5 Gm. cloves, bruised Dose: four fluidrachms (15 cc.)
Buchu (Br. 1914)	5 Gm. buchu leaves Dose: one fluidounce (30 cc.)
Calumbæ (Br. 1914)	5 Gm. calumba root. Infuse for thirty minutes Dose: one fluidounce (30 cc.)
Caryophylli (Br. 1914)	2.5 Gm. cloves, bruised Dose: one fluidounce (30 cc.)
Cascarillæ (Br. 1914)	5 Gm. cascarilla Dose: one fluidounce (30 cc.)
Chiratæ (Br. 1914)	5 Gm. chiretta Dose: four fluidrachms (15 cc.)
Cinchonæ (N. F. IV)	Mix 10 cc. of aromatic sulphuric acid with 500 cc. of water and percolate 60 Gm. of cinchona (No. 40 powder) first with this mixture and then with enough water to make 1000 cc. Dose: twelve fluidrachms (50 cc.)
Ergotæ (Br. 1914)	5 Gm. of ergot, freshly crushed Dose: two fluidounces (60 cc.)
Krameriæ (Br. 1914)	5 Gm. of krameria root, bruised Dose: one fluidounce (30 cc.)

Table of Some Unofficial Infusions—*Continued*

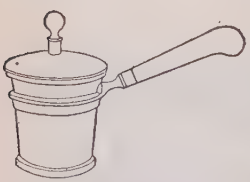
Title	*Directions*
Infusum Pruni Virginianæ (N. F. IV)	Macerate 40 Gm. of Wild Cherry in No. 20 powder in a percolator with 900 cc. of cold water for three hours. Then percolate into 50 cc. of glycerin and after pressing the drug, pour on enough water to make the percolate measure 1000 cc. Mix well Dose: two fluidounces (60 cc.)
Quassiæ (Br. 1914)	1 Gm. quassia wood, rasped Dose: two fluidounces (60 cc.)
Rhei (Br. 1914)	5 Gm. rhubarb root, sliced Dose: one fluidounce (30 cc.)
Salviæ	3.2 Gm. sage. Infuse for thirty minutes
Scoparii (Br. 1914)	10 Gm. broom tops, bruised Dose: one fluidounce (30 cc.)
Senegæ (Br. 1914)	5 Gm. of senega root, No. 10 powder. Infuse for thirty minutes Dose: one fluidounce (30 cc.)
Sennæ (Br. 1914)	10 Gm. of senna; 0.5 Gm. ginger, sliced Dose: two fluidounces (60 cc.)
Uvæ Ursi (Br. 1914)	5 Gm. bearberry leaves, bruised Dose: one fluidounce (30 cc.)

Decocta—*Decoctions*

Decoctions are liquid preparations made by *boiling* vegetable substances with water. The object sought in preparing decoctions is to secure, in aqueous solution, the soluble active principles of drugs which are not injured by heat. It is obvious that very few drugs are suited to this form of administration, and decoctions are rapidly declining in favor. Hot infusion will generally afford a means of obtaining all the benefits that are derived from boiling the drug with water, while the prolonged action of boiling water generally exercises a dissociating effect upon the active principles. The disadvantages of hot infusions are possessed in a more marked degree by decoctions (see page 357). In compound decoctions the ingredients are preferably added at different periods of the operation, the hard, ligneous drugs being added first, and the aromatics, or those containing volatile oils, at the close of the process, so that loss of activity of the latter may not ensue.

The earthenware or porcelain vessels used in preparing infusions are preferred for decoctions (see page 358), as they will bear the heat of boiling water, if heated gradually. Fig. 421 shows a block-tin vessel employed for preparing decoctions, used largely in Germany and to some extent here. It is preferably used in connection with the brass water bath, *R* (see Fig. 422). The rim, *F*, is somewhat flexible, while a small aperture permits the escape of steam. The empyreumatic odor which many decoctions possess when made over a naked fire, and caused by particles adhering to the bottom of the vessel and becoming charred, is avoided by the use of the water bath.

Fig. 421



Block-tin decoction vessel

Fig. 422

Brass water bath

The use of iron vessels is not advisable, because of the discoloration which is caused by the tannin of astringent drugs reacting with the iron, but the white enameled, double boilers are admirably suited for the making of decoctions.

A general formula for decoctions is given in the U. S. P. X as follows:

Official General Process for Decoctions

Decoctions must be freshly made, and when their strength is not otherwise directed, they are to be prepared by the following general formula:

	Metric	Alternative
The Drug, coarsely comminuted	**50 Gm.**	365 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	1 pint

Place the drug in a suitable vessel provided with a cover, pour upon it 1000 cc. [1 pint] of cold water, cover it well, and boil for fifteen minutes. Then allow it to cool to about 40° C., express, strain the expressed liquid, and pass enough cold water through the strainer to make the product measure 1000 cc. [1 pint].

Caution—The strength of decoctions of energetic or powerful drugs should be specially directed by the physician.

Table of Some Unofficial Decoctions

Title	*Directions*
Decoctum Acaciæ Corticis (Br. 1914)	Boil 6 Gm. of bruised acacia bark with 120 cc. of distilled water for ten minutes, strain and add enough distilled water to make 100 cc. Dose: four fluidrachms (15 cc.)
Agropyri (Br. 1914)	Boil 5 Gm. of cut couch grass with 120 cc. of distilled water for ten minutes, strain and add enough distilled water to make 100 cc. Dose: four fluidrachms (15 cc.)
Aloes Compositum (Br. 1914)	Coarsely powder 1 Gm. of extract of aloes and 0.5 Gm. of myrrh and boil them with 0.5 Gm. of potassium carbonate and 4 Gm. of extract of liquorice in 40 cc. of water for five minutes. When cold, add 30 cc. of compound tincture of cardamom, set aside for two hours, strain and add enough distilled water to make 100 cc. Dose: four fluidrachms (15 cc.)
Cetrariæ (U. S. P. 1890)	Macerate 5 Gm. of cetraria with 40 cc. of cold water for thirty minutes, express and throw the liquid away. Boil the residue with 100 cc. of water for thirty minutes, strain and add water to make 100 cc.
Gossypii Radicis Corticis (Br. 1914)	Boil 20 Gm. of bruised cotton root bark with 200 cc. of distilled water until reduced to about 100 cc. Strain and add enough water to make 100 cc. Dose: four fluidrachms (15 cc.)
Hæmatoxyli (Br. 1914)	Boil 5 Gm. of logwood with 120 cc. of water for ten minutes, adding 1 Gm. of cinnamon bark toward the end of the time, strain, and add enough water to make 100 cc. Dose: two fluidounces (60 cc.)
Ispaghulæ (Br. 1914)	Boil 1.5 Gm. of bruised ispaghula with 120 cc. of distilled water for ten minutes, strain and add enough distilled water to make 100 cc. Dose: four fluidrachms (15 cc.)
Sappan (Br. 1914)	Boil 5 Gm. of sappan, in chips, with 120 cc. of water for ten minutes, adding 1 Gm. of bruised cinnamon bark toward the end of the time. Strain and add water to make 100 cc. Dose: four fluidrachms (15 cc.)
Sarsaparillæ Compositum (N. F. IV)	Boil 10 Gm. of sarsaparilla, cut and bruised and 2 Gm. of guaiac wood, rasped, with 100 cc. of water for thirty minutes, replacing any water lost by evaporation. Then add 2 Gm. of sassafras, No. 20 powder, 2 Gm. of glycyrrhiza (cut and bruised) and 1 Gm. of mezereum and macerate in a covered vessel for two hours. Strain and add enough cold water to make 100 cc. Dose: four fluidounces (120 cc.)
Sarsaparillæ Compositum Fortius (Zittmann's Decoction Stronger)	Macerate 20 Gm. of cut sarsaparilla in 520 cc. of water for twenty-four hours, add 1 Gm. of sucrose and 1 Gm. of alum and digest on a water bath for three hours Add 1 Gm. of bruised anise, 1 Gm. of bruised fennel, 5 Gm. of cut senna and 2 Gm. of cut liquorice root and digest for 15 minutes. Strain and add enough water to make 500 cc.
Sarsaparillæ Compositum Mitius (Zittmann's Decoction Milder)	Macerate 10 Gm. of cut sarsaparilla in 480 cc. of water for twenty-four hours, then digest on a water bath for three hours and afterwards add 1 Gm. cut lemon peel, 1 Gm. bruised cinnamon, 1 Gm. bruised cardamom and 1 Gm. of cut liquorice root, digest for fifteen minutes, strain and add enough water to make 500 cc.

CHAPTER XXXII

ALCOHOLIC LIQUIDS MADE BY PERCOLATION OR MACERATION

Tincturæ—*Tinctures*

Tinctures are liquid preparations made by extracting the useful principles from drugs by the use of appropriate menstrua or solvents containing alcohol. There are, however, several exceptions, in which chemical substances are dissolved in alcoholic liquids. Tinctures differ from spirits in being made from *non-volatile* bodies, the tinctures containing iodine being the only exception to this rule. They are made by percolation, maceration, solution, or dilution and the menstrua employed in the official tinctures are alcohol, dilute alcohol of various strengths, aromatic spirit of ammonia, ether, ammonia water, or mixtures of alcohol, water, and glycerin. In some unofficial tinctures, spirit of ether, ammoniated alcohol, and spirit of nitrous ether are used. The use of alcohol as a solvent for the active or useful principles in drugs has been practiced for many years, but it has required a long time and much experience to determine the proper proportion of water to add to the alcohol. The menstrua should dissolve the therapeutically valuable constituents of the drugs without extracting the inert principles, and yet contain sufficient alcohol to secure permanent preparations that will not in time deposit a portion of their active constituents. The advantages of alcohol as a menstruum have been proved so thoroughly, that the use of aqueous preparations has greatly declined in this country; and yet there are some instances, particularly in the case of the weak tinctures and those requiring a large dose, in which the therapeutic action of the menstruum almost equals that of the drug. In these cases, however, the physician may prefer the fluidextract when he does not desire the stimulating action of the alcohol in the tincture.

In selecting the menstrua the proportion of water in each case is made as high as possible without endangering the permanency of the preparation, one especial advantage being that such tinctures may be added in small proportions to aqueous preparations without serious precipitation. In this respect tinctures have usually a great advantage over fluidextracts, and weaker alcoholic menstrua are often used successfully for tinctures when they would be entirely unsuitable for fluidextracts. This may be explained by the fact that tinctures, on account of their comparative weakness, have a much larger proportion of menstruum than fluidextracts with which to exhaust the drug, and may therefore have the excess over the proportion of alcohol used in the fluidextract made up with water. It has been proved that a pint of diluted alcohol will extract by percolation a larger proportion of the soluble principles of a drug than half a pint of alcohol and half a pint of water percolated separately through the drug. The properties of *alcohol* are considered under another head (page 905), yet it seems desirable to note here the solvent properties of this valuable preservative. It mixes freely with water, ether, acetic acid, a number of volatile oils, and castor oil; it dissolves resins, stearoptens, tannins, organic acids, chlorophyll, alkaloids, balsams, iodine, ferric chloride, ammonium carbonate, etc. *Diluted alcohol* extracts from drugs, gum, extractive, chlorophyll, albumin, coloring matter, resins, volatile oils, alkaloids, sugar, tannin, etc. *Glycerin* is used in tinctures to prevent precipitation by retaining in solution principles which would otherwise in time be deposited.

The Strength of Tinctures—For many years there was no uniformity in the proportion of drug to finished tincture but the Brussels Protocol of 1902 established a general principle which has brought about international uniformity. The Protocol agreement provided for 10 per cent drug strength in tinctures of potent or therapeutically active drugs and 20 per cent strength for other tinctures. There is practical conformity to this agreement in the U. S. P., the strength, however, being slightly differently expressed, *i.e.* 10 Gm. of potent drug represented by 100 cc. of tincture, instead of 10 per cent, by weight, and 20 Gm. per 100 cc. for others. The difference is negligible, simply meeting the conditions in this country where finished products are usually measured instead of weighed.

There are several exceptions to this general rule, as in tincture of iodine (7 Gm. per 100 cc.) and in the tinctures of orange peel and lemon peel (50 Gm. per 100 cc.), but special conditions governed the decisions in these cases.

A number of tinctures are to be assayed and the final volume adjusted to conform with the rubrics, but the standard of strength adopted represents an average drug in an amount equivalent to the International agreement.

Preparation—There are three different methods represented in the processes for making tinctures: 1. By percolation. 2. By maceration. 3. By solution or dilution.

1. **By Percolation**—This is the best method for making tinctures, when the drugs are capable of being readily comminuted and extracted, and it is always directed by the Pharmacopœia when practicable. The special advantages of percolation over maceration and expression are seen in the saving of time and labor, and in the greater efficiency of the product if the process has been carefully and skilfully performed. The U. S. P. has provided a Type Process for tinctures which are to be made by *Percolation*. In the text under the title only the drug, the size of the powder, and the menstruum are given, and reference is then made to the Type Process which is as follows:

Type Process P—Percolation

Moisten the powdered drug or mixed drugs designated in the formula with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp and to maintain it so after macerating for six hours in a tightly-covered container. Transfer it to a percolator, pack it firmly, unless otherwise directed, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the menstruum to make the finished tincture measure 1000 cc. and mix thoroughly.

Modification for Assayed Tinctures—In tinctures that are directed to be assayed, allow the percolation to proceed until the percolate measures 950 cc. Assay a portion of this percolate as directed and from the alkaloidal content thus determined, or from the biological activity, ascertain by calculation the strength of the remainder of the liquid, and make the finished tincture conform to the required standard, adding sufficient of the menstruum if necessary, and mix thoroughly.

2. **By Maceration**—This method of making tinctures is officially used in the case of resins, balsams, gums, soap, etc., where the practical difficulties likely to be encountered in percolation would offset any advantages that the latter process might possess (see page 231). The U. S. P. also provides a Type

Process for tinctures to be made by *Maceration*, only giving the title, drug, size of powder, and the menstruum, with reference to the Type Process, which is as follows:

Type Process M—Maceration

Macerate the drug or mixed drugs designated in the formula in a stoppered container, in a moderately warm place, with 750 cc. of the prescribed solvent (unless a different amount is specified in the formula). Continue the maceration with frequent agitation during three days or until the active constituents of the drug are practically extracted. Transfer the mixture to a filter, and, when the liquid has drained off, gradually wash the residue on the filter with enough of the solvent directed to make the filtrate measure 1000 cc., and mix thoroughly.

3. **By Solution or Dilution**—A few tinctures are made in this way, such as tincture of iodine, by dissolving iodine in a solution of potassium iodide and adding alcohol; tincture of ferric chloride, by diluting the solution of ferric chloride with alcohol, etc.

TINCTURA ACONITI. U.S. Tincture of Aconite

[Tr. Aconit.—Aconiti Tinctura P. I.]

Tincture of Aconite, administered subcutaneously to guinea pigs, has a minimum lethal dose of not less than 0.00,035 cc. and not more than 0.00,045 cc. for each Gm. of body weight of guinea pig.

	Metric	Alternative
Aconite, in fine powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (page 365), using a mixture of 7 volumes of alcohol and 3 volumes of water as the menstruum. Adjust the volume of the finished Tincture to conform to the above biological standard.

Assay—Use guinea pigs weighing from 275 Gm. to 325 Gm. each and in good health. Dilute the Tincture with distilled water to make the dose about 1 cc., and inject into the guinea pig under the skin of the abdomen. The standard dose must kill within six hours at least two of every three guinea pigs injected.

This assay is explained on page 1506.

Alcohol content, by volume, 61 to 65 per cent.

An assayed tincture only should be dispensed, as aconite is easily rendered inert through the decomposition of the aconitine.

In the U. S. P. 1890 Tincture of Aconite, each 100 cc. represented 35 Gm. of drug, so that the tincture was three and one-half times stronger than the present official tincture. In the renewal of old prescriptions this former strength may be required.

N. F. Preparations—Dentilinimentum Aconiti Compositum; Dentilinimentum Aconiti et Iodi Compositum.

Uses—A cardiac, circulatory sedative, used in fevers and heart disease. It must be used with caution.

Average dose—10 minims (0.6 cc.).

TINCTURA ASAFŒTIDÆ. U.S. Tincture of Asafetida

[Tr. Asafœt.]

	Metric	Alternative
Asafetida, bruised	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), using alcohol as the solvent.

Alcohol content, by volume, 78 to 85 per cent.

N. F. Preparation—Mistura Magnesii, Asafœtidæ et Opii.

Uses—Employed as a carminative and for flatulence. Also used in hysteria and as an expectorant in bronchitis.

Average dose—15 minims (1 cc.).

TINCTURA AURANTII AMARI. U. S. Tincture of Bitter Orange Peel

[Tr. Aurant. Amar.]

	Metric	Alternative
Bitter Orange Peel, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using a mixture of 3 volumes of alcohol and 2 volumes of water as the menstruum.

Alcohol content, by volume, 53 to 56 per cent.

N. F. Preparation—Elixir Aurantii Amari.

Uses—An adjuvant; used for its flavor and bitterness.

Average dose—1 fluidrachm (4 cc.).

TINCTURA AURANTII DULCIS. U. S. Tincture of Sweet Orange Peel

[Tr. Aurant. Dulc.]

	Metric	Alternative
Sweet Orange Peel, the outer yellow rind, grated from the fresh fruit	**500 Gm.**	16 oz. av. 302 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), macerating the drug in 1000 cc. [2 pints] of alcohol and completing the preparation with alcohol. Use purified cotton as the filtering medium.

The white portion of the rind must not be used, as the proportion of oil, which is only in the yellow rind, is reduced and the bitter principle hesperidin is introduced.

Alcohol content, by volume, 73 to 76 per cent.

U. S. P. Preparation—Syrupus Aurantii.

N. F. Preparations—Elixir Gentianæ Glycerinatum; Elixir Pepsini et Rennini Compositum; Elixir Taraxaci Compositum; Elixir Terpini Hydratis.

Uses—A flavor, used almost exclusively in syrups and elixirs. This tincture was introduced to insure a delicate orange flavor direct from the fruit instead of depending upon the oil of orange which so frequently is terebinthinate and unfit for use. The tincture keeps well.

Average dose—1 fluidrachm (4 cc.).

TINCTURA BELLADONNÆ. U. S. Tincture of Belladonna

[Tr. Bellad.—Tinctura Belladonnæ Foliorum U. S. P. IX, Belladonnæ Tinctura P. I.]

Tincture of Belladonna yields, from each 100 cc., not less than 0.027 Gm. and not more than 0.033 Gm. of the alkaloids of belladonna leaves.

	Metric	Alternative
Belladonna Leaves, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (page 365), using diluted alcohol as the menstruum, and adjust the volume of the finished Tincture by the addition of diluted alcohol to make each 100 cc. contain 0.03 Gm. of the alkaloids of belladonna leaves.

Assay—Proceed by Type Process D, taking 100 cc. of Tincture of Belladonna, use chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.02893 Gm. of the alkaloids of belladonna leaves (Proximate Assays, pages 1496 and 1499).

Alcohol content, by volume, 44 to 47 per cent.

Uses—To check excessive secretion (as sweat), to relieve local spasms, especially of the bowel, as a circulatory and respiratory stimulant, etc.

Average dose—10 minims (0.6 cc.).

TINCTURA BENZOINI. U.S. Tincture of Benzoin

[Tr. Benz.]

	Metric	Alternative
Benzoin, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), using alcohol as the solvent.

Alcohol content, by volume, 75 to 83 per cent.

N. F. Preparation—Unguentum Picis Compositum.

Uses—Chiefly employed in the preparation of toilet lotions when combined with rose water and glycerin. The Sumatra benzoin is preferable for this purpose, the Siam variety not containing sufficient gum to produce a satisfactory suspension.

Average dose—15 minims (1 cc.).

TINCTURA BENZOINI COMPOSITA. U.S. Compound Tincture of Benzoin

[Tr. Benz. Co.]

	Metric	Alternative
Benzoin, in moderately coarse powder	**100 Gm.**	1 oz. av. 148 gr.
Aloe, in moderately coarse powder	**20 Gm.**	292 gr.
Storax	**80 Gm.**	2 oz. av. 293 gr.
Tolu	**40 Gm.**	1 oz. av. 147 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), using alcohol as the solvent.

Alcohol content, by volume, 74 to 80 per cent.

Average dose—30 minims (2 cc.).

Uses—Especially valuable in acute laryngitis, as in croup, when added to hot water and the vapor inhaled. By adding a teaspoonful of the tincture to boiling water in a teapot, and drawing the vapor through the spout into the throat, very effective results may be obtained. Also administered, in sugar, for throat and bronchial inflammation and as a local application, when mixed with glycerin and water, for ulcers, bedsores, cracked nipples, and the fissures of the lips and anus.

History—This popular preparation has had more different Latin titles and synonyms since its origin in the fifteenth or sixteenth century than any other official preparation. Many of these are significant of its uses or its originators, introducers or patrons, for it has figured as a nostrum as well as in the pharma-

copœias of the past three hundred years. Among these names are: *Balsamum Equitis Sancti Victoris, Balsamum Commendatoris, Balsamum Catholicum, Balsamum Traumaticum, Balsamum Vulnerarium, Balsamum Persicum, Balsamum Suecium, Balsamum Friari, Balsamum Vervaini, Guttæ Nader, Guttæ Jesuitarum, Tinctura Balsamica, Balsam of the Holy Victorious Knight, Commander's Balsam, Turlington's Drops, Persian Balsam, Swedish Balsam, Vervain Balsam, Turlington's Balsam of Life, Balsam de Maltha, Ward's Balsam, Jerusalem Balsam, Saint Victor's Balsam, Wade's Drops, Wound Elixir,* and *Balsamic Tincture.* Some of the older formulas contained myrrh, olibanum, angelica root and St. John's-wort flowers in addition to the present ingredients. Peruvian balsam sometimes replaced the tolu.

TINCTURA CALUMBÆ. U.S. Tincture of Calumba
[Tr. Calumb.]

	Metric	Alternative
Calumba, in coarse powder	200 Gm.	6 oz. av. 296 gr.
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (page 365), packing the moistened drug moderately and using a mixture of 3 volumes of alcohol and 2 volumes of water as the menstruum.

Alcohol content, by volume, 53 to 56 per cent.

Uses—A bitter tonic, especially useful in lack of tone in the gastrointestinal tract. *Average dose*—1 fluidrachm (4 cc.).

TINCTURA CANTHARIDIS. U.S. Tincture of Cantharides
[Tr. Canthar.—Cantharidis Tinctura P. I.]

	Metric	Alternative
Cantharides, in fine powder	100 Gm.	3 oz. av. 148 gr.
Glacial Acetic Acid	50 Gm.	1 fl. oz. 288 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Moisten the cantharides with a mixture of the glacial acetic acid and 50 cc. [1 fl. oz. 288 min.] of alcohol. Transfer it to a covered percolator and allow to macerate for twenty-four hours, then percolate slowly, using alcohol as the menstruum, until the Tincture measures 1000 cc. [2 pints].

Alcohol content, by volume, 82 to 87 per cent.

The preliminary digestion is necessary to insure the complete extraction of the cantharidin.

Uses—In amenorrhea and as a uterine stimulant. It must be used with caution as it is a powerful irritant to the urinary and genital organs. It frequently is employed as a stimulant in hair tonics.

Average dose—1½ minims (0.1 cc.).

TINCTURA CAPSICI. U.S. Tincture of Capsicum
[Tr. Capsic.]

	Metric	Alternative
Capsicum, in moderately coarse powder	100 Gm.	3 oz. av. 148 gr.
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (page 365), using a mixture of 95 volumes of alcohol and 5 volumes of water as the menstruum.

Tincture of Capsicum should meet the requirements of the following test: Mix 10 cc. of the tincture with 40 cc. of alcohol in a stoppered flask, and dilute 0.1 cc. of the clear liquid with 140 cc. of distilled water containing 10 per cent of sucrose. Five cc. of this dilution swallowed at one time will produce a distinct sensation of pungency in the mouth and throat of at least two out of three individuals.

The organoleptic test has been introduced to insure the selection of the true cayenne peppers, which possess the pungency and irritant quality expected of this Tincture.

Alcohol content, by volume, 84 to 88 per cent.

N. F. Preparations—Mistura Chloroformi et Morphinæ Compositа; Mistura Opii et Chloroformi Composita; Mistura Opii et Rhei Composita.

Uses—A gastro-intestinal stimulant. Also employed as a local counter-irritant by applying it on blotting paper.

Average dose—8 minims (0.5 cc.).

TINCTURA CARDAMOMI. U.S. Tincture of Cardamom
[Tr. Cardam.]

	Metric	Alternative
Cardamom Seed, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using diluted alcohol as the menstruum.

Alcohol content, by volume, 44 to 46 per cent.

N. F. Preparation—Vinum Rhei Compositum.

Uses—A tonic and aromatic.

Average dose—30 minims (2 cc.).

TINCTURA CARDAMOMI COMPOSITA. U.S. Compound Tincture of Cardamom
[Tr. Cardam. Co.]

	Metric	Alternative
Cardamom Seed, in moderately coarse powder	**20 Gm.**	292 gr.
Cinnamon, in fine powder	**25 Gm.**	365 gr.
Caraway, in moderately coarse powder	**12 Gm.**	175 gr.
Cochineal, in fine powder	**5 Gm.**	73 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), macerating the mixed powders in 750 cc. [24 fl. oz.] of a mixture of 50 cc. [1 fl. oz. 288 min.] of glycerin and 950 cc. [30 fl. oz. 192 min.] of diluted alcohol and completing the preparation by using first the remainder of the mixture prepared as directed above, and then diluted alcohol.

Alcohol content, by volume, 45 to 47 per cent.

N. F. Preparations—Elixir Euphorbiæ Compositum; Elixir Gentianæ Glycerinatum; Elixir Viburni Prunifolii; Syrupus Eriodictyi Aromaticus.

Uses—An agreeable aromatic and carminative; also used as a vehicle because of its pleasant flavor and beautiful color.

Average dose—1 fluidrachm (4 cc.).

TINCTURA CINCHONÆ. U.S. Tincture of Cinchona
[Tr. Cinch.]

Tincture of Cinchona yields, from each 100 cc., not less than 0.8 Gm. and not more than 1 Gm. of the alkaloids in cinchona.

	Metric	Alternative
Cinchona, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (page 365), using as the first menstruum a mixture of 75 cc. [2 fl. oz. 192 min.] of glycerin, 675 cc. [21 fl. oz. 288 min.] of alcohol, and 250 cc. [8 fl. oz.] of water, and completing the percolation with a mixture of 2 volumes of alcohol and 1 volume of water. Adjust the volume of the finished Tincture to make each 100 cc. contain 0.9 Gm. of the alkaloids of cinchona.

Assay—Proceed by Type Process C, taking 25 cc. of Tincture of Cinchona to which is added 5 cc. of diluted hydrochloric acid before evaporation, use 200 cc. of ether-chloroform mixture, and decant an aliquot portion of 160 cc. of the ethereal solution, representing 20 cc. of Tincture. Use chloroform for the final extraction and determine the alkaloids gravimetrically (Proximate Assays, pages 1497 and 1499).

Alcohol content, by volume, 60 to 64 per cent.

Uses—A bitter tonic, too weak in alkaloids to be of value in malaria.

Average dose—1 fluidrachm (4 cc.).

TINCTURA CINCHONÆ COMPOSITA. U.S. Compound Tincture of Cinchona

[Tr. Cinch. Co.]

Compound Tincture of Cinchona yields, from each 100 cc., not less than 0.4 Gm. and not more than 0.5 Gm. of the alkaloids of cinchona.

	Metric	Alternative
Cinchona, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Bitter Orange Peel, in moderately coarse powder	**80 Gm.**	2 oz. av. 293 gr.
Serpentaria, in fine powder	**20 Gm.**	292 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P as modified for assayed tinctures (page 365), using as the first menstruum a mixture of 75 cc. [2 fl. oz. 192 min.] of glycerin, 675 cc. [21 fl. oz. 288 min.] of alcohol, and 250 cc. [8 fl. oz.] of water, and complete the percolation with a mixture of 2 volumes of alcohol and 1 volume of water. Adjust the volume of the finished Tincture to make each 100 cc. contain 0.45 Gm. of the alkaloids of cinchona.

This has been known for many years as *Huxham's tincture* or *Tincture of Bark* and was always made from red cinchona. The latter is no longer distinguishable from yellow cinchona, due to extensive hybridizing, so that the U. S. P. X permits any cinchona bark to be used.

Assay—Proceed by Type Process C, taking 50 cc. of Compound Tincture of Cinchona, to which is added 5 cc. of diluted hydrochloric acid before evaporation, use 200 cc. of ether-chloroform mixture, and decant an aliquot portion of 160 cc., representing 40 cc., of the Tincture. Use chloroform for the final extraction and determine the alkaloids gravimetrically (Proximate Assays, pages 1497 and 1499).

Alcohol content, by volume, 58 to 64 per cent.

N. F. Preparation—Gargarisma Guaiaci Composita.

History—This preparation was devised by Dr. John Huxham and published in his essay on Fevers in 1755 and was first adopted in the London Pharmacopœia of 1788 as an official preparation.

Uses—An excellent bitter tonic but not suitable for malarial treatment. It should not be dispensed with forms of iron which combine with tannin to form inky products.

Average dose—1 fluidrachm (4 cc.).

TINCTURA COLCHICI. U.S. Tincture of Colchicum

[Tr. Colch.—Tinctura Colchici Seminis U.S.P. IX, Colchici Tinctura P. I.]

Tincture of Colchicum yields, from each 100 cc., not less than 0.036 Gm. and not more than 0.044 Gm. of colchicine.

	Metric	Alternative
Colchicum Seed, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (page 365), using a mixture of 3 volumes of alcohol and 2 volumes of water as the menstruum, and adjust the volume of the finished Tincture to make each 100 cc. contain 0.04 Gm. of colchicine.

This tincture is of the same drug strength as the N. F. IV *Wine of Colchicum Seed* which has been deleted. It is understood that this tincture is to be dispensed if the wine is prescribed. The Wine of Colchicum Corm was four times this strength and a 40 per cent tincture has been introduced into the N. F. to take its place (see Tinctura Colchici Cormi Fortior, page 388).

Assay—Evaporate 150 cc. of Tincture of Colchicum on a water bath to about 15 cc., cool, and dissolve the residue in sufficient distilled water to make 290 cc. Add 10 cc. of solution of lead subacetate, and agitate the mixture frequently during one hour. Filter off 200 cc. and proceed as directed under *Colchici Semen*, pages 1497 and 1499, line of the assay, beginning with the word "Add".

Alcohol content, by volume, 54 to 57 per cent.

Uses—In chronic rheumatism and gout.

Average dose—30 minims (2 cc.).

TINCTURA DIGITALIS. U.S. Tincture of Digitalis

[Tr. Digit.—Digitalis Tinctura P. I.]

Tincture of Digitalis, injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.0055 cc. and not more than 0.0065 cc. equivalent to not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each Gm. of body weight of frog.

	Metric	Alternative
Digitalis, in fine powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Pack the Digitalis firmly in a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids, and percolate slowly with purified petroleum benzin until a few drops of the percolate evaporated from filter paper leave no greasy stain. Reject the benzin percolate. Remove the drug from the percolator and expose it to the air until the odor of benzin is no longer noticeable. Prepare from this a tincture by Type Process P, as modified for assayed tinctures (page 365), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum. Adjust the volume of the finished Tincture to conform to the above biological standard.

Alcohol content, by volume, 67 to 72 per cent.

Assay—Proceed as directed on page 1504.

Uses—Employed as a stimulant in acute circulatory failure, as a diuretic in dropsical conditions, and as a cardiac tonic in heart disease. Only the physiologically assayed tincture should be dispensed.

Caution—It is sometimes prescribed in much larger doses than that mentioned. In such cases the pharmacist should assure himself that the dose prescribed is intended.

Average dose—15 minims (1 cc.).

TINCTURA FERRI CHLORIDI. U. S. Tincture of Ferric Chloride
[Tr. Ferr. Chlor.—Tincture of Iron]

A hydro-alcoholic solution containing about 13 per cent of ferric chloride [$FeCl_3$], corresponding to not less than 4.48 per cent of Fe.

	Metric	Alternative
Solution of Ferric Chloride	**350 cc.**	11 fl. oz. 96 min.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the solution with enough alcohol to make 1000 cc. [2 pints].

The requirement of many years standing, to age for at least three months, has been omitted from the U. S. P. X. This was for the purpose of developing ethyl chloride, the value of which has been questioned.

The description, tests and assay will be found on page 716.

Preserve in amber-colored, glass-stoppered bottles, protected from light.
Alcohol content, by volume, 58 to 64 per cent.

N. F. Preparation—Elixir Chloridorum.

Uses—A chalybeate in anemia, locally as an astringent in hemorrhages, and when mixed with glycerin, a local application for pharyngitis.

Average dose—10 minims (0.6 cc.).

TINCTURA GAMBIR COMPOSITA. U. S. Compound Tincture of Gambir
[Tr. Gambir Co.—Compound Tincture of Pale Catechu]

	Metric	Alternative
Gambir, in moderately coarse powder	**50 Gm.**	1 oz. av. 293 gr.
Cinnamon, in fine powder	**25 Gm.**	365 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), using diluted alcohol as the solvent.

Alcohol content, by volume, 44 to 47 per cent.

N. F. Preparation—Tinctura Opii et Gambir Composita.

Uses—An astringent, chiefly employed in diarrhea mixtures. This preparation replaces the former *Compound Tincture of Catechu*, catechu no longer being available. The two drugs are similar in character and constituents.

Average dose—1 fluidrachm (4 cc.).

TINCTURA GENTIANÆ COMPOSITA. U. S. Compound Tincture of Gentian
[Tr. Gentian. Co.]

	Metric	Alternative
Gentian, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Bitter Orange Peel, in moderately coarse powder	**40 Gm.**	1 oz. av. 147 gr.
Cardamom Seed, in moderately coarse powder	**10 Gm.**	146 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), packing the mixed drugs moderately, using as the first menstruum a mixture of 100 cc. [3 fl. oz. 96 min.] of glycerin, 500 cc. [1 pint] of alcohol and 400 cc. [12 fl. oz. 384 min.] of water, and completing the percolation with diluted alcohol.

Alcohol content, by volume, 43 to 47 per cent.

History—This was originally a patent medicine in England in 1712 under the name of *Stoughton's Great Cordial Elixir*, later shortened to *Stoughton's Elixir*.

Uses—A bitter tonic, much used in dyspepsia.

Average dose—1 fluidrachm (4 cc.).

TINCTURA HYOSCYAMI. U.S. Tincture of Hyoscyamus

[Tr. Hyosc.—Tincture of Henbane, Hyoscyami Tinctura P. I.]

Tincture of Hyoscyamus yields, from each 100 cc., not less than 0.0055 Gm. and not more than 0.0075 Gm. of the alkaloids of hyoscyamus.

	Metric	Alternative
Hyoscyamus, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (page 365), using diluted alcohol as the menstruum. Adjust the volume of the finished Tincture to make each 100 cc. contain 0.0065 Gm. of the alkaloids of hyoscyamus.

Assay—Proceed by Type Process D, taking 250 cc. of Tincture of Hyoscyamus, evaporate to about 25 cc., use chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.02893 Gm. of the alkaloids of hyoscyamus (Proximate Assays, pages 1498 and 1499).

Alcohol content, by volume, 44 to 46 per cent.

Uses—Employed to allay nervous irritation, particularly in nervous cough, whooping-cough, and colic. Also, to relieve local spasms, to check excessive secretion, and to give relief in urinary incontinence due to irritated bladder.

Average dose—30 minims (2 cc.).

TINCTURA IODI. U.S. Tincture of Iodine

[Tr. Iodi]

An alcoholic solution of iodine and potassium iodide, containing, in each 100 cc., not less than 6.5 Gm. and not more than 7.5 Gm. of I, and not less than 4.5 Gm. and not more than 5.5 Gm. of KI.

	Metric	Alternative
Iodine	**70 Gm.**	1 oz. av. 74 gr.
Potassium Iodide	**50 Gm.**	365 gr.
Distilled Water	**50 cc.**	384 min.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	1 pint

Dissolve the potassium iodide in the distilled water contained in a bottle graduated to 1000 cc. [1 pint], add the iodine, and agitate the mixture until solution is effected. Then add sufficient alcohol to make 1000 cc. [1 pint] of Tincture, and mix thoroughly.

The water has been added to this formula to assist in the solution of the iodine, which, in the presence of the potassium iodide, is rendered readily soluble. The potassium iodide was not introduced, however, to increase the iodine solubility, although advantage is taken of its presence to aid in the rapidity of solution, but it is added as a preservative and when present prevents the rapid change of iodine to hydriodic acid. It is, therefore, important not to omit it from the formula.

See also Iodum, page 575.

Assay for Potassium Iodide—Measure exactly 5 cc. of Tincture of Iodine, evaporate in a tared dish or watch glass on a water bath, and then add several small successive portions of water, drop by drop, until all of the iodine has volatilized and a white residue remains. The residue should weigh not less than 0.225 Gm. and not more than 0.275 Gm. and should respond to the tests for identity under *Potassii Iodidum.*

This assay is explained on page 1476.

Assay for Iodine—Measure exactly 5 cc. of the Tincture, dilute with 25 cc. of distilled water, and titrate the solution with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.01269 Gm. of I.

This assay is explained on page 1469.

Preserve in tightly-stoppered bottles, using only glass or rubber stoppers.

Alcohol content, by volume, 82 to 84 per cent.

Uses—Applied locally as a counterirritant, and also for its effect in sprains, chronic rheumatism, gout, chilblains, enlarged glands, and lymph-nodes, and under many other conditions.

It is extensively used to sterilize the skin before minor operations or injections, for disinfecting wounds, and in treating erysipelas, although for this purpose a half strength preparation (3.5 per cent) is usually employed. In this strength it is frequently available in ampuls for first aid treatment (see Ampullæ Iodi, Part XI). The International Protocol (P.I.) Tincture of Iodine contains 10 per cent of iodine in 95 per cent alcohol.

Average dose—1½ minims (0.1 cc.).

TINCTURA KINO. U.S. Tincture of Kino

[Tr. Kino]

	Metric	Alternative
Kino	**100 Gm.**	365 gr.
To make	**1000 cc.**	8 fl. oz.

Place the kino in a capacious flask, and pour on it 500 cc. [4 fl. oz.] of boiling water. Agitate the mixture thoroughly, and heat it for one hour on a water bath containing boiling water, shaking it frequently. Allow the liquid to cool, add enough recently boiled water to make the product measure 500 cc. [4 fl. oz.], and add 500 cc. [4 fl. oz.] of alcohol. Stopper the flask, set it aside in a cool place for twenty-four hours, and then decant the mixture through cheesecloth.

The preliminary heating in the process of manufacture for this tincture is to destroy an enzyme, naturally existent in the drug, which if present would soon cause gelatinization of the tincture.

Preserve in a cool, dark place in small bottles, tightly stoppered.
Alcohol content, by volume, 45 to 47 per cent.

N. F. Preparation—Tinctura Kino et Opii Composita.

Uses—Employed as an astringent, especially in diarrhea.

Average dose—1 fluidrachm (4 cc.).

TINCTURA KRAMERIÆ. U.S. Tincture of Krameria

[Tr. Kramer.]

	Metric	Alternative
Krameria, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using diluted alcohol as the menstruum.

Alcohol content, by volume, 40 to 45 per cent.

Uses—An astringent, employed in diarrhea mixtures.

Average dose—1 fluidrachm (4 cc.).

TINCTURA LAVANDULÆ COMPOSITA. U.S. Compound Tincture of Lavender

[Tr. Lavand. Co.—Compound Spirit of Lavender]

	Metric	Alternative
Oil of Lavender	**8 cc.**	123 min.
Oil of Rosemary	**2 cc.**	31 min.
Cinnamon, in moderately coarse powder	**20 Gm.**	292 gr.
Clove, in moderately coarse powder	**5 Gm.**	73 gr.
Myristica, in moderately coarse powder	**10 Gm.**	146 gr.
Red Saunders, in moderately coarse powder	**10 Gm.**	146 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), macerating the mixed drugs in a mixture of 750 cc. [24 fl. oz.] of alcohol, in which the oils have been dissolved, and 250 cc. [8 fl. oz.] of water. Complete the preparation with a menstruum of 3 volumes of alcohol and 1 volume of water.

Alcohol content, by volume, 67 to 72 per cent.

U. S. P. Preparation—Liquor Potassii Arsenitis.
N. F. Preparations—Mistura Copaibæ; Mistura Copaibæ et Opii.

History—This was at first a very complex preparation, containing more than 25 ingredients, in the London Pharmacopœia of 1721. It was at one time called *Palsy Drops*.

Uses—Employed in nausea and flatulence.

Average dose—30 minims (2 cc.).

TINCTURA LIMONIS. U. S. Tincture of Lemon

[**Tr. Limon.**—TINCTURA LIMONIS CORTICIS U. S. P. IX]

	Metric	Alternative
Lemon Peel (the outer yellow rind, grated from the fresh fruit)	**500 Gm.**	16 oz. av. 302 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), macerating the drug in 1000 cc. [2 pints] of alcohol, and complete the preparation with alcohol. Use purified cotton as the filtering medium.

The white portion of the rind must not be used, as the proportion of oil, which is only in the yellow rind, is reduced and the bitter principle, hesperidin, introduced.

Alcohol content, by volume, 70 to 75 per cent.

U. S. P. Preparation—Syrupus Acidi Citrici.
N. F. Preparation—Emulsum Petrolati.

Uses—It is intended to replace oil of lemon as a flavor, its fineness of flavor being assured as it comes from the fresh fruit, and being in alcoholic solution it is more stable than the oil.

TINCTURA LOBELIÆ. U. S. Tincture of Lobelia

[**Tr. Lobel.**—LOBELIÆ TINCTURA P. I.]

	Metric	Alternative
Lobelia, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using diluted alcohol as the menstruum.

Alcohol content, by volume, 44 to 47 per cent.

Uses—An anti-asthmatic and nauseating expectorant.

Average dose—15 minims (1 cc.).

TINCTURA MYRRHÆ. U. S. Tincture of Myrrh

[**Tr. Myrrh.**]

	Metric	Alternative
Myrrh, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), using alcohol as the solvent.

Alcohol content, by volume, 83 to 88 per cent.

Uses—A local stimulant application to indolent ulcers, sore gums, sore mouth, and ulcerated sore throat.

Average dose—30 minims (2 cc.).

TINCTURA NUCIS VOMICÆ. U.S. Tincture of Nux Vomica

[**Tr. Nuc. Vom.**—Strychni Tinctura P. I.]

Tincture of Nux Vomica yields, from each 100 cc., not less than 0.237 Gm. and not more than 0.263 Gm. of the alkaloids of nux vomica.

	Metric	Alternative
Nux Vomica, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (page 365), using a mixture of 10 cc. [154 min.] of acetic acid, 750 cc. [24 fl. oz.] of alcohol, and 240 cc. [7 fl. oz. 326 min.] of water as the first menstruum, and completing the percolation with a mixture of 3 volumes of alcohol and 1 volume of water. Adjust the volume of the finished tincture by the addition of sufficient of the second menstruum to make each 100 cc. contain 0.25 Gm. of the alkaloids of nux vomica. Cool the Tincture in a proper container by exposure to a temperature of 5° C., and filter.

Assay—Proceed by Type Process D, taking 50 cc. of Tincture of Nux Vomica, use chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.0364 Gm. of the alkaloids of nux vomica (Proximate Assays, pages 1498 and 1499).

Alcohol content, by volume, 67 to 72 per cent.

N. F. Preparation—Elixir Phosphori et Nucis Vomicæ.

Uses—A bitter tonic, useful in lack of tone in the gastro-intestinal area.

Average dose—15 minims (1 cc.).

TINCTURA OPII. U.S. Tincture of Opium

[**Tr. Opii.**—Tinctura Opii Deodorati U.S.P. IX, Laudanum, Tincture of Deodorized Opium, Denarcotized Tincture of Opium, Opii Tinctura P. I.]

Tincture of Opium yields, from each 100 cc., not less than 0.95 Gm. and not more than 1.05 Gm. of anhydrous morphine.

	Metric	Alternative
Granulated Opium	**100 Gm.**	3 oz. av. 148 gr.
Paraffin	**50 Gm.**	1 oz. av. 293 gr.
Alcohol	**200 cc.**	6 fl. oz. 192 min.
Water, a sufficient quantity,		
To make about	**1000 cc.**	2 pints

Heat 500 cc. [1 pint] of water to boiling, pour it on the granulated opium contained in a suitable vessel, and stir the mixture frequently during twenty-four hours. Transfer the mixture to a percolator, and, when the original menstruum has ceased to drop, continue the percolation slowly, gradually adding water until the opium is exhausted.

Concentrate the percolate by evaporation on a water bath until it measures 150 cc. [4 fl. oz. 384 min.], add the paraffin, and continue the heating until this is entirely melted. Beat the mixture thoroughly and set it aside to cool.

When cool, pierce a hole through the top layer of paraffin and drain off the liquid, add to this 600 cc. [19 fl. oz.] of water, and filter, add the alcohol to the filtered liquid, and wash the residual paraffin and the filter with small portions of water until the combined liquids measure 950 cc. [30½ fl. oz.].

Assay a portion of this liquid as directed below, and, from the morphine content thus determined, ascertain by calculation the amount of anhydrous morphine in the remainder of the liquid, and adjust the volume of the finished Tincture by the addition of a mixture of 1 volume of alcohol and 4 volumes of water, to make each 100 cc. contain 1 Gm. of anhydrous morphine.

The U. S. P. X dropped the old formula for Laudanum and recognizes but one Tincture of Opium, which meets every need. The treatment with paraffin denarcotizes the preparation, making it less likely to produce nausea than the older tincture.

Assay—Evaporate 80 cc. of Tincture of Opium on a water bath until the alcohol is removed. Then proceed as directed in the assay under *Opium*, pages 1498 and 1499, thirteenth line of the Assay, beginning with the word "transfer". The result of the assay indicates the amount of morphine obtained from 40 cc. of the Tincture of Opium.

Alcohol content, by volume, 17 to 19 per cent.

N. F. Preparations—Linimentum Opii Compositum; Lotio Plumbi et Opii; Mistura Carminativa; Mistura Copaibæ et Opii; Mistura Magnesiæ, Asafœtidæ et Opii; Mistura Opii et Chloroformi Composita; Mistura Opii et Rhei Composita; Tinctura Ipecacuanhæ et Opii; Tinctura Opii et Gambir Composita.

History—The name Laudanum was invented by Paracelsus who applied it to a solid preparation of secret composition. The Laudanum of the early editions of the London Pharmacopœia (17th century) were solid preparations of Opium.

The first liquid preparation of opium to be called Laudanum was the crocated tincture of opium now official in the N. F. and originated by Doctor Sydenham about 1670.

Black Drop or *Quaker Laudanum* were the synonyms for Vinegar of Opium which is no longer official, but which was originally three times the strength of ordinary laudanum.

The word laudanum, according to Quercetanus who wrote a pharmacopœia in 1619, is derived from the Latin *laudo* to praise, on account of the praiseworthy character of the remedy.

The original deodorized tincture of opium had its origin in a secret preparation made by a London druggist named Battley, under the name Liquor Opii Sedativus.

Uses—Employed whenever opium is indicated. It relieves violent pain, produces sleep, allays inflammation and irritation, and reduces secretions. The latter property explains its use in many diarrhea mixtures.

Average dose—10 minims (0.6 cc.).

Caution—This tincture is subject to the rules and regulations of the Narcotic Act and should never be used or dispensed without a physician's advice. (See Part VII.)

TINCTURA OPII CAMPHORATA. U.S. Camphorated Tincture of Opium

[Tr. Opii Camph.—Paregoric, Paregoric Elixir, Opii Tinctura Benzoici P. I.]

	Metric	Alternative
Powdered Opium	**4 Gm.**	**58 gr.**
Benzoic Acid	**4 Gm.**	**58 gr.**
Camphor	**4 Gm.**	**58 gr.**
Oil of Anise	**4 cc.**	**1 fl. dr.**
To make	**1000 cc.**	**2 pints**

Prepare a Tincture by Type Process M (page 366), macerating the ingredients in a mixture of 40 cc. [1 fl. oz. 134 min.] of glycerin and 950 cc. [30½ fl. oz.] of diluted alcohol, completing the preparation with diluted alcohol.

Alcohol content, by volume, 43 to 46 per cent.

U. S. P. Preparation—Mistura Glycyrrhizæ Composita.
N. F. Preparation—Mistura Pectoralis, Stoke's.

History—This preparation was originated by Professor LeMort of the University of Leyden about 1715. It was official in the 1721 edition of the London Pharmacopœia under the name *Elixir Asthmaticum*, which name was changed to *Elixir Paregoricum*, meaning soothing elixir, in 1746. It has also been known as *Tinctura Camphoræ Composita* and *Tinctura Opii Benzoica*, and the formula has changed in minor details many times since its introduction into medicine. The word Paregoric was used by the ancient writers on pharmacy and medicine in a generic sense to denote an anodyne or soothing preparation.

Uses—A mild anodyne in cough, nausea, and abdominal pains. It should never be used to quiet restless infants, as a habit may be induced. It contains 0.4 to 1 per cent of opium. Paregoric is one of the exempted preparations under the Narcotic Act, but its sale is subject to strict regulations under the Act, and the pharmacist is held strictly accountable for its legitimate distribution (see Part VII).

Average dose—1 fluidrachm (4 cc.).

TINCTURA RHEI. U. S. Tincture of Rhubarb

[Tr. Rhei]

	Metric	Alternative
Rhubarb, in moderately coarse powder	200 Gm.	6 oz. av. 296 gr.
Cardamom Seed, in moderately coarse powder	30 Gm.	1 oz. av.
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (page 365), using a mixture of 100 cc. [3 fl. oz. 96 min.] of glycerin, 500 cc. [1 pint] of alcohol, and 400 cc. [12 fl. oz. 384 min.] of water as the first menstruum, completing the percolation with diluted alcohol.

Alcohol content, by volume, 43 to 46 per cent.

N. F. Preparation—Mistura Opii et Rhei Composita.

Uses—It is employed in constipation and diarrhea but rhubarb is usually administered in some other form than the tincture.

Average dose—1 fluidrachm (4 cc.).

TINCTURA RHEI AROMATICA. U. S. Aromatic Tincture of Rhubarb

[Tr. Rhei Arom.]

	Metric	Alternative
Rhubarb, in moderately coarse powder	200 Gm.	6 oz. av. 296 gr.
Cinnamon, in moderately coarse powder	40 Gm.	1 oz. av. 147 gr.
Clove, in moderately coarse powder	40 Gm.	1 oz. av. 147 gr.
Myristica, in moderately coarse powder	20 Gm.	292 gr.
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (page 365), using a mixture of 100 cc. [3 fl. oz. 96 min.] of glycerin, 500 cc. [1 pint] of alcohol, and 400 cc.

[12 fl. oz. 384 min.] of water as the first menstruum, completing the percolation with diluted alcohol.

Alcohol content, by volume, 43 to 46 per cent.

U. S. P. Preparation—Syrupus Rhei Aromaticus.

Uses—Used almost exclusively in preparing the Compound Syrup of Rhubarb.

Average dose—1 fluidrachm (4 cc.).

TINCTURA SCILLÆ. U. S. Tincture of Squill

[Tr. Scill.]

Tincture of Squill, injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.0055 cc. and not more than 0.0065 cc. equivalent to not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each Gm. of body weight of frog.

	Metric	Alternative
Squill, in coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 cc.**	2 pints

Moisten the drug with sufficient menstruum, prepared by mixing 3 volumes of alcohol and 1 volume of water, and macerate in a closed vessel in a moderately warm place for twenty-four hours, stirring occasionally. Then transfer it to a percolator, shake it down evenly without packing, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding sufficient of the same menstruum until the percolate measures 950 cc. [30½ fl. oz.].

Assay a portion of this percolate as directed below, and, from the result thus obtained, adjust the volume of the finished Tincture by the addition of menstruum to conform to the above biological standard.

Assay—Proceed as directed under Tinctura Digitalis, page 1504.

Alcohol content, by volume, 64 to 67 per cent.

NOTE—This is probably the best preparation of squill, as neither water nor acetic acid completely extracts the drug. Mucilage is present in such large proportion in the tissue of squill that the drug cannot be packed for percolation without blocking the flow of percolate, therefore the U. S. P. direction to "shake down evenly without packing".

Uses—As a diuretic and heart stimulant. Occasionally used in small doses for expectorant action.

Average dose—15 minims (1 cc.).

TINCTURA STRAMONII. U. S. Tincture of Stramonium

[Tr. Stramon.]

Tincture of Stramonium yields, from each 100 cc., not less than 0.0225 Gm. and not more than 0.0275 Gm. of the alkaloids of stramonium.

	Metric	Alternative
Stramonium, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (page 365), using diluted alcohol as the menstruum, and adjust the volume of

the finished Tincture by the addition of diluted alcohol to make each 100 cc. contain 0.025 Gm. of the alkaloids of stramonium.

Assay—Proceed by Type Process D, taking 100 cc. of Tincture of Stramonium, use chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.02893 Gm. of the alkaloids of stramonium (Proximate Assays, pages 1498 and 1499).

Alcohol content, by volume, 44 to 47 per cent.

Uses—Its uses are practically identical with those of belladonna. An anodyne and antispasmodic. Employed for checking excessive secretions.

Average dose—12 minims (0.75 cc.).

TINCTURA STROPHANTHI. U.S. Tincture of Strophanthus

[**Tr. Strophanth.**—STROPHANTHI TINCTURA P. I.]

Tincture of Strophanthus, injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.00,005,5 cc. and not more than 0.00,006,5 cc., equivalent to not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each Gm. of body weight of frog.

	Metric	Alternative
Strophanthus, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
To make about	**1000 cc.**	2 pints

Pack the strophanthus in a cylindrical glass percolator, provided with a stop-cock and arranged with a cover and a receptacle suitable for volatile liquids, and percolate it slowly with purified petroleum benzin until a few drops of the percolate, evaporated from filter paper, leave no greasy stain. Reject the benzin percolate. Remove the powdered drug from the percolator, and expose it to the air until the odor of benzin is no longer noticeable. Prepare from this a tincture by Type Process P, as modified for assayed tinctures (page 365), using alcohol as the menstruum, and allowing the moistened drug to macerate for forty-eight hours before starting the percolation, instead of twenty-four hours as directed in Type Process P. Adjust the volume of the finished Tincture to conform to the above biological standard.

Assay—Proceed as directed under Tinctura Digitalis, page 1504.

Alcohol content, by volume, 88 to 92 per cent.

Uses—It belongs to the "digitalis group" and is used as a stimulant to circulation, especially in chronic heart weakness.

Average dose—8 minims (0.5 cc.).

TINCTURA TOLU. U.S. Tincture of Tolu

[**Tr. Tolu.**—TINCTURA TOLUTANA U.S.P. IX, TOLU TINCTURE]

	Metric	Alternative
Tolu	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (page 366), using alcohol as the solvent.

Alcohol content, by volume, 80 to 85 per cent.

U. S. P. Preparation—Syrupus Tolu.

Uses—A balsamic preparation employed as an addition to expectorant mixtures. Also used in the preparation of the syrup and in applying a coating to oxidizable pills.

Average dose—30 minims (2 cc.).

TINCTURA VALERIANÆ. U.S. Tincture of Valerian

[Tr. Valer.]

	Metric	Alternative
Valerian, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

Alcohol content, by volume, 66 to 70 per cent.

Uses—A sedative used in nervous conditions, as in hysteria.

Average dose—1 fluidrachm (4 cc.).

TINCTURA VALERIANÆ AMMONIATA. U.S. Ammoniated Tincture of Valerian

[Tr. Valer. Ammon.]

	Metric	Alternative
Valerian, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using aromatic spirit of ammonia as the menstruum.

Alcohol content, by volume, 62 to 65 per cent.

Uses—The same as the simple tincture.

Average dose—30 minims (2 cc.).

TINCTURA VERATRI VIRIDIS. U.S. Tincture of Veratrum Viride

[Tr. Verat. Vir.]

	Metric	Alternative
Veratrum Viride, in moderately coarse powder	**100 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using alcohol as the menstruum.

Alcohol content, by volume, 88 to 92 per cent.

Uses—Employed for the reduction of high blood pressure in arteriosclerosis and threatened apoplexy, also used in uremic convulsion and other conditions due to excessive blood pressure and to reduce over-activity of the heart.

Average dose—15 minims (1 cc.).

Norwood's Tincture of Veratrum, formerly largely used, contained about 40 per cent of veratrum. The U.S.P. tincture is now made exclusively from veratrum viride; veratrum album must be excluded.

TINCTURA ZINGIBERIS. U.S. Tincture of Ginger

[Tr. Zingib.—Tincture of Jamaica Ginger]

	Metric	Alternative
Ginger, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (page 365), using a mixture of 850 cc. [27 fl. oz. 96 min.] of alcohol and 150 cc. [4 fl. oz. 384 min.] of water as the menstruum.

Test for Purity—Evaporate 10 cc. of Tincture of Ginger to dryness in a small flask. Add 5 cc. of half-normal alcoholic potassium hydroxide, and boil the mixture gently for thirty minutes under a reflux condenser. Remove the condenser, and evaporate the alcohol on a water bath. Then add 50 cc. of distilled water to the residue, agitate the mixture, filter, transfer the aqueous filtrate to a separatory funnel, and shake it out with 25 cc. of ether. Evaporate the separated ether solution spontaneously by adding it, a few drops at a time, to the center of a watch glass, and cautiously apply the tip of the tongue to the dry residue. The taste should be slightly camphoraceous but not sharp or bitingly pungent (*capsicum or similar pungent substitute*).

Alcohol content, by volume, 74 to 78 per cent.

Uses—A carminative and stomachic, and an adjuvant in diarrhea and tonic mixtures.

Average dose of the tincture—30 minims (2 cc.).

Tincture of ginger is classified as a beverage under the regulations governing the Volstead Act and cannot be sold except upon a physician's prescription. A double-strength tincture of ginger was formerly permitted to be sold without restriction but that privilege was withdrawn on January 1, 1926 (see Part VII). It was formerly largely used in domestic medicine, but no longer being available the fluidextract will doubtless take its place. *The dose of the fluidextract is 8 minims (0.5 cc.).*

TINCTURA ALOES. N. F. Tincture of Aloe

(U. S. P. IX)

[Tr. Aloes]

	Metric	Alternative
Aloe, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Glycyrrhiza, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (see page 366), using diluted alcohol as the solvent.

Approximate alcohol content, by volume, 46 per cent.

Uses—A purgative.

Average dose—30 minims (2 cc.).

TINCTURA ALOES ET MYRRHÆ. N. F. Tincture of Aloe and Myrrh

[Tr. Aloe. et Myrrh.]

	Metric	Alternative
Aloe, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Myrrh, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Glycyrrhiza, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (see page 366), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 62 per cent.

History—This is an ancient preparation called *Elixir Proprietatis* which was extolled even as far back as the time of Paracelsus in the fifteenth century. It has been officially recognized ever since the 1724 edition of the London Pharmacopœia.

Uses—A purgative and emmenagogue.

Average dose—30 minims (2 cc.).

TINCTURA AMARA. N. F. Bitter Tincture

[Tr. Amar.—Stomachic Tincture, Bitter Stomachic Drops, Stomach Drops]

	Metric	Alternative
Gentian, in moderately coarse powder	**60 Gm.**	2 oz. av.
Centaury, in moderately coarse powder	**60 Gm.**	2 oz. av.
Bitter Orange Peel, in moderately coarse powder	**60 Gm.**	2 oz. av.
Zedoary, in moderately coarse powder	**20 Gm.**	292 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 58 per cent.

Uses—A bitter tonic.

Average dose—30 minims (2 cc.).

TINCTURA ANTIMONII. N. F. Tincture of Antimony

(Replacing Vinum Antimonii N. F. IV)
(Strength of Vinum Stibiatum, P. I.)

[Tr. Antimon.]

	Metric	Alternative
Antimony and Potassium Tartrate	**4 Gm.**	58 gr.
Boiling Distilled Water	**25 cc.**	384 min.
Caramel	**2 cc.**	31 min.
Acetic Ether	**2 cc.**	31 min.
Alcohol	**200 cc.**	6 fl. oz. 192 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the antimony and potassium tartrate in the boiling distilled water; add about 700 cc. [22 fl. oz.] of distilled water, the alcohol, caramel, and acetic ether, then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Note—Tincture of Antimony may be dispensed when Vinum Antimonii (Wine of Antimony) is ordered.

Approximate alcohol content, by volume, 18 per cent.

Uses—As a nauseating expectorant and sudorific.

Average dose—15 minims (1 cc.).

TINCTURA ANTIPERIODICA. N. F. Antiperiodic Tincture

[Tr. Antiperiod.—Warburg's Tincture]

	Metric	Alternative
Rhubarb, in moderately coarse powder	**8.00 Gm.**	117 gr.
Angelica Fruit, in moderately coarse powder	**8.00 Gm.**	117 gr.
Inula, in moderately coarse powder	**4.00 Gm.**	58 gr.
Saffron, in moderately coarse powder	**4.00 Gm.**	58 gr.
Fennel, in moderately coarse powder	**4.00 Gm.**	58 gr.
Gentian, in moderately coarse powder	**2.00 Gm.**	29 gr.
Zedoary, in moderately coarse powder	**2.00 Gm.**	29 gr.
Cubeb, in moderately coarse powder	**2.00 Gm.**	29 gr.
Myrrh, in coarse powder	**2.00 Gm.**	29 gr.
Camphor, in coarse powder	**2.00 Gm.**	29 gr.
Agaric, in moderately coarse powder	**2.00 Gm.**	29 gr.
Pepper, in moderately coarse powder	**0.35 Gm.**	5 gr.
Cinnamon, in moderately coarse powder	**0.75 Gm.**	11 gr.
Ginger, in moderately coarse powder	**0.75 Gm.**	11 gr.
Quinine Hydrochloride	**15.00 Gm.**	219 gr.
Aloe	**35.00 Gm.**	1 oz. av. 74 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix alcohol and water in the proportion of three volumes of alcohol and two volumes of water. Saturate the mixed drugs with the menstruum and having macerated them for twenty-four hours percolate them in the usual manner, until the Tincture measures 960 cc. [30 fl. oz. 346 min.]. In this dissolve the quinine hydrochloride and aloe by the aid of a gentle heat, and add sufficient menstruum to make the product measure 1000 cc. [2 pints]. Finally filter the Tincture through paper.

Approximate alcohol content, by volume, 55 per cent.

History—Warburg's Tincture was originated by Dr. Carl Warburg, an Austrian physician, about 1840 and acquired a large use, especially in India, for the treatment of malarial fevers. Its formula, published about 1875, was even more complex than here given. Although he used it as a nostrum or secret remedy, the Austrian Ministry of Health in 1848 required it to be kept in stock in all drug stores. Doctor Warburg later divulged the formula after having accumulated a large fortune, but he suffered reverses and died in England in comparative poverty about forty years ago.

Uses—It is an antiperiodic.

Dose—The dosage of Warburg's Tincture depends on the kind used—whether with aloe or without—and the intended purpose, and varies from 1 fluidrachm (4 cc.) to 4 fluidrachms (15 cc.). The larger quantity is given when Doctor Warburg's original directions are followed for administering the remedy in remittent fevers. These directions were as follows: "One-half ounce to be given alone, without dilution, after the bowels have been evacuated by any convenient purgative, all liquids being withheld. After three hours another half ounce is to be given."

TINCTURA ANTIPERIODICA SINE ALOE. N. F. Antiperiodic Tincture without Aloe

[Tr. Antiperiod. s. Aloe.—Warburg's Tincture without Aloe]

Prepare the Tincture as directed under *Tinctura Antiperiodica*, omitting the Aloe.

Approximate alcohol content, by volume, 55 per cent.

Dose—See *Tinctura Antiperiodica*.

Uses—An antiperiodic.

TINCTURA ARNICÆ. N. F. Tincture of Arnica

(U. S. P. IX)

[Tr. Arnic.]

	Metric	Alternative
Arnica, in coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Moisten the drug with 500 cc. [1 pint] of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand well covered for twenty-four hours, then pack it with moderate pressure and allow the percolation to proceed slowly, pouring on additional diluted alcohol as needed. When the percolate measures 250 cc. [8 fl. oz.], stop the flow, macerate the drug for an additional twenty-hour hours, and then continue the percolation until the total percolate measures 500 cc. [1 pint]. Again interrupt the percolation, macerate the drug for another twelve hours and afterwards collect an additional 250 cc. [8 fl. oz.] of percolate. Again macerate the drug for twelve hours and then allow the percolation to proceed slowly, pouring on sufficient diluted alcohol to make 1000 cc. [2 pints] of Tincture.

Approximate alcohol content, by volume, 45 per cent.

Uses—Externally as an embrocation in bruises.

Average dose—15 minims (1 cc.).

TINCTURA AROMATICA. N. F. Aromatic Tincture

[Tr. Arom.]

	Metric	Alternative
Cinnamon, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Ginger, in moderately coarse powder	**40 Gm.**	1 oz. av. 147 gr.
Galangal, in moderately coarse powder	**20 Gm.**	292 gr.
Clove, in coarse powder	**20 Gm.**	292 gr.
Cardamom Seed, in coarse powder	**20 Gm.**	292 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

Uses—A carminative and aromatic.

Average dose—30 minims (2 cc.).

TINCTURA BRYONIÆ. N. F. Tincture of Bryonia
[Tr. Bryon.]

	Metric	Alternative
Bryonia, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using alcohol as the menstruum.

Approximate alcohol content, by volume, 90 per cent.

Uses—A hydragogue cathartic employed in dropsy.

Average dose—1 fluidrachm (4 cc.).

TINCTURA CACTI GRANDIFLORI. N. F. Tincture of Cactus Grandiflorus
[Tr. Cact. Grand.]

	Metric	Alternative
Cactus Grandiflorus	**500 Gm.**	16 oz. av. 302 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Cut the cactus grandiflorus and crush it in a mortar, then add 700 cc. [22½ fl. oz.] of alcohol, transfer the mixture to a closed vessel, and macerate for seven days with occasional agitation. Express the drug, measure the expressed liquid, and set it aside in a closed container. Pack the residue firmly in a percolator and slowly percolate it with alcohol until a sufficient quantity of percolate is obtained which when added to the reserved expressed liquid will make the product measure 1000 cc. [2 pints]. Filter the Tincture and store it in well-stoppered bottles, in a cool place.

In this tincture the fresh succulent stems of cactus grandiflorus must be used. These are preserved in alcohol until the tincture is to be made.

Approximate alcohol content, by volume, 75 per cent.

Uses—Claimed to be of value as a cardiac regulator in functional disorders of the heart.

Average dose—15 minims (1 cc.).

TINCTURA CALENDULÆ. N. F. Tincture of Calendula
[Tr. Calend.]

	Metric	Alternative
Calendula, in coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using alcohol as the menstruum.

Approximate alcohol content, by volume, 90 per cent.

Uses—A feeble aromatic. Its extensive reputation for many years as an active remedy has been shown to have been without justification. The alcohol in the tincture is its most active constituent.

TINCTURA CAPSICI ET MYRRHÆ. N. F. Tincture of Capsicum and Myrrh
[Tr. Capsic. et Myrrh.—Hot Drops, Thomsonian Number Six]

	Metric	Alternative
Capsicum, in coarse powder	**30 Gm.**	1 oz. av.
Myrrh, in moderately coarse powder	**120 Gm.**	4 oz. av. 3 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the powders with an equal bulk of clean, fine sand, and prepare a Tincture by Type Process P (see page 365), using a mixture of nine volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 78 per cent.

History—This is one of the few surviving "Thomsonian preparations", a system of medicine founded by Dr. Samuel Thomson of Massachusetts about 1800, consisting chiefly of the use of steam baths and vegetable remedies, the most important of which were lobelia and capsicum. *Composition Powder* (see page 483) was another of the Thomsonian remedies.

Uses—A powerful gastric stimulant and carminative.

Average dose—30 minims (2 cc.).

TINCTURA CIMICIFUGÆ. N. F. Tincture of Cimicifuga

[Tr. Cimicif.]

	Metric	Alternative
Cimicifuga, in moderately coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using alcohol as the menstruum.

Approximate alcohol content, by volume, 87 per cent.

Uses—Used for chorea or St. Vitus' dance, but with caution. An alterative and sedative in chronic rheumatic disorders.

Average dose—1 fluidrachm (4 cc.).

TINCTURA CINNAMOMI. N. F. Tincture of Cinnamon

(U. S. P. IX)

[Tr. Cinnam.]

	Metric	Alternative
Cinnamon, in coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Glycerin,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of 75 volumes of glycerin, 675 volumes of alcohol, and 250 volumes of water, as the menstruum.

Preparation—Elixir Taraxaci Compositum; Mistura Rhei Alkalina.

Approximate alcohol content, by volume, 63 per cent.

Uses—A flavoring agent used especially in diarrhea mixtures.

Average dose—30 minims (2 cc.).

TINCTURA COCCULI. N. F. Tincture of Cocculus

[Tr. Coccul.—Tinctura Cocculi Indici, N. F. IV]

	Metric	Alternative
Cocculus, in coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 45 per cent.

Uses—This tincture is used almost exclusively for external application to destroy parasites.

TINCTURA COLCHICI CORMI FORTIS. N. F. Stronger Tincture of Colchicum Corm

(Replacing Vinum Colchici Cormi, N. F. IV)

[Tr. Colch. Corm. Fort.]

One hundred cc. of Stronger Tincture of Colchicum Corm yields not less than 0.126 Gm. and not more than 0.154 Gm. of colchicine.

	Metric	Alternative
Colchicum Corm, in moderately coarse powder	**400 Gm.**	13 oz. av. 154 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed Tinctures (see page 365), using a mixture of *one volume* of alcohol and *two volumes* of water as the menstruum, and adjust the finished tincture so that each 100 cc. contains 0.140 Gm. of colchicine.

Assay—Evaporate 37.5 cc. of Stronger Tincture of Colchicum Corm to 15 cc. and proceed as directed under Fluidextractum Colchici Cormi, rinsing the dish with a portion of the water there directed.

NOTE—Stronger Tincture of Colchicum Corm may be dispensed when Vinum Colchici Cormi is ordered.

Approximate alcohol content, by volume, 26 per cent.

Uses—In gout.

Average dose—10 minims (0.6 cc.).

TINCTURA CROCI. N. F. Tincture of Saffron

[Tr. Croc.]

	Metric	Alternative
Saffron	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 44 per cent.

Uses—Employed chiefly for its color and flavor.

TINCTURA CUBEBÆ. N. F. Tincture of Cubeb

[Tr. Cubeb.]

	Metric	Alternative
Cubeb, in coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using alcohol as the menstruum.

Approximate alcohol content, by volume, 86 per cent.

Uses—A diuretic and carminative.

Average dose—1 fluidrachm (4 cc.).

TINCTURA DELPHINII. N. F. Tincture of Larkspur

[Tr. Delphin.]

	Metric	Alternative
Larkspur Seed, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using alcohol as the menstruum.

Approximate alcohol content, by volume, 90 per cent.

Uses—Tincture of Larkspur is rarely used internally, but is commonly employed externally to destroy parasites.

TINCTURA FERRI CHLORIDI ÆTHEREA. N. F. Ethereal Tincture of Ferric Chloride

[**Tr. Ferr. Chlor. Æth.**—Bestuscheff's Tincture, Lamotte's Drops]

An ethereal-alcoholic solution containing ferroso-ferric chloride corresponding to not less than 0.75 Gm. of Fe in each 100 cc.

	Metric	Alternative
Solution of Ferric Chloride	**60 cc.**	1 fl. oz. 442 min.
Ether	**250 cc.**	8 fl. oz.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the solution of ferric chloride with 625 cc. [20 fl. oz.] of alcohol, add the ether, and then sufficient alcohol to make the product measure 1000 cc. [2 pints]. Pour the Tincture into bottles made of flint glass, which should not be entirely filled, cork them tightly and expose them to the rays of the sun, until the liquid has been completely decolorized. Then remove the bottles from the sunlight and open them occasionally, until the liquid has again assumed a yellow color.

Preserve the Tincture in a cool and dark place.

Assay—Evaporate 25 cc. of Ethereal Tincture of Ferric Chloride, accurately measured, to dryness in an evaporating dish on a water bath. Dissolve the residue in 5 cc. of hydrochloric acid and 10 cc. of solution of hydrogen dioxide and evaporate this solution to dryness on a water bath. Dissolve the residue in 25 cc. of warm distilled water, transfer this solution to a 250 cc. glass-stoppered flask, add about 1 Gm. of potassium iodide and allow the mixture to stand for thirty minutes at a temperature of 40° C. Cool the liquid, add 100 cc. of distilled water, and titrate the liberated iodine with tenth-normal sodium thiosulphate. Each cc. of tenth-normal sodium thiosulphate consumed corresponds to 0.005584 Gm. of Fe.

Approximate alcohol content, by volume, 65 per cent.

History—The secret of the formula of this preparation was purchased from Count Bestoujeff (this name has been anglicized to Bestuscheff or Bestucheff, both being found in literature) by Catherine II of Russia in the eighteenth century. It had been known by the name *Tinctura Tonica Nervina Bestucheffi.*

The same preparation had been purchased a short time before by Louis XV of France who pensioned its alleged originator, La Motte, by paying him 4000 livres a year. The preparation at this time was selling at the rate of about $5.00 for a half ounce bottle.

Uses—An iron tonic.

Average dose—30 minims (2 cc.).

TINCTURA FERRI CITROCHLORIDI. N. F. Tincture of Ferric Citrochloride

[**Tr. Ferr. Citrochlor.**—Tasteless Tincture of Ferric Chloride, Tasteless Tincture of Iron]

A hydro-alcoholic solution containing ferric citrochloride corresponding to not less than 4.48 Gm. of Fe in each 100 cc.

	Metric	Alternative
Solution of Ferric Chloride	**350 cc.**	11 fl. oz. 96 min.
Sodium Citrate	**450 Gm.**	15 oz. av. 9 gr.
Alcohol	**150 cc.**	4 fl. oz. 384 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the solution of ferric chloride with 150 cc. [4 fl. oz.] of water, and dissolve the sodium citrate in this mixture with the aid of a gentle heat. Then add the alcohol, and when the solution has become cold, add sufficient water to make the product measure 1000 cc. [2 pints]. Set the Tincture aside in a cold place for a few days, so that the excess of saline matter may separate, and then filter.

Preserve the Tincture in amber-colored bottles.

Assay—Evaporate 5 cc. of Tincture of Ferric Citrochloride, accurately measured, to dryness in an evaporating dish on a water bath. Dissolve the residue in 5 cc. of hydrochloric acid and 10 cc. of solution of hydrogen dioxide and evaporate this solution to dryness on a water bath. Dissolve the residue in 25 cc. of warm distilled water, transfer the solution to a 250 cc. glass-stoppered flask, add 3 cc. of hydrochloric acid and about 1 Gm. of potassium iodide and allow the mixture to stand for thirty minutes at a temperature of 40° C. Cool the solution, add 100 cc. of distilled water and titrate the liberated iodine with tenth-normal sodium thiosulphate. Each cc. of tenth-normal sodium thiosulphate used corresponds to 0.005584 Gm. of Fe.

N. F. Preparations—Elixir Ferri, Quininæ et Strychninæ; Elixir Gentianæ et Ferri; Liquor Ferri Salicylatis.

Approximate alcohol content, by volume, 14 per cent.

Uses—An iron tonic, employed where tannins are likely to be present, since this form of iron only slightly darkens the preparation.

Average dose—8 minims (0.5 cc.).

The iron solution must not be excessively acid or the characteristic green color will not develop. The U. S. P. test for limit of free acid will check this factor. The direction about aging before use is important if subsequent precipitation is to be avoided.

TINCTURA FERRI POMATA. N. F. Tincture of Ferrated Extract of Apple

[Tr. Ferr. Pomat.—Tinctura Ferri Malatis Crudi, Tincture of Crude Malate of Iron]

	Metric	Alternative
Ferrated Extract of Apple	**100 Gm.**	3 oz. av. 148 gr.
Alcohol	**100 cc.**	3 fl. oz. 96 min.
Cinnamon Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the ferrated extract of apple in 750 cc. [24 fl. oz.] of cinnamon water, add the alcohol, filter, and pass sufficient cinnamon water through the filter to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 9 per cent.

Uses—A hematinic containing iron in the form of malate.

Average dose—1 fluidrachm (4 cc.).

TINCTURA GALLÆ. N. F. Tincture of Nutgall

[Tr. Gall.]

	Metric	Alternative
Nutgall, in moderately coarse powder	**200 Gm.**	6 oz av. 296 gr.
Glycerin,		
Alcohol, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (see page 366), using a mixture of nine volumes of alcohol and one volume of glycerin as the menstruum.

Approximate alcohol content, by volume, 85 per cent.

Uses—An astringent.

Average dose—1 fluidrachm (4 cc.).

TINCTURA GELSEMII. N. F. Tincture of Gelsemium

(U. S. P. IX)

[Tr. Gelsem.]

	Metric	Alternative
Gelsemium, in fine powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of 65 volumes of alcohol and 35 volumes of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

Uses—In neuralgia.

Average dose—4 minims (0.25 cc.).

TINCTURA GUAIACI. N. F. Tincture of Guaiac
[U. S. P. IX]
[Tr. Guaiac.]

	Metric	Alternative
Guaiac, in moderately coarse powder	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process M (see page 366), using alcohol as the solvent.

Approximate alcohol content, by volume, 80 per cent.

Uses—In chronic rheumatism and gout.

Average dose—1 fluidrachm (4 cc.).

TINCTURA GUAIACI AMMONIATA. N. F. Ammoniated Tincture of Guaiac
(U. S. P. IX)
[Tr. Guaiac. Ammon.]

	Metric	Alternative
Guaiac, in moderately coarse powder	200 Gm.	6 oz. av. 296 gr.
Aromatic Spirit of Ammonia, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process M (see page 366), using aromatic spirit of ammonia as the menstruum.

N. F. Preparation—Gargarisma Guaiaci Compositum.

Approximate alcohol content, by volume, 60 per cent.

Uses—In chronic rheumatism and amenorrhea.

Average dose—30 minims (2 cc.).

TINCTURA GUAIACI COMPOSITA. N. F. Compound Tincture of Guaiac
[Tr. Guaiac. Co.—Dewees' Tincture of Guaiac]

	Metric	Alternative
Guaiac	125 Gm.	4 oz. av. 75 gr.
Potassium Carbonate	6 Gm.	88 gr.
Pimenta, in fine powder	32 Gm.	1 oz. av. 30 gr.
Pumice, in fine powder	65 Gm.	2 oz. av. 74 gr.
Alcohol	435 cc.	13 fl. oz. 442 min.
Water	435 cc.	13 fl. oz. 442 min.
Diluted Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Triturate the guaiac and potassium carbonate with the pimenta and the pumice, and afterwards with the alcohol, gradually added. Then add the water slowly and triturate the mixture thoroughly. Allow the mixture to macerate during twenty-four hours, then filter and pass sufficient diluted alcohol through the filter to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 45 per cent.

Uses—Employed in rheumatism and as an emmenagogue.

Average dose—1 fluidrachm (4 cc.).

TINCTURA HUMULI. N. F. Tincture of Hop
[Tr. Humul.]

	Metric	Alternative
Hop, in coarse powder	200 Gm.	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (see page 365), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 45 per cent.

Uses—A bitter tonic and nerve sedative.

Average dose—1 fluidrachm (4 cc.).

TINCTURA HYDRASTIS. N. F. Tincture of Hydrastis
(U. S. P. IX)

[Tr. Hydrast.—Tincture of Golden Seal]

One hundred cc. of Tincture of Hydrastis yields not less than 0.36 Gm. and not more than 0.44 Gm. of the ether-soluble alkaloids of hydrastis.

	Metric	Alternative
Hydrastis, in fine powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (see page 365), using a mixture of two volumes of alcohol and *one volume* of water as the menstruum and adjusting the volume of the finished Tincture so that each 100 cc. contains 0.4 Gm. of the ether-soluble alkaloids of hydrastis.

Assay—Evaporate 50 cc. of Tincture of Hydrastis to about 10 cc., transfer the concentrated fluid to a separator and estimate the alkaloids according to Type Process D (see page 1496), using the total extraction method, and ether as the solvent. Determine the alkaloids gravimetrically after drying at 100° C.
This assay is explained on page 1500.

Approximate alcohol content, by volume, 60 per cent.

Uses—Locally in various catarrhs; internally in disorders of the stomach.

Average dose—1 fluidrachm (4 cc.).

TINCTURA IGNATIÆ. N. F. Tincture of Ignatia
[Tr. Ignat.]

One hundred cc. of Tincture of Ignatia yields not less than 0.18 Gm. and not more than 0.22 Gm. of the alkaloids of ignatia.

	Metric	Alternative
Ignatia, in fine powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P, as modified for assayed tinctures (see page 365), using a mixture of eight volumes of alcohol and one volume of water as the menstruum, and adjusting the volume of the finished Tincture so that each 100 cc. contains 0.20 Gm. of the alkaloids of ignatia.

Assay—Evaporate 100 cc. of Tincture of Ignatia on a water bath until it measures about 10 cc., transfer the concentrated fluid to a separator and estimate the alkaloids according to Type Process D (see page 1496), using the total-extraction method, and chloroform as the solvent. Determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.0364 Gm. of the alkaloids of ignatia.
This assay is explained on page 1500.

Approximate alcohol content, by volume, 80 per cent.

Uses—It contains the alkaloids strychnine and brucine and has the same medicinal uses as nux vomica.

Average dose—10 minims (0.6 cc.).

TINCTURA IODIDORUM. N. F. Tincture of Iodides

[Tr. Iodidor.—Tinctura Iodi Decolorata N. F. IV, Decolorized Tincture of Iodine]

	Metric	Alternative
Iodine	**50 Gm.**	1 oz. av. 293 gr.
Potassium Iodide	**25 Gm.**	365 gr.
Stronger Ammonia Water	**100 cc.**	3 fl. oz. 96 min.
Water	**400 cc.**	12 fl. oz. 384 min.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the potassium iodide in the water; add the iodine and 400 cc. [12 fl. oz. 384 min.] of alcohol, and agitate the mixture frequently until the iodine is completely dissolved. Add the stronger ammonia water and set the mixture aside until it becomes colorless. Then add sufficient alcohol to make the product measure 1000 cc. [2 pints], and filter.

Approximate alcohol content, by volume, 45 per cent.

Uses—This tincture was intended to provide the effects of iodine without the objectionable staining. However, as the iodine is converted into ammonium iodide, it possesses little if any therapeutic value when applied externally.

TINCTURA IODI FORTIOR. N. F. Stronger Tincture of Iodine

[Tr. Iod. Fort.—Churchill's Tincture of Iodine]

An alcoholic solution of iodine and potassium iodide containing not less than 16 Gm. and not more than 17 Gm. of I (126.92) and not less than 3 Gm. and not more than 4 Gm. of KI (166.02) in each 100 cc.

	Metric	Alternative
Iodine	**165 Gm.**	5 oz. av. 222 gr.
Potassium Iodide	**35 Gm.**	1 oz. av. 74 gr.
Water	**250 cc.**	8 fl. oz.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the potassium iodide in the water; add the iodine and 600 cc. [19 fl. oz. 96 min.] of alcohol and agitate the mixture frequently until the iodine is completely dissolved. Then add sufficient alcohol to make the product measure 1000 cc. [2 pints], and mix well.

Assay for Potassium Iodide—Evaporate 10 cc. of Stronger Tincture of Iodine in a tared porcelain dish on a water bath and gently heat the residue over a flame to volatilize the iodine; it leaves a residue weighing not less than 0.3 Gm. and not more than 0.4 Gm. which corresponds to the identity tests for Potassium Iodide.

This assay is explained on page 1476.

Assay for Iodine—Mix 2 cc. of Stronger Tincture of Iodine, accurately measured, with 25 cc. of distilled water and titrate the solution with tenth-normal sodium thiosulphate. Each cc. of tenth-normal sodium thiosulphate consumed corresponds to 0.01269 Gm. of I.

This assay is explained on page 1469.

Approximate alcohol content, by volume, 62 per cent.

Uses—A discutient and counterirritant. It is more than double the strength of the U. S. P. Tincture of Iodine, but the uses are similar.

TINCTURA IPECACUANHÆ. N. F. Tincture of Ipecac

(Replacing Vinum Ipecacuanhæ, N. F. IV)

[Tinct. Ipecac.—Tinctura Ipecacuanhæ, P. I.]

One hundred cc. of Tincture of Ipecac yields not less than 0.135 Gm. and not more than 0.165 Gm. of the ether soluble alkaloids of ipecac.

	Metric	Alternative
Fluidextract of Ipecac	**100 cc.**	3 fl. oz. 96 min.
Alcohol	**200 cc.**	6 fl. oz. 192 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the alcohol with 600 cc. [19 fl. oz.] of distilled water, add the fluidextract of ipecac and then sufficient distilled water to make the product measure 1000 cc. [2 pints]. Filter.

Note—Tincture of Ipecac may be dispensed when Vinum Ipecacuanhæ (Wine of Ipecac) is ordered.

Assay—Assay 50 cc. of the Tincture by Type Process D (see page 1496), using the direct extraction method, with ether as the solvent, and estimating the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.024 Gm. of the ether-soluble alkaloids of Ipecac.

This assay is explained on page 1500.

Approximate alcohol content, by volume, 21 per cent.

Uses—Nauseating expectorant and diaphoretic.

Average dose—15 minims (1 cc.).

TINCTURA IPECACUANHÆ ET OPII. N. F. Tincture of Ipecac and Opium

[Tr. Ipecac et Opii—TINCTURE OF DOVER'S POWDER]

	Metric	Alternative
Tincture of Opium	1000 cc.	2 pints
Fluidextract of Ipecac	100 cc.	3 fl. oz. 96 min.
Diluted Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Evaporate the tincture of opium in a tared dish on a water bath, until it measures 580 cc. [18 fl. oz. 269 min.]. When it has become cold, add to it the fluidextract of ipecac and sufficient diluted alcohol to make the product measure 1000 cc. [2 pints], and filter.

N. F. Preparation—Syrupus Ipecacuanhæ et Opii.

Approximate alcohol content, by volume, 17 per cent.

Uses—A diaphoretic and anodyne.

Average dose—8 minims (0.5 cc.).
One average dose represents:
0.50 cc. or 8 minims of Tincture of Opium.

TINCTURA JALAPÆ. N. F. Tincture of Jalap

[Tr. Jalap.]

One hundred cubic centimeters of Tincture of Jalap yields not less than 1.3 Gm., and not more than 1.5 Gm. of the resin of jalap.

	Metric	Alternative
Jalap, in fine powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 cc.	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of two volumes of alcohol and one volume of water, as the menstruum, and adjusting the volume of the finished Tincture to contain 1.4 Gm. of the resin of jalap in each 100 cc.

Assay—Mix 10 cc. of Tincture of Jalap with 10 cc. of alcohol and 10 cc. of chloroform, in a separator, and proceed as directed under Fluidextractum Jalapæ, page 430.

Approximate alcohol content, by volume, 60 per cent.

Uses—A cathartic.

Average dose—1 fluidrachm (4 cc.).

TINCTURA JALAPÆ COMPOSITA. N. F. Compound Tincture of Jalap

[Tr. Jalap. Co.]

	Metric	Alternative
Jalap, in fine powder	125 Gm.	4 oz. av. 75 gr.
Resin of Ipomea, in fine powder	30 Gm.	1 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the powders with half their weight of clean sand and prepare a Tincture by Type Process P (see page 365), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Assay—Mix 10 cc. of Compound Tincture of Jalap with 10 cc. of alcohol and 10 cc. of chloroform, in a separator, and proceed as directed under Fluidextractum Jalapæ, page 430. The 10 cc. of Compound Tincture of Jalap yields not less than 0.3 Gm. of resin.

Approximate alcohol content, by volume, 60 per cent.

Uses—A purgative.

Average dose—1 fluidrachm (4 cc.).

TINCTURA OPII CROCATA. N. F. Tincture of Opium with Saffron

[Tr. Opii Crocat.—Sydenham's Laudanum, Tinctura Opii Crocata P. I.]

One hundred cc. of Tincture of Opium with Saffron yields not less than 0.95 Gm. and not more than 1.05 Gm. of anhydrous morphine.

	Metric	Alternative
Granulated Opium	100 Gm.	3 oz. av. 148 gr.
Saffron, in coarse powder	25 Gm.	365 gr.
Cinnamon, in fine powder	6 Gm.	88 gr.
Clove, in coarse powder	6 Gm.	88 gr.
Diluted Alcohol, a sufficient quantity,		
To make about	1000 cc.	2 pints

Mix the drugs with about an equal bulk of clean sand and prepare a Tincture by Type Process P, as modified for assayed tinctures (see page 365), using diluted alcohol as the menstruum and adjusting the volume of the finished Tincture so that each 100 cc. will contain 1 Gm. of anhydrous morphine.

Assay—Evaporate 80 cc. of Tincture of Opium with Saffron on a water bath until the alcohol is all removed. Transfer the extract to a 50 cc. graduated flask and wash the evaporating dish with sufficient distilled water to make the entire volume measure exactly 50 cc. when cooled to room temperature. Place in a small mortar 4 Gm. of freshly slaked lime, add about 10 cc. of the opium solution and rub to a smooth paste, then add the remainder of the solution and rinse the flask with exactly 10 cc. of distilled water, adding the rinsings to the mortar and stir frequently during fifteen minutes. Filter through a dry filter, about 10 cm. in diameter, and transfer exactly 30 cc. of the filtrate, representing 40 cc. of the Tincture, to an Erlenmeyer flask of suitable capacity. To this add 2 cc. of alcohol and 15 cc. of ether, and, after shaking the mixture, add 1 Gm. of ammonium chloride, stopper the flask and shake it frequently during half an hour, then set it aside in a cool place for twelve hours, or over night. Remove the stopper and brush any adhering crystals back into the flask. Decant the ethereal layer into a small funnel, the neck of which has been previously closed with a pledget of purified cotton. Rinse the flask and contents with 15 cc. of ether, and, when the ether has passed through, wash the funnel and cotton with a small quantity of ether and then pour the aqueous liquid into the funnel without trying to remove the crystals. Wash the crystals in the flask and the contents of the funnel with distilled water, previously saturated with morphine until the washings are colorless. Then add a few drops of distilled water to replace the morphinated water. Incline the edge of the funnel over the mouth of the flask and by means of a glass rod carefully transfer the cotton with adhering crystals to the flask. Insert the funnel into the neck of the flask and wash the funnel with 20 cc. of tenth-normal sulphuric acid, followed by 10 cc. of distilled water, applied drop by drop around the edge of the funnel. Remove the funnel, replace the cork, warm gently and agitate until the crystals are dissolved. Rinse the cork with distilled water and titrate the excess of acid with fiftieth-normal potassium hydroxide, cochineal T.S. or methyl red T.S. being used as indicator. Each cc. of tenth-normal sulphuric acid corresponds to 0.0285 Gm. of anhydrous morphine.

This assay is explained on page 1500.

Approximate alcohol content, by volume, 44 per cent.

Uses—A sedative. Its uses are identical with those of Tinctura Opii (see page 378).

Average dose—10 minims (0.6 cc.).

TINCTURA OPII ET GAMBIR COMPOSITA. N. F. Compound Tincture of Opium and Gambir

[Tr. Opii et Gambir Co.—Tinctura Pectoralis N. F. IV, Guttæ Pectorales, Pectoral Drops, Bateman's Pectoral Drops]

	Metric	Alternative
Tincture of Opium	42 cc.	1 fl. oz. 165 min.
Compound Tincture of Gambir	64 cc.	2 fl. oz. 23 min.
Spirit of Camphor	40 cc.	1 fl. oz. 134 min.
Oil of Anise	1 cc.	15 min.
Caramel	10 cc.	154 min.
Diluted Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the several ingredients with sufficient diluted alcohol to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 40 per cent.

Uses—This preparation although called "pectoral drops", is more suitable for intestinal than for pectoral complaints.

Average dose—For infants, 10 minims (0.6 cc.).

One average dose represents:

0.025 cc. or ⅔ minim of Tincture of Opium.

TINCTURA PASSIFLORÆ. N. F. Tincture of Passion Flower

[Tr. Passiflor.]

	Metric	Alternative
Passion Flower, in coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 45 per cent.

Uses—Employed in neuralgia, dysmenorrhea, and diarrhea; and used as an analgesic and anodyne.

Average dose—15 minims (1 cc.).

TINCTURA PERSIONIS. N. F. Tincture of Cudbear

[Tr. Persion.]

	Metric	Alternative
Cudbear, in fine powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the cudbear with about twice its volume of clean sand and prepare a Tincture by Type Process P (see page 365), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 70 per cent.

N. F. Preparation—Syrupus Phosphatum Compositus.

Uses—Employed only as a purplish-red coloring agent in syrups and elixirs.

TINCTURA PERSIONIS COMPOSITA. N. F. Compound Tincture of Cudbear

[Tr. Persion. Co.]

	Metric	Alternative
Cudbear, in fine powder	**15 Gm.**	219 gr.
Caramel	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix one volume of alcohol with two volumes of water and macerate the cudbear with 750 cc. [24 fl. oz.] of this menstruum during twelve hours, agitating occasionally. Then filter, add the caramel, previously dissolved in 125 cc. [4 fl. oz.] of the menstruum, and finally pass enough of the menstruum through the filter to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 26 per cent.

N. F. Preparations—Elixir Ammonii Valeratis; Elixir Cinchonæ Alkaloidorum; Syrupus Bromidorum.

Uses—A reddish-brown coloring agent for syrups and elixirs.

TINCTURA PULSATILLÆ. N. F. Tincture of Pulsatilla

[Tr. Pulsatil.]

	Metric	Alternative
Pulsatilla, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of three volumes of alcohol with one volume of water as the menstruum.

Approximate alcohol content, by volume, 70 per cent.

Uses—Employed as an alterative and antispasmodic, but of uncertain value.

Average dose—30 minims (2 cc.).

TINCTURA QUASSIÆ. N. F. Tincture of Quassia
(U. S. P. IX)
[Tr. Quas.]

	Metric	Alternative
Quassia, in moderately coarse powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of one volume of alcohol and two volumes of water as the menstruum.

Approximate alcohol content, by volume, 30 per cent.

Uses—A simple bitter.

Average dose—30 minims (2 cc.).

TINCTURA QUILLAJÆ. N. F. Tincture of Quillaja
[Tr. Quilaj.]

	Metric	Alternative
Quillaja, in coarse powder	200 Gm.	6 oz. av. 296 gr.
Alcohol	350 cc.	11 fl. oz. 96 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Boil the quillaja in a covered vessel with 800 cc. [25 fl. oz. 288 min.] of water for fifteen minutes, strain while hot, and wash the residue on the strainer with 200 cc. [6 fl. oz. 192 min.] of boiling water. Then evaporate the strained liquid to 600 cc. [19 fl. oz. 96 min.], allow it to cool, add the alcohol, and set it aside for twelve hours. Decant the supernatant liquid, filter it, then pour the residue on the filter, and, when the liquid ceases to drop, wash the filter with sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 30 per cent.

Uses—It is an efficient emulsifying agent but too active an irritant to use in medicinal emulsions such as those of cod liver oil.

TINCTURA RHEI AQUOSA. N. F. Aqueous Tincture of Rhubarb
[Tr. Rhei Aq.]

	Metric	Alternative
Rhubarb	100 Gm.	3 oz. av. 148 gr.
Potassium Carbonate	10 Gm.	146 gr.
Cinnamon Water	125 cc.	4 fl. oz.
Alcohol	110 cc.	3 fl. oz. 250 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the potassium carbonate in 750 cc. [24 fl. oz.] of water and macerate the rhubarb in this solution during twenty-four hours, having first cut it into thin slices and carefully freed it from any adhering fine powder. Strain this mixture through muslin, heat the strained liquid to boiling, add the cinnamon water and alcohol, stir it well and, while warm, filter it in a covered funnel. To the cold filtrate add sufficient water to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 10 per cent.

Uses—A cathartic.

Average dose—1 fluidrachm (4 cc.).

TINCTURA RHEI DULCIS. N. F. Sweet Tincture of Rhubarb
[Tr. Rhei Dulc.]

	Metric	Alternative
Rhubarb, in moderately coarse powder	100 Gm.	3 oz. av. 148 gr.
Glycyrrhiza, in moderately coarse powder	40 Gm.	1 oz. av. 147 gr.
Anise, in coarse powder	40 Gm.	1 oz. av. 147 gr.
Cardamom Seed, in coarse powder	10 Gm.	146 gr.
Glycerin	100 cc.	3 fl. oz. 96 min.
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (see page 365), using first a menstruum of 1000 cc. [3 fl. oz. 96 min.] of glycerin, 500 cc. [1 pint] of alcohol, and 400 cc. [12 fl. oz. 384 min.] of water and following with sufficient diluted alcohol to obtain 1000 cc. [2 pints] of Tincture.

Approximate alcohol content, by volume, 45 per cent.

Uses—A laxative and carminative.

Average dose—30 minims (2 cc.).

TINCTURA RHEI ET GENTIANÆ. N. F. Tincture of Rhubarb and Gentian

[Tr. Rhei et Gent.]

	Metric	Alternative
Rhubarb, in moderately coarse powder	**70.0 Gm.**	2 oz. av. 147 gr.
Gentian, in moderately coarse powder	**17.5 Gm.**	255 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 45 per cent.

Uses—A laxative and tonic.

Average dose—1 fluidrachm (4 cc.).

TINCTURA SABAL ET SANTALI. N. F. Tincture of Saw Palmetto and Sandal Wood

[Tr. Sabal et Santal.]

	Metric	Alternative
Sabal, in coarse powder	**200 Gm.**	6 oz. av. 296 gr.
Sandalwood, in fine powder	**65 Gm.**	2 oz. av. 74 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of four volumes of alcohol and one volume of water as the menstruum, and allowing a preliminary maceration of forty-eight hours.

Approximate alcohol content, by volume, 72 per cent.

Uses—Employed in urethral irritation as an antiseptic and sedative.

Average dose—1 fluidrachm (4 cc.).

TINCTURA SANGUINARIÆ. N. F. Tincture of Sanguinaria

(U. S. P. IX)

[Tr. Sanguin.—TINCTURE OF BLOODROOT]

	Metric	Alternative
Sanguinaria, in fine powder	**100 Gm.**	3 oz. av. 148 gr.
Hydrochloric Acid	**10 cc.**	154 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix 600 cc. [19 fl. oz. 96 min.] of alcohol with 400 cc. [12 fl. oz. 384 min.] of water. Moisten the drug with a mixture of the hydrochloric acid and 30 cc. [461 min.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum, made of alcohol and water, in the same proportion as before, to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 56 per cent.

Uses—Alterative and expectorant.

Average dose—15 minims (1 cc.).

TINCTURA SERPENTARIÆ. N. F. Tincture of Serpentaria

[Tr. Serpent.]

	Metric	Alternative
Serpentaria, in moderately coarse powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of two volumes of alcohol with one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

Uses—A bitter tonic.

Average dose—1 fluidrachm (4 cc.).

TINCTURA SUMBUL. N. F. Tincture of Sumbul

[Tr. Sumbul]

	Metric	Alternative
Sumbul, in moderately coarse powder	100 Gm.	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of two volumes of alcohol with one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

Uses—A nervine, employed especially for women in cases of nervous exhaustion.

Average dose—1 fluidrachm (4 cc.).

TINCTURA VANILLÆ. N. F. Tincture of Vanilla

[Tr. Vanil.]

	Metric	Alternative
Vanilla, cut into small pieces	100 Gm.	3 oz. av. 148 gr.
Sucrose, in coarse granules	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Diluted Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Macerate the vanilla with 500 cc. [1 pint] of alcohol in a stoppered container, in a moderately warm place for two days, with frequent agitation; then transfer it to a plain filter and reserve the filtered liquid. Spread out the drug on the filter and expose it to the air until all of the alcohol has evaporated. Then grind the vanilla and sucrose to a uniform powder, pack this in a percolator and slowly percolate it with a mixture of the reserved filtrate and an equal volume of water. When the liquid ceases to drop, continue the percolation slowly, gradually adding the remainder of the prepared menstruum and then sufficient diluted alcohol to make the product measure 1000 cc. [2 pints].

Approximate alcohol content, by volume, 40 per cent.

N. F. Preparations—Elixir Ammonii Valeratis; Emulsum Olei Ricini; Syrupus Bromidorum; Syrupus Cacao Præparati; Tabellæ Santonini; Tabellæ Santonini Compositæ.

Uses—A flavoring agent.

TINCTURA VIBURNI OPULI COMPOSITA. N. F. Compound Tincture of Viburnum

[Tr. Viburn. Opul. Co.]

	Metric	Alternative
Viburnum Opulus, in moderately coarse powder	35 Gm.	1 oz. av. 74 gr.
Dioscorea, in moderately coarse powder	35 Gm.	1 oz. av. 74 gr.
Scutellaria, in moderately coarse powder	10 Gm.	146 gr.
Clove, in coarse powder	50 Gm.	1 oz. av. 293 gr.
Cinnamon, in moderately coarse powder	65 Gm.	2 oz. av. 220 gr.
Glycerin	75 cc.	2 fl. oz. 192 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Prepare a Tincture by Type Process P (see page 365), using a mixture of 75 cc. [2 fl. oz. 192 min.] of glycerin, 750 cc. [24 fl. oz.] of alcohol, and 175 cc. [5 fl. oz. 288 min.] of water as the first menstruum, and following with sufficient of a mixture of three volumes of alcohol and one volume of water to obtain 1000 cc. [2 pints] of Tincture.

Approximate alcohol content, by volume, 68 per cent.

Uses—Employed in dysmenorrhea, but of doubtful value.

Average dose—1 fluidrachm (4 cc.).

TINCTURÆ ÆTHEREÆ. N. F. Ethereal Tinctures

Ethereal Tinctures, when not otherwise directed, are to be prepared according to the following general formula.

	Metric	Alternative
The Drug, properly comminuted	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Ether, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process P (see page 365), but with proper precautions to avoid loss of menstruum by evaporation, using a mixture of one volume of ether, and two volumes of alcohol as the menstruum.

TINCTURÆ MEDICAMENTORUM RECENTIUM. N. F. Tinctures of Fresh Drugs [Tincturæ Herbarum Recentium]

Tinctures of fresh drugs, when not otherwise directed, are to be prepared according to the following general formula:

	Metric	Alternative
The Fresh Drug, cut, bruised, or crushed	**500 Gm.**	16 oz. av. 302 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a Tincture by Type Process M (see page 366), using alcohol as the menstruum, and macerating fourteen days.

Uses—Tinctures of fresh drugs are largely employed in Homeopathic practice and closely resemble the *succi* or *juices* of the British Pharmacopœia.

Table of Some Unofficial Tinctures

Title	*Directions*
Tinctura Alstoniæ (Br. 1914)	Macerate 125 Gm. of alstonia, No. 20 powder, with enough 60 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Arnicæ Radicis (U. S. P. 1890)	Percolate 100 Gm. of aconite root, No. 40 powder, with enough 65 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Berberidis (Br. 1914)	Percolate 100 Gm. of berberis, No. 60 powder, with enough 60 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Buchu (Br. 1914)	Percolate 200 Gm. of buchu leaves, No. 20 powder, with enough 60 per cent alcohol to make 1000 cc. Dose: one fluidrachm (4 cc.)
Cannabis (U. S. P. IX)	Not more than 0.3 cc. tincture per kilogram body weight should be required to produce incoordination when administered to dogs. Percolate 100 Gm. of cannabis, No. 40 powder, with enough alcohol to make 950 cc. Assay and adjust to the above standard (see page for details of assay) Dose: twelve minims (0.75 cc.)
Caramellis (N. F. IV)	Dissolve 10 Gm. of caramel in 50 cc. of water, add 25 cc. of alcohol and enough water to make 100 cc.
Cascarillæ (Br. 1914)	Percolate 200 Gm. of Cascarilla, No. 40 powder, with enough 70 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Chiratæ, Br. 1924 (U. S. P. 1890)	Percolate 100 Gm. of chirata, No. 40 powder, with enough 60 per cent alcohol to make 1000 cc. Dose: one fluidrachm (4 cc.)
Chloroformi et Morphinæ Composita (Br. 1914)	Mix 7.5 cc. of chloroform, 2.5 cc. tincture of capsicum, 10 cc. tincture of indian hemp, 0.2 cc. oil of peppermint and 25 cc. of glycerin with 45 cc. of alcohol, dissolve 1 Gm. of morphine hydrochloride in the mixture, add 5 cc. diluted hydrocyanic acid and enough alcohol to make 100 cc. Dose: five minims (0.3 cc.)
Cocci (Br. 1914)	Macerate 100 Gm. cochineal powder for seven days in enough 45 per cent alcohol to make 1000 cc. Dose: twenty minims (1.3 cc.)
Daturæ Seminum (Br. 1914)	Percolate 250 Gm. of datura seeds, No. 20 powder, with enough 70 per cent alcohol to make 1000 cc. Dose: five minims (0.3 cc.)

Table of Some Unofficial Tinctures—*Continued*

Title	*Directions*
Tinctura Ergotæ ammoniata (N. F. IV)	Percolate 250 Gm. of ergot, No. 20 powder, first with a mixture of 100 cc. ammonia water, 600 cc. of alcohol and 200 cc. of water and then with enough 60 per cent alcohol to make 1000 cc. Dose: one fluidrachm (4 cc.)
Hamamelidis (Br. 1914)	Percolate 100 Gm. of hamamelis bark, No. 20 powder, with enough 45 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Kaladanæ (Br. 1914)	Percolate 200 Gm. of kaladana, No. 40 powder, with enough 70 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Kino et Opii Composita (N. F. IV)	Triturate 8.5 Gm. of cochineal with 8 cc. of aromatic spirit of ammonia and gradually add 625 cc. of diluted alcohol. Then add 200 cc. tincture of kino, 100 cc. of tincture of opium, 65 cc. spirit of camphor, 1.5 cc. oil of clove and enough diluted alcohol to make 1000 cc. Filter Dose: one fluidrachm (4 cc.)
Lactucarii (U. S. P. IX)	Triturate 500 Gm. lactucarium to a coarse powder with sand, exhaust with benzin, dry thoroughly, percolate first with a mixture of 250 cc. of glycerin, 250 cc. of water and 500 cc. of alcohol and then diluted alcohol, until the drug is exhausted. Reserve the first 750 cc. and evaporate the remainder to 250 cc. and mix with the reserve. Filter Dose: thirty minims (2 cc.)
Lobeliæ Ætherea (Br. 1914)	Percolate 200 Gm. of lobelia, No. 40 powder, with enough spirit of ether to make 1000 cc. Dose: five minims (0.3 cc.)
Matico (U. S. P. 1890)	Percolate 100 Gm. of matico, No. 40 powder, with enough diluted alcohol to make 1000 cc. Dose: forty-five grains (3 Gm.)
Moschi (U. S. P. IX)	Macerate 5 Gm. of musk with 45 cc. of water for twenty-four hours, then add 45 cc. of alcohol and macerate for six days, filter and add diluted alcohol to make 1000 cc. Dose: one fluidrachm (4 cc.)
Oliveri Corticis (Br. 1914)	Percolate 100 Gm. of Oliver's bark, No. 40 powder, with enough 60 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Opii Ammoniata (Br. 1914)	Dissolve 5 cc. of oil of anise and 20 Gm. benzoic acid in 600 cc. of alcohol, add 150 cc. tincture of opium, 200 cc. solution of ammonia (10 per cent); filter and add enough alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Paracoto (N. F. IV)	Percolate 125 Gm. paracoto, No. 40 powder, with enough alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Pectoralis (N. F. IV)	Mix 42 cc. tincture of opium, 64 cc. compound tincture of gambir, 40 cc. spirit of camphor, 1 cc. oil of anise and 16 Gm. caramel with enough diluted alcohol to make 1000 cc. Dose: ten minims (0.6 cc.)
Physostigmatis (U. S. P. IX)	One hundred cc. of tincture yields not less than 0.013 and not more than 0.017 Gm. of alkaloids. Percolate 100 Gm. of physostigma, No. 50 powder, with alcohol, collecting 950 cc. of percolate, assaying and regulating to the above standard Dose: fifteen minims (1 cc.)
Picrorhizæ (Br. 1914)	Macerate 250 Gm. picrorhiza, cut and bruised, with enough 45 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Pimpinellæ (N. F. IV)	Percolate 200 Gm. of pimpinella, No. 40 powder, with enough 60 per cent alcohol to make 1000 cc. Dose: one fluidrachm (4 cc.)
Podophylli (Br. 1914)	Macerate 36.5 Gm. of resin of podophyllum with 900 cc. of alcohol for twenty-four hours, filter and add enough alcohol to make 1000 cc. Dose: five minims (0.3 cc.)
Podophylli Indici (Br. 1914)	Macerate 36.5 Gm. of indian podophyllum resin with enough alcohol to make 1000 cc. Dose: five minims (0.3 cc.)
Pruni Virginianæ (Br. 1914)	Macerate 200 Gm. of wild cherry bark with 365 cc. of distilled water for twenty-four hours, add 565 cc. of alcohol and macerate seven days; strain, express and add 100 cc. of glycerin Dose: thirty minims (2 cc.)
Pyrethri (U. S. P. IX)	Percolate 200 Gm. pyrethrum, No. 50 powder, with enough alcohol to make 1000 cc.
Quininæ (Br. 1914)	Dissolve 20 Gm. of quinine hydrochloride in 1000 cc. of tincture of orange Dose: one fluidrachm (4 cc.)
Quininæ Ammoniata (Br. 1914)	Mix 100 cc. of solution of ammonia (10 per cent) with 900 cc. of 60 per cent alcohol, add 20 Gm. of quinine sulphate and shake until a clear solution results, set aside for three days and filter Dose: one fluidrachm (4 cc.)
Senegæ (Br. 1914)	Percolate 200 Gm. of senega, No. 40 powder, with enough 60 per cent alcohol to make 1000 cc. Dose: thirty minims (2 cc.)
Sennæ Composita (Br. 1914)	Percolate 200 Gm. of senna leaves, 25 Gm. caraway fruit and 25 Gm. of coriander fruit, all No. 20 powder, with enough 45 per cent alcohol to make 1000 cc. Dose: two fluidrachms (8 cc.)
Stramonii (Br. 1914)	Percolate 200 Gm. of stramonium leaves, No. 20 powder, with enough 45 per cent alcohol to make 1000 cc. Dose: ten minims (0.6 cc.)
Zedoariæ Amara (N. F. IV)	Percolate 250 Gm. of zedoary, 125 Gm. aloes, 62 Gm. of rhubarb, 62 Gm. of gentian, 62 Gm. agaric and 62 Gm. saffron with enough 60 per cent alcohol to make 750 cc. Add 125 cc. glycerin and set aside. Continue percolation to exhaustion, evaporate the last percolate to 120 cc. Mix with reserved portion and add enough 60 per cent alcohol to make 1000 cc. Dose: one fluidrachm (4 cc.)

Fluidextracta—*Fluidextracts*

Fluidextracts are liquid alcoholic preparations of uniform and definite strength, made by percolating drugs with menstrua, and concentrating a portion of the percolate so that in each case one cc. represents the medicinal virtues of one Gm. of the drug; they are mostly concentrated percolates. Fluidextracts were official for the first time in 1850, and the list was then made up of *seven* concentrated preparations, although but *one* of these could be called a fluidextract within the present meaning of the term. The use of fluidextracts has greatly increased, although they are not as frequently prescribed today as was the custom twenty years ago. They are, however, frequently recommended by manufacturing pharmacists as concentrated drug preparations for making tinctures and syrups, but official processes should not be replaced by any such makeshift. The U. S. P. X contains formulas for *twenty-five* and the N. F. V for *one hundred and four* fluidextracts. They may be justly called "American preparations", their development being largely due to the investigations of American pharmacists. The striking advantages possessed by fluidextracts are: 1. Permanence. 2. Concentration. 3. The uniform relation existing between the fluidextract and the drug.

In the U. S. P., one word, "Fluidextractum", has been adopted in place of two words, "Extractum Fluidum", formerly used. The object of this change was to avoid the confusion heretofore existing due to the alphabetical arrangement, which compelled Fluidextracts to be printed with the Extracts; thus, "Extractum Rhei" had to be followed by "Extractum Rhei Fluidum". By making the Latin name for fluidextracts "Fluidextractum", these preparations are now under the letter F instead of E. The English name is, of course, "Fluidextract" instead of "Fluid Extract".

Permanence is secured by the use of alcoholic menstrua; formerly, sugar and glycerin were relied upon as preservatives, but continued experience has developed the value of alcohol, so that at present it is most largely used as the solvent. Glycerin, however, is used in the menstruum of some fluidextracts, notably those containing tannin, and has a tendency to retard precipitation.

Concentration enables the physician to decrease the bulk of the dose, diminishing the volume of the preparation so that portability is secured and any therapeutic action from the menstruum largely eliminated. It also aids greatly in securing permanence.

The uniform relation existing between the fluidextract and the drug is of great assistance to the physician in fixing the dose, because, as 1 cc. represents 1 Gm. of drug, the dose of the fluidextract must be practically the same as that of the drug. It has also obvious advantages in the arrangement of the formulas and in working from them.

Many able pharmacists have favored making fluidextracts just half their present strength, the principal arguments being that more thorough exhaustion can be secured by the ordinary operator upon the small scale, and that the fluidextracts can be made to represent the drug more accurately and honestly when *one hundred* parts by measure are made from *fifty* parts by weight of the drug than when one hundred parts by measure are made from one hundred parts by weight of the drug. The standard of strength of the official fluidextracts is based upon the theory that from a given weight of drug an amount of fluidextract shall be made equal in measure to the bulk of the same weight of distilled water; in other words, the relation is that of Gm. to cc.

The official fluidextracts are standardized whenever made from a drug capable of being assayed either chemically or biologically.

Preparation—Fluidextracts are made in several ways. The manufacturer generally adopts a different process from that directed by the Pharmacopœia, because upon the large scale some practical modifications are necessary; the finished preparation must, however, be brought to the official standard. The processes at present in use may be classified as follows: 1. Percolation with partial evaporation. 2. Fractional or divided percolation. 3. Hot water exhaustion, evaporation, and preservation.

In the preparation of fluidextracts by the appended type processes A, B, or C, the rate of percolation must be carefully controlled and, for the quantities directed in the formulas of the Pharmacopœia, the flow should not exceed ten drops per minute until the percolate to be reserved is collected, and twenty drops per minute thereafter. One thousand Gm. of powdered drug may frequently be exhausted by percolation with sufficient menstruum to yield 3000 cc. of percolate, but, in all cases the percolation should be continued until the drug is practically exhausted.

1. **Percolation and Partial Evaporation**—This process is well illustrated by the official Type Processes A and B as follows:

"*Type Process A*—This process is recommended for fluidextracts that are made with a menstruum of alcohol, or a mixture of alcohol and water, by the usual process of percolation.

"Moisten 1000 Gm. [16 oz. av. 302 gr.] of the powdered drug directed with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp and to so maintain it during maceration for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum until the drug is exhausted. Reserve the first 850 cc. [13 fl. oz. 288 min.] of the percolate (unless otherwise specified in the formula), recover the alcohol from the remainder of the percolate, and concentrate the residue to a soft extract at a temperature not exceeding 60° C. Dissolve the extract in the reserved portion, mix thoroughly, and finally add a sufficient quantity of the menstruum to make the fluidextract measure 1000 cc. [1 pint] or the volume determined by calculation from the assay."

"*Type Process B*—This process is recommended for fluidextracts in which glycerin or an acid is used in the extraction and two menstrua are successively employed.

"Moisten 1000 Gm. [16 oz. av. 302 gr.] of the powdered drug directed with a sufficient quantity of the prescribed Menstruum I to render it evenly and distinctly damp and to so maintain it during maceration for six hours in a tightly covered container. Then pack it in a cylindrical percolator, add the remainder of Menstruum I, and when this has just disappeared from the surface, gradually add Menstruum II, constantly maintaining a stratum of liquid above the drug. When the liquid begins to drop from the percolator, close the lower orifice and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding Menstruum II until the drug is exhausted. Reserve the first 850 cc. [13 fl. oz. 288 min.] of the percolate (unless otherwise specified in the formula), recover the alcohol from the remainder of the percolate, and concentrate the residue to a soft extract at a temperature not exceeding 60° C. Dissolve the extract in the reserved portion, mix thoroughly, and finally add a sufficient quantity

of Menstruum II to make the fluidextract measure 1000 cc. [1 pint] or the volume determined by calculation from the assay."

The precipitation experienced heretofore when the evaporated weak percolate was added to the reserved portion is considerably diminished by causing the former to be evaporated to a soft extract. This precipitation, formerly noticed more particularly in alcoholic fluidextracts, was due to the volatility of the alcohol in the weak percolates, which, when evaporated, left the residue to a great extent aqueous; when this residue was added to the strongly alcoholic reserved portion, a precipitation of resinous and frequently of active matter took place, which necessitated the storing of the fluidextract until precipitation ceased, and subsequent filtration. This is almost altogether avoided by evaporating to a soft extract, and the loss of activity through precipitation is thus greatly diminished.

The argument is frequently advanced that the application of heat is detrimental to solutions of organic principles, that it dissociates some, and always proves injurious to the desirable constituents, *and that no heat whatever should be used in making fluidextracts;* these views are undoubtedly correct, when considered in connection with a few special cases, but do not apply with any practical force to the moderate use of heat where recommended by the official processes upon that portion of the percolate which represents the least active and least desirable constituents of the drug, for from seven-tenths to nine-tenths of the whole amount of percolate (frequently representing ninety-five per cent of the activity of the drug) is reserved and is not subjected to heat at all. The official process of "fractional percolation" may, however, be applied to any fluidextract directed to be made by Type Process A and by this method the application of all heat is avoided. This process will now be considered:

2. **Fractional or Divided Percolation**—"*Type Process C*—This process is especially recommended for drugs containing volatile constituents or constituents which are injured by exposure to heat. This process may also be used as an alternative process in the formulas in which Type Process A is directed.

"Divide 1000 Gm. [16 oz. av. 302 gr.] of the powdered drug directed into three portions of 500 Gm., 300 Gm., and 200 Gm. [8 oz. av. 151 gr., 5 oz. av. 3 gr., 3 oz. av. 148 gr.], respectively. Moisten the first portion of the drug (500 Gm.) [8 oz. av. 151 gr.] with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp and to so maintain it during maceration for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours, and then allow the percolation to proceed slowly, gradually adding more of the menstruum. Reserve the first 200 cc. [3 fl. oz. 96 min.] of percolate, and continue the process until the additional percolate measures 1500 cc. [24 fl. oz.], the latter being collected in successive portions of 300 cc. [4¾ fl. oz.] each.

"Moisten the second portion of the powdered drug (300 Gm.) [5 oz. av. 3 gr.] with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to so maintain it during maceration for six hours in a tightly covered container. Then pack it in a cylindrical percolator, macerate, and percolate as directed for the first portion of the drug, using as menstruum the several portions of percolate from the preceding operation in the order in which they were collected, and, if this is insufficient, follow with more of the original menstruum. Reserve the first 300 cc. [4¾ fl. oz.] of percolate, and continue the

process until the additional percolate measures 800 cc. [12¾ fl. oz.], the latter being collected in successive portions of 200 cc. [3 fl. oz.] each.

"Moisten the third portion of the powdered drug (200 Gm.) [3 oz. av. 148 gr.] with a sufficient quantity of the percolate collected in the preceding operation, immediately after the reserved portion, to render it evenly and distinctly damp and to so maintain it during maceration for six hours in a tightly-covered container. Then pack it in a cylindrical percolator, macerate, and percolate as before, using as menstruum the several portions of percolate from the preceding operation in the order in which they were collected, and, if this is insufficient, follow with more of the original menstruum. Collect 500 cc. [8 fl. oz.] of percolate, and mix this with the two portions previously reserved to make 1000 cc. [1 pint] of finished fluidextract.

"When Type Process C is directed for fluidextracts which are adjusted by assay to a definite alkaloidal standard, collect only 420 cc. [6 fl. oz. 346 min.] of percolate from the third portion of drug instead of the 500 cc. [8 fl. oz.] directed above. Mix this percolate with the two portions previously reserved, assay a portion of the mixture and adjust its volume by the addition of the menstruum directed so that each 100 cc. of finished fluidextract will contain the prescribed amount of alkaloid."

The credit for the development of the fractional percolation method, which so ingeniously avoids the use of heat, is given Dr. E. R. Squibb.* It is recommended officially for the preparation of fluidextract of aconite, in which heat would be injurious, rendering the alkaloid inactive, and also by both the U. S. P. and the N. F. for any fluidextract for which Type Process A is directed.

3. **Hot Water Exhaustion and Evaporation**—This method has been adopted for several official fluidextracts in which the active constituents are soluble in water. The making of fluidextracts by this process is very economical and may be used to advantage by retail pharmacists. It is directed in the U. S. P. for such drugs as cascara sagrada. The process is as follows:

"*Type Process D*—This process is recommended for those fluidextracts in which extraction is effected by infusion and percolation with boiling water, alcohol being added to the concentrated liquid as a preservative.

"To 1000 Gm. [16 oz. av. 302 gr.] of the ground drug add 5000 cc. [5 pints] of boiling water, mix thoroughly, and allow it to macerate in a covered container in a warm place for two hours. Then transfer the moist drug to a tinned or enamelled metallic percolator, and allow percolation to proceed, gradually adding boiling water until the drug is exhausted. Evaporate the percolate on a water bath or steam bath to the volume specified, and when cold add the alcohol directed, and mix thoroughly. Allow the product to stand for seven days in a stoppered container, then decant the clear liquid, filter the remainder, and wash the residue on the filter with sufficient of a mixture of alcohol and water in the proportion used to make the fluidextract measure 1000 cc. [1 pint]."

Preservation of Fluidextracts—Very little trouble is experienced in keeping fluidextracts which have been properly made. The Pharmacopœia directs that they "should be kept in tightly-stoppered, amber-colored bottles, protected from sunlight and extremes of temperature. After keeping for one month, the clear portion should be decanted from any sediment, the remainder filtered, and the liquids thoroughly mixed before storing". Precipitation to a greater or less extent will certainly take place. This is often especially noticeable in fluidextracts made during warm weather, and is due to the greater solvent action of the menstruum at higher temperatures. Precipitation is also caused

*The Theory of Percolation by James F. Couch, A. J. P. Vol. 92, page 862.

by the variation in the strength of different portions of the menstruum in an alcoholic fluidextract; the first part of the percolate which is received contains the displaced water which was present as moisture in the powder, and the mixture of this with the strong alcoholic percolate which follows causes precipitation in time. The character of the precipitate should be ascertained in each case; if active, it should be incorporated by shaking with the fluidextract; if inert, it should be filtered out.

Some manufacturers make a practice of aging and storing fluidextracts in glass-lined or enameled tanks. Experience has shown, however, that tight wooden containers (alcohol barrels are excellent for the purpose) are preferable, as fluidextracts aged in wood will remain clear and free from sedimentation much longer than those aged in glass or enameled vessels.

Acetic Fluidextracts, or Fluidacetracts—These were proposed by C. F. Squibb, and consist of preparations made like fluidextracts of definite strength, Gm. for cc., but made with acetic acid or diluted acetic acid of various strengths. The advantages claimed for them are cheapness, permanence, and miscibility with aqueous liquids but they have the disadvantage of the presence of acetic acid, which is not always desirable, and the loading of the finished preparation with inert constituents for which acetic acid is a good solvent. This class of preparations has not gained much favor.

Fluidextracts from Fresh Drugs—Fluidextracts of this character have been used to some extent, and may be made by crushing the drug, obtaining the liquid by pressure, and adding alcohol or diluted alcohol, according to the nature of the drug, re-pressing, and making the final product represent one gram in each cc. Owing to the varying proportion of water found in fresh drugs, it is evident that each preparation must be made from a special formula, and the quantity of alcohol to be added must depend upon the amount of water present in the drug; for drugs containing princip es which are volatile or easily dissociated, this method produces good preparations, but unusual care must be exercised to secure uniformity.

Alcoholic Percentage of Fluidextracts—The National Food and Drugs Act of 1906 requires that the percentage of alcohol by volume, in all preparations containing alcohol, be stated on the label. The percentage of alcohol in fluidextracts made by type process A, B, or C, is variable and always less than that in the menstruum employed, due, among other causes, to loss of alcohol by evaporation during manufacture, the presence of a variable proportion of water in the air-dried drug, and to the extraction from the drug of its soluble constituents, which also often vary greatly in different lots of the same drug. The percentage of alcohol in the finished product can therefore only be ascertained by an actual determination, but the average alcohol content is given after each official fluidextract (see Alcohol Determination page 908).

FLUIDEXTRACTUM BELLADONNÆ FOLIORUM. U.S. Fluidextract of Belladonna Leaves

[Fldext. Bellad. Fol.]

Fluidextract of Belladonna Leaves yields, from each 100 cc., not less than 0.27 Gm. and not more than 0.33 Gm. of the total alkaloids of belladonna leaves.

	Metric	Alternative
Belladonna Leaves, in moderately coarse powder.....	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a fluidextract by Type Process A (page 403), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum, and reserving the first 800 cc. [12 fl. oz. 384 min.] of percolate.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid, and dilute this with sufficient menstruum to make each 100 cc. of the finished Fluidextract contain 0.3 Gm. of the alkaloids of belladonna leaves.

Assay—Proceed by Type Process D, taking 10 cc. of Fluidextract of Belladonna Leaves, using chloroform as the solvent and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02893 Gm. of the alkaloids of belladonna (Proximate Assays, pages 1498 and 1496).

Alcohol content, by volume, 58 to 63 per cent.

Uses—Employed as an anodyne, locally in neuralgia and nerve pains; as an antispasmodic, for checking secretions, as in coryza, night sweats, and excessive milk; also, as a narcotic and mydriatic.

Average dose—1 minim (0.06 cc.).

FLUIDEXTRACTUM BELLADONNÆ RADICIS. Fluidextract of Belladonna Root [Fldext. Bellad. Rad.]

Fluidextract of Belladonna Root yields, from each 100 cc., not less than 0.405 Gm. and not more than 0.495 Gm. of the alkaloids of belladonna root.

	Metric	Alternative
Belladonna Root, in moderately coarse powder.....	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (page 403), using a mixture of 5 volumes of alcohol and 1 volume of water as the menstruum, and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid, and dilute this with enough menstruum to make each 100 cc. of the finished Fluidextract contain 0.45 Gm. of the alkaloids of belladonna root.

Assay—Proceed by Type Process D, taking 10 cc. of Fluidextract of Belladonna Root, using chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02893 Gm. of the alkaloids of belladonna (Proximate Assays, pages 1498 and 1497).

Alcohol content, by volume, 69 to 73 per cent.

N. F. Preparation—Linimentum Belladonnæ.

Uses—Employed as an anodyne, locally in neuralgia and nerve pains; as an antispasmodic, for checking secretions, as in coryza, night sweats, and excessive milk; also, as a narcotic and mydriatic.

Average dose—¾ minim (0.05 cc.).

FLUIDEXTRACTUM BUCHU. U.S. Fluidextract of Buchu [Fldext. Buchu.]

	Metric	Alternative
Buchu, in moderately coarse powder.....	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (page 403), using alcohol as the menstruum.

Alcohol content, by volume, 78 to 84 per cent.

N. F. Preparations—Elixir Buchu; Elixir Buchu et Potassii Acetatis; Elixir Buchu, Juniperi et Potassii Acetatis.

Uses—In inflammations of the bladder. This is probably the best form for the administration of the drug.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CANNABIS. U.S. Fluidextract of Cannabis
[Fldext. Cannab.]

Fluidextract of Cannabis, administered by the mouth to dogs in doses not exceeding 0.1 cc. for each kilogram of body weight of dog, produces the same degree of incoördination as that produced by an equivalent dose of the standard fluidextract of cannabis, prepared as directed under *Cannabis*.

	Metric	Alternative
Cannabis, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using alcohol as the menstruum.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained adjust the volume of the finished Fluidextract by the addition of alcohol to conform to the above biological standard.

See page 1507 for the assay.

Alcohol content, by volume, 75 to 85 per cent.

N. F. Preparation—Collodium Salicylicum Compositum.

Uses—An analgesic in headache and neuralgia; as a sedative in neuralgia and neurasthenia and sometimes as a hypnotic. Its tendency to form a habit must not be forgotten.

Average dose—1½ minims (0.1 cc.).

FLUIDEXTRACTUM CASCARÆ SAGRADÆ. U.S. Fluidextract of Cascara Sagrada
[Fldext. Casc. Sagr.—Fluidextract of Rhamnus Purshiana]

	Metric	Alternative
Cascara Sagrada, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process D (page 405). Evaporate the aqueous percolate to 750 cc. [12 fl. oz.] and when cold gradually add 250 cc. [4 fl. oz.] of alcohol and, if necessary, sufficient water to make the product measure 1000 cc. [16 fl. oz.].

Alcohol content, by volume, 20 to 24 per cent.

Uses—A mild and effective cathartic, especially valuable because it does not produce habitual or after-constipation. Although this preparation is intensely bitter, it is sometimes desired for its stomachic effect.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM CASCARÆ SAGRADÆ AROMATICUM. U.S. Aromatic Fluidextract of Cascara Sagrada
[Fldext. Casc. Sagr. Arom.—Aromatic Fluidextract of Rhamnus Purshiana]

	Metric	Alternative
Cascara Sagrada, in coarse powder	**1000.0 Gm.**	33 oz. av. 167 gr.
Magnesium Oxide	**60.0 Gm.**	2 oz. av.
Lime	**60.0 Gm.**	2 oz. av.
Pure Extract of Glycyrrhiza	**40.0 Gm.**	1 oz. av. 147 gr.
Glycerin	**200.0 cc.**	6 oz. av. 192 min.
Alcohol	**200.0 cc.**	6 oz. av. 192 min.
Gluside	**1.0 Gm.**	15 gr.
Oil of Anise	**2.5 cc.**	38 min.
Oil of Cinnamon	**0.2 cc.**	3 min.
Oil of Coriander	**0.1 cc.**	1½ min.
Methyl Salicylate	**0.2 cc.**	3 min.
Boiling Water, a sufficient quantity		
To make	**1000 cc.**	2 pints

Slake the lime by the gradual addition of water, mix it thoroughly with the cascara sagrada and the magnesium oxide, moisten uniformly with 2000 cc. [4 pints] of boiling water, set aside in a shallow dish for forty-eight hours, stirring occasionally, and then pack in a percolator. Now pour on boiling water and allow the percolation to proceed until the drug is exhausted. Evaporate the percolate to 500 cc. [1 pint] and while yet warm dissolve in it the pure extract of glycyrrhiza. When cold, add the glycerin, then the alcohol in which the gluside and the oils have been dissolved, and finally sufficient water to make the Fluidextract measure 1000 cc. [2 pints].

The preliminary treatment of the drug with lime and magnesium oxide is for the purpose of neutralizing the acid resins present in cascara sagrada to which the bitterness is due. When these are neutralized, the drug loses its bitterness, but at the same time is reduced about 50 per cent in activity, it being necessary to double the dose.

Alcohol content, by volume, 17 to 19 per cent.

N. F. Preparations—Elixir Cascaræ Sagradæ; Elixir Cascaræ Sagradæ Compositum.

Uses—The uses are the same as for the plain Fluidextract of Cascara Sagrada but larger doses are required.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CIMICIFUGÆ. U. S. Fluidextract of Cimicifuga

[Fldext. Cimicif.—Fluidextract of Black Cohosh, Fluidextract of Black Snakeroot]

	Metric	Alternative
Cimicifuga, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using alcohol as the menstruum.

Alcohol content, by volume, 79 to 85 per cent.

N. F. Preparation—Elixir Sodii Salicylatis Compositum.

Uses—Used for chorea or St. Vitus' dance. It must be used with caution. An alterative and sedative in chronic rheumatism.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM CINCHONÆ. U. S. Fluidextract of Cinchona

[Fldext. Cinchon.]

Fluidextract of Cinchona yields, from each 100 cc., not less than 4 Gm. and not more than 5 Gm. of the total alkaloids of cinchona.

	Metric	Alternative
Cinchona, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 100 cc. [1 fl. oz. 384 min.] of hydrochloric acid, and 800 cc. [12 fl. oz. 384 min.] of alcohol as Menstruum I, and a mixture of 4 volumes of alcohol and 1 volume of water as Menstruum II.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid, and dilute this with enough of Menstruum II to make each 100 cc. of the finished Fluidextract contain 4.5 Gm. of the total alkaloids of cinchona.

Assay—Proceed by Type Process C, taking 5 cc. of Fluidextract of Cinchona, using 200 cc. of ether-chloroform mixture for maceration. Decant an aliquot portion of 160 cc., representing 4 cc. of Fluidextract of Cinchona, using chloroform for the final extraction, and determine the alkaloids gravimetrically (Proximate Assays, pages 1498 and 1497).

Alcohol content, by volume, 56 to 62 per cent.

Uses—An antiperiodic and bitter tonic.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM COLCHICI. U. S. Fluidextract of Colchicum

[**Fldext. Colch.**—FLUIDEXTRACTUM COLCHICI SEMINIS U. S. P. IX]

Fluidextract of Colchicum yields, from each 100 cc., not less than 0.36 Gm. and not more than 0.44 Gm. of colchicine.

	Metric	Alternative
Colchicum Seed, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Purified Petroleum Benzin, a sufficient quantity.		

Pack the colchicum seed in a cylindrical percolator, and slowly percolate with purified petroleum benzin until a few drops of the percolate leave no greasy stain when evaporated from filter paper. Reject the benzin solution, remove the powder from the percolator, and dry it by exposure to the air. Then proceed to make the Fluidextract by Type Process A (page 403), using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid, and dilute this with enough menstruum to make each 100 cc. of the finished Fluidextract contain 0.4 Gm. of colchicine.

Assay—Place 15 cc. of Fluidextract of Colchicum in a 500 cc. flask containing 275 cc. of distilled water, mix well, add 10 cc. of solution of lead subacetate, and agitate the mixture frequently during one hour. Filter off 200 cc. and proceed as directed under *Colchici Semen*, pages 1498 and 1497, fourth line of the Assay, beginning with the word "Add".

Alcohol content, by volume, 53 to 58 per cent.

Uses—In chronic rheumatism and acute gout.

Average dose—3 minims (0.2 cc.).

FLUIDEXTRACTUM ERGOTÆ. U. S. Fluidextract of Ergot

[**Fldext. Ergot.**—SECALIS CORNUTI EXTRACTUM FLUIDUM P. I.]

Fluidextract of Ergot, administered by intramuscular injection to single-comb, white Leghorn cocks, in doses not exceeding 0.5 cc. for each kilogram of body weight of cock, produces a darkening of the comb, corresponding in intensity to that caused by the same dose of the standard fluidextract of ergot prepared as directed under *Ergota*.

	Metric	Alternative
Ergot, recently ground and in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Purified Petroleum Benzin, a sufficient quantity.		

Pack the ergot in a cylindrical percolator, and slowly percolate with purified petroleum benzin until a few drops of the percolate leave no greasy stain when evaporated from filter paper. Reject the benzin solution, remove the drug from the percolator, and dry it by exposure to the air. Then proceed to make the Fluidextract by Type Process B (page 403), using a menstruum of 20 cc. [154 min.] of hydrochloric acid and 980 cc. [14 fl. oz. 346 min.] of diluted alcohol as Menstruum I, and diluted alcohol as Menstruum II.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained adjust the volume of the finished Fluidextract by the addition of enough Menstruum II to make it conform to the required biological standard.

See page 1509 for the assay.
Alcohol content, by volume, 37 to 42 per cent.

Uses—Often employed in the latter stages of labor as a stimulant to the uterus and a preventive of hemorrhage. Also used to control other internal hemorrhages and for the relief of chronic congestions. Because of its effect on the circulation it is also employed in a wide diversity of diseases.

Average dose—30 minims (2 cc.).

NOTE—It deteriorates rapidly during the first few months and then seems to become more stabilized. This explains the requirement that it be aged for six months before being standardized physiologically. It is preferably purchased in small containers, not larger than four ounces, or even smaller if the quantity dispensed does not justify this amount. It has been marketed in hermetically sealed vacuum tubes and the claim is made that in these, little or no deterioration results.

FLUIDEXTRACTUM ERIODICTYI. U. S. Fluidextract of Eriodictyon

[Fldext. Eriodict.—FLUIDEXTRACT OF YERBA SANTA]

	Metric	Alternative
Eriodictyon, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum, and reserving the first 800 cc. [12 fl. oz. 384 min.] of percolate.

Alcohol content, by volume, 57 to 62 per cent.

N. F. Preparations—Elixir Eriodictyi Aromaticum; Syrupus Eriodictyi Aromaticus.

Uses—A peculiar, aromatic flavor, used in syrups and elixirs, especially for masking bitter drugs like quinine. Because of its resinous character it requires an alkali to render it soluble in aqueous mixtures. It is sometimes used as an expectorant.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM EUCALYPTI. U. S. Fluidextract of Eucalyptus

[Fldext. Eucalypt.]

	Metric	Alternative
Eucalyptus, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum, and reserving the first 800 cc. [12 fl. oz. 384 min.] of percolate.

Alcohol content, by volume, 58 to 63 per cent.

Uses—The oil of this drug is most frequently employed but the fluidextract has been used in malaria when quinine was not available, and as a stimulating expectorant. It has the same general properties as the oil.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM GLYCYRRHIZÆ. U. S. Fluidextract of Glycyrrhiza

[Fldext. Glycyrrh.—Fluidextract of Licorice Root]

	Metric	Alternative
Glycyrrhiza, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process D (page 405). Promptly evaporate the aqueous percolate to 750 cc. [12 fl. oz.], allow this to cool, and gradually add 250 cc. [4 fl. oz.] of alcohol and, if necessary, sufficient water to make the product measure 1000 cc. [16 fl. oz.].

Alcohol content, by volume, 20 to 24 per cent.

U. S. P. Preparations—Elixir Glycyrrhizæ, Mistura Glycyrrhizæ Composita; Syrupus Sarsaparillæ Compositus.

N. F. Preparations—Elixir Glycyrrhizæ Aquosum; Elixir Taraxaci Compositum.

Uses—A pleasant flavor for use in syrups and elixirs to be employed as vehicles and correctives.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM GRANATI. U. S. Fluidextract of Pomegranate

[Fldext. Granat.]

	Metric	Alternative
Pomegranate, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol and 400 cc. [6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II.

Alcohol content, by volume, 34 to 40 per cent.

Uses—A tænifuge. It is usually administered after a twelve hour fast, to be followed within two hours by an active cathartic.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM HYDRASTIS. U. S. Fluidextract of Hydrastis

[Fldext. Hydrast.—Fluidextract of Golden Seal]

Fluidextract of Hydrastis yields, from each 100 cc., not less than 1.8 Gm. and not more than 2.2 Gm. of the ether-soluble alkaloids of hydrastis.

	Metric	Alternative
Hydrastis, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 600 cc. [9 fl. oz. 288 min.] of alcohol, and 200 cc. [3 fl. oz. 96 min.] of water as Menstruum I, and a mixture of 2 volumes of alcohol and 1 volume of water as Menstruum II. Reserve the first 750 cc. [12 fl. oz.] of percolate.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid, and dilute this with enough of Menstruum II to make each 100 cc. of the finished Fluidextract contain 2 Gm. of the ether-soluble alkaloids of hydrastis.

Assay—Proceed by Type Process D, taking 5 cc. of Fluidextract of Hydrastis, using ether as the solvent, and determine the alkaloids gravimetrically (Proximate Assays, page 1498).
Alcohol content, by volume, 47 to 52 per cent.

N. F. Preparations—Elixir Hydrastis Compositum; Mistura Rhei Alkalina.

Uses—Employed locally in catarrhal conditions or whenever the tone of mucous membranes is lowered, as in leucorrhea, chronic nasal inflammation, the latter stages of gonorrhea, etc.; internally in stomach troubles.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM HYOSCYAMI. U.S. Fluidextract of Hyoscyamus

[Fldext. Hyosc.—Fluidextract of Henbane]

Fluidextract of Hyoscyamus yields, from each 100 cc., not less than 0.055 Gm. and not more than 0.075 Gm. of the alkaloids of hyoscyamus.

	Metric	Alternative
Hyoscyamus, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (page 403), using a mixture of 3 volumes of alcohol and 1 volume of water as the menstruum.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid, and dilute this with enough menstruum to make each 100 cc. of the finished Fluidextract contain 0.065 Gm. of the alkaloids of hyoscyamus.

Assay—Proceed by Type Process D, taking 25 cc. of Fluidextract of Hyoscyamus, using chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02893 Gm. of the alkaloids of hyoscyamus (Proximate Assays, page 1498).
Alcohol content, by volume, 58 to 63 per cent.

Uses—Employed to allay nervous irritation, particularly in nervous cough, whooping-cough, and colic. Also to give relief in urinary incontinence due to irritated bladder.

Average dose—3 minims (0.2 cc.).

FLUIDEXTRACTUM IPECACUANHÆ. U.S. Fluidextract of Ipecac

[Fldext. Ipecac.]

Fluidextract of Ipecac yields, from each 100 cc., not less than 1.35 Gm. and not more than 1.65 Gm. of the ether-soluble alkaloids of ipecac.

	Metric	Alternative
Ipecac, in fine powder	**1000 Gm.**	**16 oz. av. 302 gr.**
Diluted Hydrochloric Acid, a sufficient quantity.		

Prepare a Fluidextract by Type Process B (page 403), using a mixture of 150 cc. [2 fl. oz. 192 min.] of diluted hydrochloric acid, 300 cc. [4 fl. oz. 384 min.] of alcohol and 300 cc. [4 fl. oz. 384 min.] of water as Menstruum I, and a mixture of 2 volumes of alcohol and 3 volumes of water as Menstruum II. Reserve the first 800 cc. [12 fl. oz. 384 min.] of percolate.

After dissolving the soft extract in the reserve liquid, assay a portion as directed below, and from the result thus obtained ascertain by calculation the amount of alkaloids in the remainder of the liquid. Test a small portion for miscibility by adding 7 cc. [108 min.] to a mixture of 10 cc. [154 min.] of glycerin and sufficient syrup to make 100 cc. [3 fl. oz. 96 min.]. If this does not produce a clear mixture, gradually add diluted hydrochloric acid, drop by

drop, until a clear mixture is obtained which will remain clear for four days. Add to the remainder of the Fluidextract the amount of diluted hydrochloric acid determined as necessary by this test and sufficient of Menstruum II to make each 100 cc. of the finished Fluidextract contain 1.5 Gm. of the ether-soluble alkaloids of ipecac.

Assay—Proceed by Type Process D, taking 5 cc. of Fluidextract of Ipecac, using ether as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.024 Gm. of the alkaloids of ipecac (Proximate Assays, page 1498).

Alcohol content, by volume, 28 to 33 per cent.

U. S. P. Preparation—Syrupus Ipecacuanhæ.

N. F. Preparations—Mistura Rhei Composita; Syrupus Asari Compositus; Tinctura Ipecacuanhæ; Tinctura Ipecacuanhæ et Opii.

Uses—Chiefly employed in making the syrup and other preparations. It may be used as an emetic in the treatment of amebic dysentery, or for any other condition for which ipecac is prescribed.

Average dose—Expectorant, 1 minim (0.06 cc.).
Emetic, 15 minims (1 cc.).

FLUIDEXTRACTUM RHEI. U. S. Fluidextract of Rhubarb
[Fldext. Rhei]

	Metric	Alternative
Rhubarb, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum.

Alcohol content, by volume, 55 to 63 per cent.

U. S. P. Preparation—Syrupus Rhei.

N. F. Preparations—Elixir Catharticum Compositum; Mistura Rhei Alkalina; Mistura Rhei Composita.

Uses—A cathartic. Employed in making many other preparations.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM RHOIS GLABRÆ. U. S. Fluidextract of Rhus Glabra
[Fldext. Rhois Glab.]

	Metric	Alternative
Rhus Glabra, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol, and 400 cc. [6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II.

Alcohol content, by volume, 37 to 43 per cent.

Uses—An astringent, especially useful as a gargle. Also employed in diarrhea.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM ROSÆ. U. S. Fluidextract of Rose
[Fldext. Ros.]

	Metric	Alternative
Red Rose, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol, and 400 cc.

[6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II.

Alcohol content, by volume, 35 to 40 per cent.

U. S. P. Preparation—Mel Rosæ.
N. F. Preparations—Syrupus Rosæ; Trochisci Eucalypti Gummi.

Uses—A flavor and an astringent employed in sore throat.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM SARSAPARILLÆ. U. S. Fluidextract of Sarsaparilla

[Fldext. Sarsap.]

	Metric	Alternative
Sarsaparilla, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using diluted alcohol as the menstruum.

Alcohol content, by volume, 37 to 42 per cent.

U. S. P. Preparation—Syrupus Sarsaparillæ Compositus.

Uses—It has been used as an alterative but possesses little or no medicinal value. It was introduced into the U. S. P. as a pharmaceutic necessity for the making of the compound syrup which is employed chiefly as a vehicle for iodides.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM SCILLÆ. U. S. Fluidextract of Squill

[Fldext. Scill.]

Fluidextract of Squill, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.00,055 cc. and not more than 0.00,065 cc. of Fluidextract, or the equivalent in Fluidextract of not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each gram of body weight of frog.

	Metric	Alternative
Squill, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Diluted Alcohol,		
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 cc.**	16 fl. oz.

Mix 2000 cc. [2 pints] of alcohol with 1000 cc. [1 pint] of water, moisten the squill thoroughly with a sufficient quantity of the mixture, and allow it to macerate for two hours in a tightly-covered container. Then transfer to a percolator, shake it down evenly without packing, and pour on enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more menstruum composed of 2 volumes of alcohol and 1 volume of water. When the percolate measures 1000 cc. [1 pint], close the lower orifice, and macerate the drug for twelve hours before continuing the percolation. Then collect a second 1000 cc. [1 pint] of percolate, again interrupt the percolation, macerate for twelve hours, and then continue the percolation until the total percolate measures 5000 cc.

[5 pints]. Recover the alcohol from the percolate at as low a temperature as possible, and then concentrate the residue to a volume measuring 800 cc. [12 fl. oz. 384 min.]. When the residue is cold, add slowly, with continuous agitation, 2000 cc. [2 pints] of alcohol, and set the mixture aside in a tightly-stoppered container for twelve hours. Decant the supernatant liquid from the syrupy layer, filter the decanted liquid, and wash the syrupy residue with two portions of 300 cc. [4 fl. oz. 384 min.] each of a mixture of 4 volumes of alcohol and 1 volume of water, passing the washings through the filter into the previously collected alcoholic liquid. Reduce the combined alcoholic liquids to 800 cc. [12 fl. oz. 384 min.] by distillation, assay a portion as directed below, and from the result thus obtained adjust the volume of the finished Fluidextract by the addition of diluted alcohol to conform to the above biological standard.

See page 1505 for the Assay.
Alcohol content, by volume, 47 to 52 per cent.

U. S. P. Preparation—Syrupus Scillæ Compositus.
N. F. Preparation—Mistura Pectoralis, Stokes'.

Uses—Squill belongs to the "digitalis group", being similar in action. Employed as a diuretic in dropsy, especially when associated with cardiac troubles, but not often used in heart disease because of its irritant action on the kidneys. Given in bronchitis as an expectorant.

Average dose—1½ minims (0.1 cc.).

FLUIDEXTRACTUM SENEGÆ. U. S. Fluidextract of Senega

[Fldext. Seneg.]

	Metric	Alternative
Senega, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Ammonia Water,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	16 fl. oz.

Moisten the drug with a sufficient quantity of a mixture of 2 volumes of alcohol and 1 volume of water, pack it in a cylindrical percolator and add more of the menstruum to saturate the drug and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more of the same menstruum until the drug is exhausted. Reserve the first 800 cc. [12 fl. oz. 384 min.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and then gradually add ammonia water until the product is faintly alkaline and has a slight odor of ammonia. Finally add enough of the menstruum to make the Fluidextract measure 1000 cc. [16 fl. oz.].

Ammonia water is added to prevent gelatinization of the pectin in this drug.

Alcohol content, by volume, 45 to 50 per cent.

U. S. P. Preparations—Syrupus Scillæ Compositus; Syrupus Senegæ.
N. F. Preparation—Mistura Pectoralis.

Uses—A stimulating expectorant useful in bronchitis.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM SENNÆ. U. S. Fluidextract of Senna

[Fldext. Senn.]

	Metric	Alternative
Senna, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using a mixture of 1 volume of alcohol and 2 volumes of water as the menstruum, and reserving the first 800 cc. [12 fl. oz. 384 min.] of percolate.

Alcohol content, by volume, 23 to 27 per cent.

U. S. P. Preparation—Syrupus Sennæ.

N. F. Preparations—Elixir Cascaræ Sagradæ Compositum; Elixir Catharticum Compositum; Syrupus Ficorum Compositus; Syrupus Sennæ Aromaticus.

Uses—A cathartic, frequently producing griping, when used alone. It is chiefly used to make other preparations.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM UVÆ URSI. U. S. Fluidextract of Uva Ursi

[Fldext. Uvæ Ursi]

	Metric	Alternative
Uva Ursi, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 300 cc. [4 fl. oz. 384 min.] of alcohol, and 500 cc. [8 fl. oz.] of water as Menstruum I, and a mixture of 1 volume of alcohol and 2 volumes of water as Menstruum II. Reserve the first 800 cc. [12 fl. oz. 384 min.] of percolate.

Alcohol content, by volume, 18 to 25 per cent.

Uses—A mild, astringent diuretic, used in cystitis, chronic gonorrhea, and pyelitis.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM ZINGIBERIS. U. S. Fluidextract of Ginger

[Fldext. Zingib.]

	Metric	Alternative
Ginger, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using alcohol as the menstruum.

Alcohol content, by volume, 78 to 83 per cent.

U. S. P. Preparation—Syrupus Zingiberis.

N. F. Preparation—Elixir Hydrastis Compositum.

Uses—A carminative and stomachic, but chiefly used in the making of other preparations of ginger.

Average dose—8 minims (0.5 cc.).

FLUIDEXTRACTUM ACONITI. N. F. Fluidextract of Aconite

(U. S. P. IX)

[Fldext. Aconit.]

When assayed biologically, the minimum lethal dose of Fluidextract of Aconite should not be greater than 0.00004 cc. for each Gm. of body weight, of guinea pig.

	Metric	Alternative
Aconite, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process C, as modified for alkaloidal drugs (see page 405), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Assay—For method of assaying Fluidextract of Aconite see Biological Assays, U. S. P. X. Approximate alcohol content, by volume, 65 per cent.

N. F. Preparation—Linimentum Aconiti et Chloroformi.

Uses—In fevers and heart disease.

Average dose—1 minim (0.06 cc.).

FLUIDEXTRACTUM ADONIDIS. N. F. Fluidextract of Adonis

[Fldext. Adonid.]

	Metric	Alternative
Adonis, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 58 per cent.

Uses—A cardiac tonic resembling digitalis in action. Used in combination with bromides; it is also employed in epilepsy.

Average dose—2 minims (0.125 cc.).

FLUIDEXTRACTUM ALETRIDIS. N. F. Fluidextract of Aletris

[Fldext. Aletrid.]

	Metric	Alternative
Aletris, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

N. F. Preparations—Elixir Aletridis Compositum; Elixir Viburni Opuli Compositum.

Uses—A bitter tonic; it has been used in dropsy, colic, and chronic rheumatism.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM ANGELICÆ RADICIS. N. F. Fluidextract of Angelica Root

[Fldext. Angel. Rad.]

	Metric	Alternative
Angelica Root, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of five volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 68 per cent.

Uses—A gastric stimulant and carminative.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM APII FRUCTUS. N. F. Fluidextract of Celery Fruit

[Fldext. Apii Fruct.]

	Metric	Alternative
Celery Fruit, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum. In order to remove any separated oil, after permitting the fluidextract to stand, filter it through an alcohol-wetted filter, rejecting the final few cubic centimeters remaining on the filter with the oil.

Approximate alcohol content, by volume, 85 per cent.

N. F. Preparation—Elixir Guaranæ et Apii.

Uses—A nerve sedative, especially used in menstrual disorders.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM APOCYNI. N. F. Fluidextract of Apocynum
[Fldext. Apocyn.]

	Metric	Alternative
Apocynum, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and two volumes of water as menstruum.

Assay—For a method of assaying Fluidextract of Apocynum see Biological Assays, U. S. P. X.

Approximate alcohol content, by volume, 48 per cent.

Caution—It has been stated that the absorption of Apocynum in the gastro-intestinal tract is uncertain and irregular. To avoid possible toxic or cumulative action of the drug, the physician should determine in each case the tolerance of the patient, and regulate the dosage accordingly.

Uses—Employed in cardiac and renal dropsy. It belongs to the "digitalis group" of cardiac tonics and is a powerful diuretic but must be used with caution.

Average dose—12 minims (0.75 cc.).

FLUIDEXTRACTUM ARALIÆ. N. F. Fluidextract of Aralia
[Fldext. Aral.]

	Metric	Alternative
Aralia, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 54 per cent.

Uses—An alterative.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM ARNICÆ. N. F. Fluidextract of Arnica
[Fldext. Arnic.]

	Metric	Alternative
Arnica, in coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 55 per cent.

Uses—A stimulant and alterative, rarely used.

Average dose—1½ minims (0.1 cc.).

FLUIDEXTRACTUM ASCLEPIADIS. N. F. Fluidextract of Asclepias
[Fldext. Asclepiad.]

	Metric	Alternative
Asclepias, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—A diaphoretic, expectorant, and cathartic.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM AVENÆ SATIVÆ. N. F. Fluidextract of Oat
[Fldext. Aven. Sativ.]

	Metric	Alternative
Oat, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and three volumes of water as the menstruum.

Approximate alcohol content, by volume, 34 per cent.

N. F. Preparation—Elixir Hydrastis Compositum.

Uses—An alterative.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM BAPTISIÆ. N. F. Fluidextract of Baptisia

[Fldext. Baptis.]

	Metric	Alternative
Baptisia, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

N. F. Preparation—Dentifricium.

Uses—It has been used for its laxative and stimulant properties, but its main use in pharmacy is for its yellow color.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM BERBERIDIS. N. F. Fluidextract of Berberis

[Fldext. Berberid.]

	Metric	Alternative
Berberis, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—A bitter tonic.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM BOLDI. N. F. Fluidextract of Boldo

[Fldext. Boldi]

	Metric	Alternative
Boldo, in moderately fine powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum.

Approximate alcohol content, by volume, 80 per cent.

Uses—An alterative and tonic.

Average dose—8 minims (0.5 cc.).

FLUIDEXTRACTUM BUCHU COMPOSITUM. N. F. Compound Fluidextract of Buchu

[Fldext. Buchu Co.]

	Metric	Alternative
Buchu, in moderately coarse powder	**625 Gm.**	10 oz. av. 188 gr.
Cubeb, in moderately coarse powder	**125 Gm.**	2 oz. av. 38 gr.
Juniper Berries, in moderately coarse powder	**125 Gm.**	2 oz. av. 38 gr.
Uva Ursi, in moderately coarse powder	**125 Gm.**	2 oz. av. 38 gr.
To make	**1000 cc.**	1 pint

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

N. F. Preparation—Elixir Buchu Compositum.

Uses—For chronic inflammations of the genito-urinary tract.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CALENDULÆ. N. F. Fluidextract of Calendula

[Fldext. Calend.]

	Metric	Alternative
Calendula, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 52 per cent.

Uses—Externally for sprains and bruises.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM CALUMBÆ. N. F. Fluidextract of Calumba

[Fldext. Calumb.]

	Metric	Alternative
Calumba, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 54 per cent.

Uses—A simple bitter, especially valuable in the convalescent period after fevers or severe diarrhea.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CASTANEÆ. N. F. Fluidextract of Castanea

[Fldext. Castan.]

	Metric	Alternative
Castanea, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Glycerin	**100 cc.**	1 fl. oz. 288 min.
Alcohol,		
Water, each, a sufficient quantity		
To make	**1000 cc.**	1 pint

Pour 5000 cc. [5 pints] of boiling water upon the powder, allow it to macerate two hours, then express the liquid, transfer the residue to a percolator, and pour water upon it until the powder is practically exhausted. Evaporate the united liquids, on a water bath, to 2000 cc. [2 pints], allow it to cool, and add 600 cc. [9 fl. oz. 288 min.] of alcohol. When the insoluble matter has subsided, separate the clear liquid, filter the remainder, evaporate the united liquids to 700 cc. [11 fl. oz. 96 min.], allow to cool, add the glycerin, and lastly, enough alcohol to make the Fluidextract measure 1000 cc. [1 pint].

Approximate alcohol content, by volume, 16 per cent.

Uses—An astringent, chiefly used for local application.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM CATARIÆ. N. F. Fluidextract of Catnep

[Fldext. Catar.]

	Metric	Alternative
Catnep, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and four volumes of water as the menstruum.

Approximate alcohol content, by volume, 35 per cent.

N. F. Preparation—Elixir Catariæ et Fœniculi.

Uses—A carminative, antispasmodic, and emmenagogue.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM CAULOPHYLLI. N. F. Fluidextract of Caulophyllum

[Fldext. Caulophyl.]

	Metric	Alternative
Caulophyllum, in fine powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

N. F. Preparations—Elixir Aletridis Compositum; Elixir Heloniadis Compositum.

Uses—Said to be an emmenagogue, antispasmodic, and sedative.

Average dose—8 minims (0.5 cc.).

FLUIDEXTRACTUM CHIMAPHILÆ. N. F. Fluidextract of Chimaphila

[Fldext. Chimaphil.]

	Metric	Alternative
Chimaphila, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 36 per cent.

Uses—A feeble diuretic, exerting some antiseptic action in the urine.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CHIONANTHI. N. F. Fluidextract of Chionanthus

[Fldext. Chionanth.]

	Metric	Alternative
Chionanthus, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 55 per cent.

Uses—A diuretic and aperient.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CHIRATÆ. N. F. Fluidextract of Chirata

[Fldext. Chirat.]

	Metric	Alternative
Chirata, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 42 per cent.

Uses—A bitter tonic. As it is free from tannin it may be prescribed with iron.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM COCILLANÆ. N. F. Fluidextract of Cocillana

[Fldext. Cocillan.]

	Metric	Alternative
Cocillana, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 65 per cent.

Uses—A nauseating expectorant, similar in action to ipecac.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM COFFEÆ. N. F. Fluidextract of Coffee

[Fldext. Coff.—Fluidextractum Coffeæ Tostæ, Fluidextract of Roasted Coffee]

	Metric	Alternative
Coffee, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 65 cc. [1 fl. oz. 19 min.] of glycerin, 250 cc. [4 fl. oz.] of alcohol, and 685 cc. [10 fl. oz. 460 min.] of water as Menstruum I and a mixture of one volume of alcohol and three volumes of water as Menstruum II.

Approximate alcohol content, by volume, 20 per cent.

Uses—A flavor.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM COLCHICI CORMI. N.F. Fluidextract of Colchicum Corm

[Fldext. Colch. Corm.]

One hundred cc. of Fluidextract of Colchicum Corm yields not less than 0.31 Gm. and not more than 0.39 Gm. of colchicine.

	Metric	Alternative
Colchicum Corm, in moderately coarse powder.....	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A, as modified for assayed Fluidextracts (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum. Moisten the drug with 350 cc. [5 fl. oz. 288 min.] of this mixture.

After dissolving the soft extract in the reserve, assay 15 cc. of this liquid as directed below and, from the result thus obtained, ascertain by calculation the amount of colchicine in the remainder of the liquid, and add sufficient menstruum to make the finished Fluidextract contain 0.35 Gm. of colchicine in each 100 cc.

Assay—To 15 cc. of Fluidextract of Colchicum Corm, add 275 cc. of distilled water and 10 cc. of solution of lead subacetate, both accurately measured. Agitate the mixture frequently during one hour and filter off 200 cc. Dissolve 2 Gm. of sodium phosphate in the clear filtrate, shake the mixture frequently during half an hour and filter off 100 cc., representing 5 cc. of the Fluidextract. Transfer to a separator and completely extract the alkaloid with chloroform until the liquid gives no test with iodine T.S. Evaporate the chloroformic solution on a water bath, add to the residue 1 cc. of alcohol and again evaporate to dryness. Again add 1 cc. of alcohol, evaporate to dryness and dry to constant weight at 100° C. Cool and weigh. To this weighed residue, add 5 cc. of tenth-normal sulphuric acid and 5 cc. of distilled water, and digest at 70° C., for ten minutes. Filter the solution through a pledget of purified cotton and wash the container and cotton with distilled water, rejecting the filtrate and washings. Rinse the container with a little alcohol and pass the alcohol through the pledget of cotton, collecting the filtrate in a tared flask. Wash the cotton first with alcohol, then with ether, collecting the washings in the flask. Evaporate the liquid, dry the residue at 100° C., cool, and weigh. Deduct this weight from the weight first obtained. The difference is the weight of colchicine obtained from 5 cc. of Fluidextract of Colchicum Corm.

Approximate alcohol content, by volume, 52 per cent.

Uses—Useful in chronic rheumatism and acute gout.

Average dose—3 minims (0.2 cc.).

FLUIDEXTRACTUM CONDURANGO. N.F. Fluidextract of Condurango

[Fldext. Condur.]

	Metric	Alternative
Condurango, in moderately coarse powder.....	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—An alterative and stomachic.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM CONVALLARIÆ RADICIS. N.F. Fluidextract of Convallaria Root

[Fldext. Conval. Rad.]

	Metric	Alternative
Convallaria Root, in moderately coarse powder.....	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 58 per cent.

Uses—It belongs to the "digitalis group" and has been used in dropsy. It is emetic and cathartic in action.

Average dose—8 minims (0.5 cc.).

FLUIDEXTRACTUM COPTIS. N. F. Fluidextract of Coptis
[Fldext. Copt.]

	Metric	Alternative
Coptis, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—A folk remedy for aphthous stomatitis. It is mildly astringent and bitter.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CORNI. N. F. Fluidextract of Cornus
[Fldext. Corni]

	Metric	Alternative
Cornus, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 150 cc. [2 fl. oz. 192 min.] of glycerin and 850 cc. [13 fl. oz. 288 min.] of diluted alcohol as Menstruum I and diluted alcohol as Menstruum II.

Approximate alcohol content, by volume, 40 per cent.

Uses—A feeble tonic. It has been used as an antiperiodic but is probably worthless.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM CORYDALIS. N. F. Fluidextract of Corydalis
[Fldext. Corydal.]

	Metric	Alternative
Corydalis, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 62 per cent.

N. F. Preparation—Elixir Corydalis Compositum.

Uses—A diuretic and alterative.

Average dose—10 minims (0.65 cc.).

FLUIDEXTRACTUM CUBEBÆ. N. F. Fluidextract of Cubeb
[Fldext. Cubeb.]

	Metric	Alternative
Cubeb, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum.

Approximate alcohol content, by volume, 72 per cent.

Uses—An antiseptic diuretic and stimulant to the genito-urinary and bronchial mucous membrane.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM CYPRIPEDII. N. F. Fluidextract of Cypripedium
[Fldext. Cypriped.]

	Metric	Alternative
Cypripedium, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—An antispasmodic and nerve stimulant similar to valerian in action. Used in hysteria, neuralgia, and hypochondriasis.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM DAMIANÆ. N. F. Fluidextract of Damiana
[Fldext. Damian.]

	Metric	Alternative
Damiana, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

Uses—A mild purgative and feeble tonic, recommended for the treatment of sexual debility.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM DIGITALIS. N. F. Fluidextract of Digitalis
(U. S. P. IX)
[Fldext. Digit.]

When assayed biologically, the minimum lethal dose should not be greater than 0.0006 cc. of the Fluidextract, or the equivalent in Fluidextract of 0.0000005 Gm. of ouabain, for each Gm. of body weight of frog.

	Metric	Alternative
Digitalis, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of five volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 70 per cent.

Assay—For a method of assaying Fluidextract of Digitalis see page 1504.

Uses—In heart disease. Chiefly used in veterinary practice.

Average dose—1½ minims (0.1 cc.).

FLUIDEXTRACTUM DIOSCOREÆ. N. F. Fluidextract of Dioscorea
[Fldext. Dioscor.]

	Metric	Alternative
Dioscorea, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—An expectorant and diaphoretic.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM DROSERÆ. N. F. Fluidextract of Drosera
[Fldext. Droser.]

	Metric	Alternative
Drosera, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 55 per cent.

Uses—Recommended as an antispasmodic in whooping-cough.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM DULCAMARÆ. N. F. Fluidextract of Dulcamara
[Fldext. Dulcam.]

	Metric	Alternative
Dulcamara, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 42 per cent.

Uses—A diuretic and alterative used in chronic rheumatism and in obstinate skin eruptions.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM ECHINACEÆ. N.F. Fluidextract of Echinacea

[Fldext. Echin.]

	Metric	Alternative
Echinacea, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 65 per cent.

Uses—An alterative; supposed to be useful in infectious diseases.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM EUONYMI. N.F. Fluidextract of Euonymus

[Fldext. Euonym.]

	Metric	Alternative
Euonymus, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 42 per cent.

Caution—It has been stated that the absorption of Euonymus in the gastro-intestinal tract is uncertain and irregular. To avoid possible toxic or cumulative action of the drug, the physician should carefully determine in each case the tolerance of the patient, and regulate the dosage accordingly.

Uses—Originally employed as a cathartic. It has been shown to belong to the "digitalis group".

It has been used in dropsy and as a diaphoretic in muscular rheumatism and acute coryza.

Average dose—8 minims (0.5 cc.).

FLUIDEXTRACTUM EUPATORII. N.F. Fluidextract of Eupatorium

[Fldext. Eupator.]

	Metric	Alternative
Eupatorium, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 40 per cent.

Uses—Employed as a bitter tonic and diaphoretic. In large doses it is emetic and cathartic.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM EUPHORBIÆ. N.F. Fluidextract of Euphorbia

[Fldext. Euphorb.]

	Metric	Alternative
Euphorbia, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

N. F. Preparation—Elixir Euphorbiæ Compositum.

Uses—Employed in asthma and bronchial catarrh.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM FRANGULÆ. N. F. Fluidextract of Frangula

(U. S. P. IX)

[Fldext. Frang.]

	Metric	Alternative
Frangula, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Alcohol	**250 cc.**	4 fl. oz.

Prepare a Fluidextract by Type Process D (see page 405). Evaporate the aqueous percolate to 750 cc. [12 fl. oz.] and, when cold, add the alcohol and, if necessary, sufficient water to make the product measure 1000 cc. [1 pint].

Approximate alcohol content, by volume 23 per cent.

N. F. Preparation—Elixir Catharticum Compositum.

Uses—As a laxative.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM FUCI. N. F. Fluidextract of Fucus

[Fldext. Fuci]

	Metric	Alternative
Fucus, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 65 per cent.

Uses—Used chiefly as an "anti-fat"; it is supposed to act as a stimulant to the thyroid gland.

Average dose—10 minims (0.6 cc.).

FLUIDEXTRACTUM GALEGÆ. N. F. Fluidextract of Galega

[Fldext. Galeg.]

	Metric	Alternative
Galega, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 42 per cent.

Uses—A diuretic and galactagogue.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM GELSEMII. N. F. Fluidextract of Gelsemium

(U. S. P. IX)

[Fldext. Gelsem.]

	Metric	Alternative
Gelsemium, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 65 per cent.

N. F. Preparation—Elixir Sodii Salicylatis Compositum.

Uses—In neuralgia.

Average dose—½ minim (0.03 cc.).

FLUIDEXTRACTUM GENTIANÆ. N. F. Fluidextract of Gentian

(U. S. P. IX)

[Fldext. Gentian.]

	Metric	Alternative
Gentian, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 36 per cent.

N. F. Preparations—Elixir Gentianæ; Elixir Gentianæ Glycerinatum; Elixir Hydrastis Compositum.

Uses—In bitter tonics.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM GERANII. N. F. Fluidextract of Geranium

[Fldext. Geran.]

	Metric	Alternative
Geranium, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and two volumes of water as the menstruum. Reserve the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 45 per cent.

Uses—An astringent, especially well adapted to the treatment of diarrhea and cholera infantum in infants and delicate persons. Applied externally to indolent ulcers, as an injection in gleet and leucorrhea, and as a gargle in mouth and throat affections.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM GOSSYPII CORTICIS. N. F. Fluidextract of Cotton Root Bark

[Fldext. Gossyp. Cort.]

	Metric	Alternative
Cotton Root Bark, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 82 per cent.

Uses—An emmenagogue; it must be sold with caution as it may be employed as an abortifacient.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM GRINDELIÆ. N. F. Fluidextract of Grindelia

(U. S. P. IX)

[Fldext. Grindel.]

	Metric	Alternative
Grindelia, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 58 per cent.

Uses—For bronchial catarrh and asthma.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM GUARANÆ. N. F. Fluidextract of Guarana

(U. S. P. IX)

[Fldext. Guaran.]

One hundred cc. of Fluidextract of Guarana yields not less than 3.6 Gm. and not more than 4.4 Gm. of caffeine.

	Metric	Alternative
Guarana, in fine powder	**1000 Gm**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A, as modified for assayed Fluidextracts (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum, and reserving the first 800 cc. [12 fl. oz. 384 min.] of percolate.

After dissolving the soft extract in the reserve, assay a portion as directed below, and from the result thus obtained, ascertain by calculation the amount of alkaloid in the remainder of the liquid and dilute this with enough menstruum to make each 100 cc. of the finished Fluidextract contain 4 Gm. of caffeine.

Assay—Introduce 5 cc. of Fluidextract of Guarana into a saparator, add 1 cc. of ammonia water, and shake out the alkaloid with chloroform until completely extracted, as shown by testing with iodine T.S. Evaporate the combined chloroform solutions to dryness and dissolve the residue in 20 cc. of distilled water with the aid of heat. Allow this to cool, filter it into a separator and wash the container and filter with several small portions of distilled water, adding the rinsings to the liquid in the separator. Then shake out the alkaloid with chloroform until completely extracted, as shown by testing with iodine T.S., evaporate the combined chloroform solutions and dry the residue to constant weight at 80° C. The weight represents the caffeine in 5 cc. of Fluidextract of Guarana.

Approximate alcohol content, by volume, 60 per cent.

N. F. Preparations—Elixir Guaranæ; Elixir Guaranæ et Apii.

Uses—In headaches.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM HAMAMELIDIS FOLIORUM. N.F. Fluidextract of Hamamelis Leaves

[**Fldext. Hamamel. Fol.**]

	Metric	Alternative
Hamamelis Leaves, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 300 cc. [4 fl. oz. 384 min.] of alcohol and 500 cc. [8 fl. oz.] of water as Menstruum I and a mixture of one volume of alcohol and two volumes of water as Menstruum II.

Approximate alcohol content, by volume, 20 per cent.

Uses—A mild astringent, employed locally in the treatment of varicose veins and hemorrhoids.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM HELONIADIS. N.F. Fluidextract of Helonias

[**Fldext. Helon.**]

	Metric	Alternative
Helonias, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

N. F. Preparations—Elixir Aletridis Compositum; Elixir Heloniadis Compositum.

Uses—A tonic, anthelmintic, and diuretic. By some believed to be useful in menstrual disorders.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM HUMULI. N.F. Fluidextract of Hop

[**Fldext. Humul.**]

	Metric	Alternative
Hop, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of five volumes of alcohol and three volumes of water as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 50 per cent.

Uses—A nerve sedative, used in hysteria and nervousness.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM HYDRANGEÆ. N. F. Fluidextract of Hydrangea

[Fldext. Hydrang.]

	Metric	Alternative
Hydrangea, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and two volumes of water as the menstruum.

Approximate alcohol content, by volume, 50 per cent.

Uses—A diuretic.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM IRIDIS VERSICOLORIS. N. F. Fluidextract of Blue Flag

[Fldext. Irid. Vers.]

	Metric	Alternative
Blue Flag, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum.

Approximate alcohol content, by volume, 80 per cent.

N. F. Preparation—Elixir Corydalis Compositum.

Uses—An alterative and cholagogue cathartic.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM JALAPÆ. N. F. Fluidextract of Jalap

[Fldext. Jalap.]

One hundred cc. of Fluidextract of Jalap yields not less than 6.5 Gm. and not more than 7.5 Gm. of the resin of Jalap.

	Metric	Alternative
Jalap, in fine powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Intimately mix the ground drug with 1500 Gm. [25 oz. av.] of clean sand and prepare a Fluidextract by Type Process A (see page 403), as modified for assayed Fluidextracts, using alcohol as the menstruum.

After dissolving the soft extract in the reserve, assay 2 cc. of the liquid by the process given below, and from the result thus obtained ascertain the amount of resin in the remainder of the liquid, and add sufficient menstruum to make the finished Fluidextract contain 7 Gm. of resin in each 100 cc.

Assay—To 18 cc. of alcohol, contained in a separator, add 2 cc. of Fluidextract of Jalap and 10 cc. of chloroform. Mix well, then add 20 cc. of a saturated solution of potassium citrate. Shake the mixture thoroughly for two minutes, then set aside for 12 hours, or over night. Draw off and discard the lower aqueous liquid and filter the chloroformic solution through a small filter wetted with alcohol-chloroform, into a tared flask or beaker. Rinse the separator with a mixture of 10 cc. of alcohol and 5 cc. of chloroform and pass the rinsings through the filter. Evaporate the mixed chloroformic liquids to dryness on a water bath, dry at 100° C., cool, and weigh.

Approximate alcohol content, by volume, 80 per cent.

Uses—A cathartic.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM JUGLANDIS. N. F. Fluidextract of Juglans

[Fldext. Jugland.]

	Metric	Alternative
Juglans, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol, and 400 cc. [6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II.

Approximate alcohol content, by volume, 38 per cent.

N. F. Preparation—Elixir Cascaræ Sagradæ Compositum.

Uses—A mild cathartic.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM JUNIPERI. N. F. Fluidextract of Juniper Berries

[Fldext. Junip.]

	Metric	Alternative
Juniper Berries, in coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 50 per cent.

N. F. Preparation—Elixir Buchu, Juniperi et Potassii Acetatis.

Uses—A diuretic.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM KAVÆ. N. F. Fluidextract of Kava

[Fldext. Kav.]

	Metric	Alternative
Kava, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and two volumes of water as the menstruum.

Approximate alcohol content, by volume, 52 per cent.

Uses—A diuretic and alterative; at one time largely employed in the treatment of gonorrhea, its value being due to its rendering the urine antiseptic.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM KOLÆ. N. F. Fluidextract of Kola

[Fldext. Kol.]

One hundred cc. of Fluidextract of Kola yields not less than 0.85 Gm. and not more than 1.15 Gm. of caffeine.

	Metric	Alternative
Kola, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A, as modified for assayed Fluidextracts (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

After dissolving the soft extract in the reserve, assay 10 cc. of this liquid as directed below, and from the result thus obtained, ascertain by calculation, the amount of caffeine contained in the remainder of the liquid, and add sufficient menstruum to make the finished Fluidextract contain 1.0 Gm. of caffeine in each 100 cc.

Assay—Proceed as directed under Fluidextractum Guaranæ, using 10 cc. of the Fluidextract of Kola, chloroform as the solvent, and drying the caffeine at 80° C. Determine the caffeine gravimetrically.

Approximate alcohol content, by volume, 55 per cent.

Uses—It contains caffeine and may be used for the same purposes as that drug.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM KRAMERIÆ. N. F. Fluidextract of Krameria

[Fldext. Kramer.]

	Metric	Alternative
Krameria, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol and 400 cc. [6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II. Reserve the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 35 per cent.

N. F. Preparations—Syrupus Krameriæ.

Uses—An astringent, especially useful in diarrhea.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM LAPPÆ. N. F. Fluidextract of Lappa
[Fldext. Lapp.]

	Metric	Alternative
Lappa, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 800 cc. [12 oz. av. 384 min.] of the percolate.

Approximate alcohol content, by volume, 40 per cent.

Uses—A diuretic and diaphoretic alterative, used in chronic skin diseases and in gouty tendencies.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM LEPTANDRÆ. N. F. Fluidextract of Leptandra
[Fldext. Leptand.]

	Metric	Alternative
Leptandra, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

Uses—A cholagogue laxative.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM LOBELIÆ. N. F. Fluidextract of Lobelia
(U. S. P. IX)
[Fldext. Lobel.]

	Metric	Alternative
Lobelia, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 50 cc. [384 min.] of acetic acid, 500 cc. [8 fl. oz.] of alcohol, and 450 cc. [7 fl. oz. 96 min.] of water as Menstruum I, and diluted alcohol as Menstruum II.

Approximate alcohol content, by volume, 40 per cent.

N. F. Preparation—Elixir Euphorbiæ Compositum.

Uses—An expectorant.

Average dose—1½ minims (0.1 cc.).

FLUIDEXTRACT LUPULINI. N. F. Fluidextract of Lupulin
[Fldext. Lupulin.]

	Metric	Alternative
Lupulin	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum.

Approximate alcohol content, by volume, 55 per cent.

Uses—An aromatic bitter and mild sedative.

Average dose—8 minims (0.5 cc.).

FLUIDEXTRACT MANACÆ. N. F. Fluidextract of Manaca
[Fldext. Manac.]

	Metric	Alternative
Manaca, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 64 per cent.

N. F. Preparation—Elixir Manacæ Compositum.

Uses—Recommended for the treatment of chronic and subacute rheumatism.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM MATICO. N. F. Fluidextract of Matico

[Fldext. Matic.]

	Metric	Alternative
Matico, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

Uses—Employed in diseases of the genito-urinary tract because of its oil, the action being similar to cubeb; also used as a hemostatic for small wounds.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM MEZEREI. N. F. Fluidextract of Mezereum

[Fldext. Mezer.]

	Metric	Alternative
Mezereum, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 55 per cent.

N. F. Preparation—Linimentum Sinapis Compositum.

Uses—Of little value internally; externally a rubefacient and vesicant.

FLUIDEXTRACTUM MITCHELLÆ. N. F. Fluidextract of Mitchella

[Fldext. Mitchel.]

	Metric	Alternative
Mitchella, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

N. F. Preparations—Elixir Aletridis Compositum; Elixir Heloniadis Compositum.

Uses—In cystitis.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM NUCIS VOMICÆ. N. F. Fluidextract of Nux Vomica

(U. S. P. IX)

[Fldext. Nuc. Vom.]

One hundred cc. of Fluidextract of Nux Vomica yields not less than 2.37 Gm. and not more than 2.63 Gm. of the alkaloids of nux vomica.

	Metric	Alternative
Nux Vomica, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A, as modified for assayed Fluidextracts (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum, and reserving the first 800 cc. [12 fl. oz. 384 min.] of percolate.

After dissolving the soft extract in the reserve, assay a portion as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid and dilute this with enough menstruum to make each 100 cc. of the finished Fluidextract contain 2.5 Gm. of the alkaloids of nux vomica.

Assay—Assay 10 cc. of Fluidextract of Nux Vomica by Type Process D (see page 1496), using chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.0364 Gm. of the alkaloids of nux vomica.

This assay is explained on page 1500.

Approximate alcohol content, by volume, 60 per cent.

Uses—A bitter tonic.

Average dose—1½ minims (0.1 cc.).

FLUIDEXTRACTUM PAREIRÆ. N. F. Fluidextract of Pareira

[Fldext. Pareir.]

	Metric	Alternative
Pareira, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—In inflammation of the genito-urinary system.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM PHYTOLACCÆ. N. F. Fluidextract of Phytolacca

[Fldext. Phytolac.]

	Metric	Alternative
Phytolacca, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 40 per cent.

Uses—An emetic and purgative; and given in chronic rheumatism, but it must be used with caution.

Average dose—Emetic, 15 minims (1 cc.); alterative, 1½ minims (0.1 cc.).

FLUIDEXTRACT PRUNI VIRGINIANÆ. N. F. Fluidextract of Wild Cherry

[Fldext. Prun. Virg.]

	Metric	Alternative
Wild Cherry, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Glycerin	**200 cc.**	3 fl. oz. 96 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 cc.**	1 pint

Moisten the drug with a mixture of the glycerin and 400 cc. [6 fl. oz. 192 min.] of water, pack loosely in a cylindrical percolator, and macerate for twenty-four hours. Then add a mixture of 250 cc. [4 fl. oz.] of alcohol and 150 cc. [2 fl. oz. 192 min.] of water, macerate for twenty-four hours longer, and then percolate slowly with a mixture of one volume of alcohol and three volumes of water until the drug is practically exhausted.

Reserve the first 850 cc. [13 fl. oz. 288 min.] of percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion and add enough of a mixture of one volume of alcohol and three volumes of water to make the Fluidextract measure 1000 cc. [1 pint].

Approximate alcohol content, by volume, 16 per cent.

N. F. Preparation—Elixir Taraxaci Compositum.

Uses—A cough sedative of doubtful utility.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM QUASSIÆ. N. F. Fluidextract of Quassia

[Fldext. Quass.]

	Metric	Alternative
Quassia, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of one volume of alcohol and two volumes of water as the menstruum.

Approximate alcohol content, by volume, 24 per cent.

Uses—A simple bitter, useful in failure of appetite and in constipation due to the debility of intestinal muscular coating.

Average dose—8 minims (0.5 cc.).

FLUIDEXTRACTUM QUERCUS. N. F. Fluidextract of Quercus

[Fldext. Querc.]

	Metric	Alternative
Quercus, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol and 400 cc. [6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II. Reserve the first 700 cc. [11 fl. oz. 96 min.] of the percolate.

Approximate alcohol content, by volume, 36 per cent.

Uses—An astringent, especially for external preparations.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM RHAMNI CATHARTICÆ. N. F. Fluidextract of Rhamnus Cathartica

[Fldext. Rham. Cathart.]

	Metric	Alternative
Rhamnus Cathartica, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 750 cc. [12 fl. oz.] of the percolate.

Approximate alcohol content, by volume, 40 per cent.

N. F. Preparation—Syrupus Rhamni Catharticæ.

Uses—A laxative.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM RUBI. N. F. Fluidextract of Rubus

[Fldext. Rubi.]

	Metric	Alternative
Rubus, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 38 per cent.

N. F. Preparation—Syrupus Rubi.

Uses—Astringent for diarrhea.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM RUMICIS. N. F. Fluidextract of Rumex

[Fldext. Rumic.]

	Metric	Alternative
Rumex, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by moistening the ground drug with 350 cc. [5 fl. oz. 288 min.] of diluted alcohol and then proceeding as directed in Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 40 per cent.

Uses—A feeble astringent.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM SABAL. N. F. Fluidextract of Sabal

(U. S. P. IX)

[Fldext. Sabal]

	Metric	Alternative
Sabal, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 65 per cent.

Uses—In genito-urinary diseases and occasionally in bronchitis.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM SANGUINARIÆ. N.F. Fluidextract of Sanguinaria

[Fldext. Sanguin.]

	Metric	Alternative
Sanguinaria, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (see page 403), using 50 cc. [384 min.] of hydrochloric acid, 200 cc. [3 fl. oz. 96 min.] of water and 750 cc. [12 fl. oz.] of alcohol as Menstruum I, and a mixture of three volumes of alcohol and one volume of water as Menstruum II.

Approximate alcohol content, by volume, 58 per cent.

Uses—In bronchitis.

Average dose—1½ minims (0.1 cc.).

FLUIDEXTRACTUM SANTALI ALBI. N.F. Fluidextract of Sandalwood

[Fldext. Santal. Alb.]

	Metric	Alternative
Sandalwood, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum.

Approximate alcohol content, by volume, 80 per cent.

N. F. Preparation—Elixir Sabal et Santali Compositum.

Uses—In genito-urinary diseases and occasionally in bronchitis.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM SARSAPARILLÆ COMPOSITUM. N.F. Compound Fluidextract of Sarsaparilla

(U. S. P. IX)

[Fldext. Sarsap. Co.]

	Metric	Alternative
Sarsaparilla, in coarse powder	**750 Gm.**	12 oz. av. 234 gr.
Glycyrrhiza, in coarse powder	**120 Gm.**	2 oz. av.
Sassafras, in moderately coarse powder	**100 Gm.**	1 oz. av. 293 gr.
Mezereum, in moderately coarse powder	**30 Gm.**	219 gr.

Mix the powders and prepare a Fluidextract by Type Process B (see page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol, and 400 cc. [6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II.

Approximate alcohol content, by volume, 35 per cent.

Uses—An alterative.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM SCOPARII. N.F. Fluidextract of Scoparius

[Fldext. Scopar.]

	Metric	Alternative
Scoparius, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 750 cc. [12 fl. oz.] of the percolate.

Approximate alcohol content, by volume, 40 per cent.

Uses—As a diuretic in dropsy.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM SCUTELLARIÆ. N. F. Fluidextract of Scutellaria

[Fldext. Scutellar.]

	Metric	Alternative
Scutellaria, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 40 per cent.

Uses—In neuralgia and nervous diseases.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM SENECIONIS. N. F. Fluidextract of Senecio

[Fldext. Senecion.]

	Metric	Alternative
Senecio, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 55 per cent.

Uses—An emmenagogue.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM SERPENTARIÆ. N. F. Fluidextract of Serpentaria

[Fldext. Serpentar.]

	Metric	Alternative
Serpentaria, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 65 per cent.

Uses—A simple bitter.

Average dose—15 minims (1 cc.).

FLUIDEXTRACTUM SOLANI. N. F. Fluidextract of Solanum

[Fldext. Solan.]

	Metric	Alternative
Solanum, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 50 per cent.

Uses—An antispasmodic and aphrodisiac.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM STILLINGIÆ. N. F. Fluidextract of Stillingia

(U. S. P. IX)

[Fldext. Stilling.]

	Metric	Alternative
Stillingia, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 43 per cent.

N. F. Preparation—Elixir Corydalis Compositum.

Uses—An alterative.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM STILLINGIÆ COMPOSITUM. N. F. Compound Fluidextract of Stillingia

[Fldext. Stilling. Co.]

	Metric	Alternative
Stillingia, in moderately coarse powder	**250 Gm.**	4 oz. av. 75 gr.
Corydalis, in moderately coarse powder	**250 Gm.**	4 oz. av. 75 gr.
Blue Flag, in moderately coarse powder	**125 Gm.**	2 oz. av. 38 gr.
Sambucus, in moderately coarse powder	**125 Gm.**	2 oz. av. 38 gr.
Chimaphila, in moderately coarse powder	**125 Gm.**	2 oz. av. 38 gr.
Coriander, in moderately coarse powder	**63 Gm.**	1 oz. av. 22 gr.
Prickly Ash Berries, in moderately coarse powder	**62 Gm.**	1 oz. av. 15 gr.
To make	**1000 cc.**	1 pint

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 38 per cent.

N. F. Preparation—Syrupus Stillingiæ Compositus.

Uses—Employed as an alterative in syphilis and chronic rheumatism, but is of no real value.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM STRAMONII. N. F. Fluidextract of Stramonium

[Fldext. Stramon.]

One hundred cc. of Fluidextract of Stramonium yields not less than 0.22 Gm. and not more than 0.28 Gm. of the alkaloids of stramonium.

	Metric	Alternative
Stramonium, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A, as modified for assayed Fluidextracts (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

After dissolving the soft extract in the reserve, assay 10 cc. of this liquid as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid, and add to this enough menstruum to make each 100 cc. of the finished Fluidextract contain 0.25 Gm. of the alkaloids of stramonium.

Assay—Assay 10 cc. of Fluidextract of Stramonium by Type Process D (see page 1496), using the total extraction method, chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02892 Gm. of the alkaloids of stramonium.

Approximate alcohol content, by volume, 64 per cent.

Uses—Antihidrotic, to relieve spasm, anti-asthmatic.

Average dose—1 minim (0.05 cc.).

FLUIDEXTRACTUM TARAXACI. N. F. Fluidextract of Taraxacum

(U. S. P. IX)

[Fldext. Tarax.]

	Metric	Alternative
Taraxacum, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 500 cc. [8 fl. oz.] of alcohol and 400 cc. [6 fl. oz. 192 min.] of water as Menstruum I, and diluted alcohol as Menstruum II.

Approximate alcohol content, by volume, 36 per cent.

N. F. Preparations—Elixir Gentianæ Glycerinatum; Elixir Taraxaci Compositum.

Uses—A diuretic and alterative.

Average dose—2½ fluidrachms (10 cc.).

FLUIDEXTRACTUM THUJÆ. N. F. Fluidextract of Thuja

[Fldext. Thuj.]

	Metric	Alternative
Thuja, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using alcohol as the menstruum.

Approximate alcohol content, by volume, 80 per cent.

Uses—In chronic bronchitis; also catarrh of the urinary organs.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM THYMI. N. F. Fluidextract of Thyme

[Fldext. Thym.]

	Metric	Alternative
Thyme, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process B (see page 403), using a mixture of 100 cc. [1 fl. oz. 288 min.] of glycerin, 250 cc. [4 fl. oz.] of alcohol, and 650 cc. [10 fl. oz. 192 min.] of water as Menstruum I, and a mixture of one volume of alcohol and three volumes of water as Menstruum II.

Approximate alcohol content, by volume, 18 per cent.

N. F. Preparation—Syrupus Thymi.

Uses—In chronic bronchitis and whooping-cough.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM TONGÆ. N. F. Fluidextract of Tonga

[Fldext. Tong.]

	Metric	Alternative
Tonga, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of one volume of alcohol and three volumes of water as the menstruum.

Approximate alcohol content, by volume, 20 per cent.

Uses—In rheumatism.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM TRIFOLII. N. F. Fluidextract of Trifolium

[Fldext. Trifol.]

	Metric	Alternative
Trifolium, in moderately coarse powder	**1000 Gm.**	**16 oz. av. 302 gr.**

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum and reserving the first 800 cc. [12 fl. oz. 384 min.] of the percolate.

Approximate alcohol content, by volume, 40 per cent.

Uses—An alterative and antispasmodic.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM TRIFOLII COMPOSITUM. N. F. Compound Fluidextract of Trifolium

[Fldext. Trifol. Co.]

	Metric	Alternative
Trifolium, in moderately coarse powder	**215 Gm.**	**3 oz. av. 258 gr.**
Glycyrrhiza, in moderately coarse powder	**215 Gm.**	**3 oz. av. 258 gr.**
Berberis, in moderately coarse powder	**108 Gm.**	**1 oz. av. 351 gr.**
Cascara Amarga, in moderately coarse powder	**108 Gm.**	**1 oz. av. 351 gr.**
Lappa, in moderately coarse powder	**108 Gm.**	**1 oz. av. 351 gr.**
Phytolacca, in moderately coarse powder	**108 Gm.**	**1 oz. av. 351 gr.**
Stillingia, in moderately coarse powder	**108 Gm.**	**1 oz. av. 351 gr.**
Xanthoxylum, in moderately coarse powder	**30 Gm.**	**219 gr.**
To make	**1000 cc.**	**1 pint**

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of one volume of alcohol and three volumes of water as the menstruum.

Approximate alcohol content, by volume, 15 per cent.

N. F. Preparation—Syrupus Trifolii Compositus.

Uses—An alterative.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM TRILLII. N. F. Fluidextract of Trillium

[Fldext. Trill.]

	Metric	Alternative
Trillium, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 60 per cent.

N. F. Preparation—Elixir Viburni Opuli Compositum.

Uses—In uterine diseases.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM TRITICI. N. F. Fluidextract of Triticum

(U. S. P. IX)

[Fldext. Tritic.]

	Metric	Alternative
Triticum, finely cut	**1000 Gm.**	16 oz. av. 302 gr.
Alcohol	**200 cc.**	3 fl. oz. 96 min.

Prepare a Fluidextract by Type Process D (see page 405), evaporate the aqueous percolate to 800 cc. [12 fl. oz. 384 min.] and when cold add the alcohol, and if necessary, sufficient water to make the product measure 1000 cc. [1 pint].

Approximate alcohol content, by volume, 18 per cent.

Uses—In uterine disorders.

Average dose—2½ fluidrachms (10 cc.).

FLUIDEXTRACTUM VALERIANÆ. N. F. Fluidextract of Valerian

[Fldext. Valer.]

	Metric	Alternative
Valerian, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of four volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 65 per cent.

Uses—In hysteria and nervousness.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM VERBASCI FOLIORUM. N. F. Fluidextract of Mullein Leaves

[Fldext. Verbasc. Fol.]

	Metric	Alternative
Mullein Leaves, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 38 per cent.

Uses—A demulcent, domestically employed in acute bronchitis.

Average dose—1 fluidrachm (4 cc.).

FLUIDEXTRACTUM VIBURNI OPULI. N. F. Fluidextract of Viburnum Opulus

[Fldext. Viburn. Opul.]

	Metric	Alternative
Viburnum Opulus, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 50 per cent.

N. F. Preparations—Elixir Aletridis Compositum; Elixir Heloniadis Compositum; Elixir Viburni Opuli Compositum.

Uses—In uterine disorders.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM VIBURNI PRUNIFOLII. N. F. Fluidextract of Viburnum Prunifolium

(U. S. P. IX)

[Fldext. Viburn. Prun.]

	Metric	Alternative
Viburnum Prunifolium, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of two volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 56 per cent.

N. F. Preparation—Elixir Viburni Prunifolii.

Uses—In uterine disorders.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM XANTHOXYLI. N. F. Fluidextract of Xanthoxylum

(U. S. P. IX)

[Fldext. Xanthox.]

	Metric	Alternative
Xanthoxylum, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using a mixture of three volumes of alcohol and one volume of water as the menstruum.

Approximate alcohol content, by volume, 62 per cent.

N. F. Preparations—Elixir Corydalis Compositum; Elixir Hydrastis Compositum.

Uses—A counterirritant.

Average dose—30 minims (2 cc.).

FLUIDEXTRACTUM ZEÆ. N. F. Fluidextract of Zea

[Fldext. Zea]

	Metric	Alternative
Zea, finely cut	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidextract by Type Process A (see page 403), using diluted alcohol as the menstruum.

Approximate alcohol content, by volume, 30 per cent.

N. F. Preparation—Elixir Sabal et Santali Compositum.

Uses—A diuretic.

Average dose—1 fluidrachm (4 cc.).

Table of Some Unofficial Fluidextracts

In the following preparations, where possible, type processes A, B, C, or D, will be referred to for directions (see pages 403, 404 and 405). Unless otherwise stated, quantities will be based upon 1000 Gm. of drug, yielding 1000 cc. of finished fluidextract.

Title	*Directions*
Fluidextractum Aromaticæ (U. S. P. IX)	Prepare from aromatic powder by type process C, using alcohol as the menstruum (aromatic powder consists of 350 Gm. saigon cinnamon, 350 Gm. ginger, 150 Gm. cardamom seed and 150 Gm. of myristica) Dose: fifteen minims (1 cc.)
Arnicæ Radicis (U. S. P. 1890)	Prepare by type process A, using 70 per cent alcohol as the menstruum Dose: one fluidrachm (4 cc.)
Aspidospermatis (U. S. P. IX)	Prepare by type process B, using a mixture of 110 cc. glycerin, 670 cc. alcohol and 220 cc. water as menstruum I, and 64 per cent alcohol as menstruum II Dose: one fluidrachm (4 cc.)
Aurantii Amari (U. S. P. IX)	Prepare by type process C, using 70 per cent alcohol as the menstruum Dose: fifteen minims (1 cc.)
Belæ (Br. 1914)	Macerate 1000 Gm. of bruised bael fruit for twelve hours in 5000 cc. of chloroform water. Pour off the liquid and repeat the maceration twice, an hour each time, using 5000 cc. of chloroform water for each maceration. Evaporate the mixed liquid to 750 cc. and add 250 cc. of alcohol Dose: one fluidrachm (4 cc.)
Cinchonæ Aquosum (N. F. IV)	One hundred cc. contains from 4.5 to 5.5 Gm. of cinchona alkaloids. Percolate the drug to exhaustion using first a mixture of 30 cc. of hydrochloric acid, 125 cc. of glycerin, and 5000 cc. of water, and afterwards water to exhaustion. Reserve the first 700 cc. of percolate, evaporate the remainder to 400 cc., at not over 80° C., add the reserve portion and evaporate to 700 cc. Assay and add enough alcohol and water to make the finished fluidextract contain 12 per cent by volume of absolute alcohol and the amount of alkaloids required Dose: fifteen minims (1 cc.)
Conii (N. F. IV)	One hundred cc. contains from 0.35 Gm. to 0.45 Gm. of coniine. Prepare by type process C, as modified for assayed fluidextracts, using first a mixture of 20 cc. of acetic acid and 980 cc. of diluted alcohol as the menstruum, and then diluted alcohol Dose: 3 minims (0.2 cc.)
Convallariæ (N. F. IV)	Prepare by type process A, using a mixture of 2 volumes of alcohol and 1 volume of water as the menstruum Dose: 3 minims (0.2 cc.)
Cusso (U. S. P. 1890)	Prepare by type process A, using alcohol as the menstruum
Helianthemi (N. F. IV)	Prepare by type process A, using diluted alcohol as the menstruum Dose: one fluidrachm (4 cc.)
Menispermi (U. S. P. 1890)	Prepare by type process A, using 64 per cent alcohol as the menstruum Dose: thirty minims (2 cc.)
Opii Liquidum (Br. 1914)	Triturate 37.5 Gm. of dry extract of opium with 700 cc. of water, stir frequently during twenty-four hours, add 200 cc. alcohol, set aside for twenty-four hours, filter, and add enough distilled water to make 1000 cc.
Paracoto (N. F. IV)	Prepare by type process A, using 85 per cent alcohol as the menstruum Dose: five minims (0.3 cc.)
Petroselini Radicis (N. F. IV)	Prepare by type process A, using 64 per cent alcohol as the menstruum Dose: thirty minims (2 cc.)
Picrorhizæ (Br. 1914)	Prepare by type process A, using 60 per cent alcohol as the menstruum
Pilocarpi (U. S. P. IX)	One hundred cc. contains from 0.55 Gm. to 0.65 Gm. of alkaloids. Prepare by type process A, using 64 per cent alcohol as the menstruum and reserving the first 800 cc. Assay and adjust the final volume to the required standard Dose: thirty minims (2 cc.)
Podophylli (U. S. P. IX)	Prepare by type process A, using alcohol as the menstruum Dose: eight minims (0.5 cc.)
Spigeliæ (U. S. P. IX)	Prepare by type process A, using diluted alcohol as the menstruum Dose: one fluidrachm (4 cc.)
Staphisagriæ (U. S. P. IX)	Prepare by type process A, using alcohol as the menstruum
Sumbul (U. S. P. IX)	Prepare by type process A, using 75 per cent alcohol as the menstruum Dose: thirty minims (2 cc.)
Veratri Viridis (U. S. P. IX)	Prepare by type process A, using alcohol as the menstruum Dose: one and one half minims (0.1 cc.)
Verbenæ (N. F. IV)	Prepare by type process A, using diluted alcohol as the menstruum Dose: fifteen minims (1 cc.)

CHAPTER XXXIII

GLYCERIN PREPARATIONS MADE BY PERCOLATION OR MACERATION

Fluidglycerata—*Fluidglycerates*

Fluidglycerates are intended to be of the same drug strength as Fluidextracts. They contain approximately 50 per cent, by volume, of glycerin and no alcohol. The drug should be in a coarse or moderately coarse powder unless otherwise directed. Fluidglycerates made from drugs that do not require either an acid or an alkaline menstruum may be prepared by the following general process.

General Process

	Metric	Alternative
The Drug, in coarse powder	1000 Gm.	16 oz. av. 302 gr.
Glycerin	500 cc.	8 fl. oz.
Water	1500 cc.	24 fl. oz.
Chloroform Water, a sufficient quantity,		
To make	1000 cc.	1 pint

Mix the glycerin and water and moisten the drug thoroughly with a portion of the mixture, then pack it very lightly in a cylindrical percolator, and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and then the chloroform water.

Reserve the first 500 cc. [8 fl. oz.] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger, until reduced to 600 cc. [9 fl. oz. 288 min.], then add the reserved portion and continue evaporation until the product measures 1000 cc. [1 pint]. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder. Mix well.

FLUIDGLYCERATUM CASCARÆ SAGRADÆ. N. F. Fluidglycerate of Cascara Sagrada

[Fldglycer. Casc. Sagr.]

	Metric	Alternative
Cascara Sagrada, in coarse powder	1000 Gm.	16 oz. av. 302 gr.

Prepare a Fluidglycerate by the General Process (see page 443), using 500 cc. [8 fl. oz.] of menstruum to moisten the drug.

Uses—A laxative.

Average dose—15 minims (1 cc.).

FLUIDGLYCERATUM CASCARÆ SAGRADÆ AROMATICUM. N. F. Aromatic Fluidglycerate of Cascara Sagrada

[Fldglycer. Casc. Sagr. Arom.]

	Metric	Alternative
Cascara Sagrada, in coarse powder	750 Gm.	12 oz. av. 226 gr.
Fluidglycerate of Glycyrrhiza	250 cc.	4 fl. oz.
Lime	20 Gm.	146 gr.
Heavy Magnesium Oxide	20 Gm.	146 gr.
Glycerin	375 cc.	6 fl. oz.
Oil of Fennel	1 cc.	8 min.
Oil of Clove	1 cc.	8 min.
Oil of Cinnamon	1 cc.	8 min.
Water,		
Chloroform Water, each, a sufficient quantity,		
To make	1000 cc.	1 pint

Slake the lime, mix it with the magnesium oxide and 1500 cc. [24 fl. oz.] of water and stir in the cascara sagrada, moistening the drug evenly and thoroughly. Expose the moist powder to the air until dry. Mix the glycerin with 1125 cc. [18 fl. oz.] of water and moisten the cascara sagrada with 600 cc. [9 fl. oz. 288 min.] of this menstruum, pack it lightly in a cylindrical percolator and add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice and, having closely covered the percolator, macerate the mixture for forty-eight hours. Then allow the percolation to proceed slowly until the drug is practically exhausted, using first the remainder of the menstruum and afterwards chloroform water.

Reserve the first 375 cc. [6 fl. oz.] of the percolate and evaporate the remainder on a water bath, the weaker portion first, then the stronger portion until it is reduced to 450 cc. [7 fl. oz. 96 min.], then add the reserved portion and continue the evaporation until the liquid measures 747 cc. [11 fl. oz. 457 min.]. When cold, add the fluidglycerate of glycyrrhiza and the volatile oils and mix thoroughly. Allow the preparation to stand for a few days, then decant the clear portion and strain the remainder.

N. F. Preparation—Syrupus Ficorum Compositus.

Uses—A laxative.

Average dose—15 minims (1 cc.).

FLUIDGLYCERATUM GLYCYRRHIZÆ. N. F. Fluidglycerate of Glycyrrhiza

[Fldglycer. Glycyrrhiz.]

	Metric	Alternative
Glycyrrhiza, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.
Glycerin	**500 cc.**	8 fl. oz.
Boiling Water, a sufficient quantity, To make	**1000 cc.**	1 pint

Macerate the glycyrrhiza in hot water for six hours, then exhaust it by percolation with boiling water. Boil the percolate down in a steam pan to a volume of about 2000 cc. [2 pints], and filter it. Then evaporate the filtered liquid to a volume of about 500 cc. [8 fl. oz.], add the glycerin, allow the liquid to cool, then add sufficient water to make the product measure 1000 cc. [1 pint].

N. F. Preparations—Elixir Bromidorum Quinque, Elixir Guaranæ et Apii; Fluidglyceratum Cascaræ Sagradæ Aromaticum; Syrupus Glycyrrhizæ.

Uses—A vehicle and flavor.

Average dose—30 minims (2 cc.).

FLUIDGLYCERATUM KRAMERIÆ. N. F. Fluidglycerate of Krameria

[Fldglycer. Kramer.]

	Metric	Alternative
Krameria, in coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidglycerate by the General Process (see page 443), using 600 cc. [9 fl. oz. 288 min.] of menstruum to moisten the drug.

Uses—An astringent for diarrhea.

Average dose—15 minims (1 cc.).

FLUIDGLYCERATUM RHEI. N. F. Fluidglycerate of Rhubarb

[Fldglycer. Rhei]

	Metric	Alternative
Rhubarb, in moderately coarse powder	**1000 Gm.**	16 oz. av. 302 gr.

Prepare a Fluidglycerate by the General Process (see page 443), using 500 cc. [8 fl. oz.] of menstruum to moisten the drug.

Uses—A laxative.

Average dose—15 minims (1 cc.).

Unofficial Glycerin Preparation

Title	*Directions*
Glyceritum Hydrastis (N. F. IV)	Exhaust 100 Gm. of hydrastis by percolation with alcohol, distil the alcohol from the percolate, pour the thick liquid into 45 cc. of ice water and cool for twenty-four hours. Filter, assay, add water to make each 10 cc. contain 0.25 Gm. of alkaloids and finally add an equal volume of glycerin Dose: thirty minims (2 cc.)

CHAPTER XXXIV

OLEORESINOUS LIQUIDS MADE BY PERCOLATION

Oleoresinæ—*Oleoresins*

The oleoresins are liquid preparations, consisting principally of natural oils and resins extracted from vegetable substances by percolation with acetone or ether. The latter is now directed in the Pharmacopœia for this purpose, but acetone has been used and apparently produces identical products. Alcohol is used in preparing the oleoresin of cubeb, this being the one drug in which it is satisfactory. The choice between ether and acetone is largely a question of cost although the acetone is less dangerous and therefore preferred by many manufacturers. Either will produce a U. S. P. product, under the general authorization of the U. S. P. The oleoresins were formerly classed with fluidextracts, but they differ essentially from them: 1. They do not bear a uniform relation to the drug as do the fluidextracts, of Gm. to cc., and the yield of oleoresin obtained from the drug varies according to the proportion of oil and resin naturally present. 2. The menstruum (ether) extracts principles which are often insoluble in alcohol, diluted alcohol or water. 3. They are without exception the most concentrated liquid preparations of drugs that are produced.

Fig. 423

Percolator for volatile liquids

Oleoresins are prepared by percolating the powdered drug contained in a cylindrical percolator provided with a cover and a receptacle suitable for volatile liquids, with the menstruum directed, until exhausted, recovering the greater part of the liquid by distillation, and exposing the residue in a shallow dish to spontaneous evaporation until the remaining solvent has evaporated. Fig. 423 shows a convenient percolator for making oleoresins. The powder should not be packed too tightly in the narrow percolator; the exit tube affords a means of easily regulating the flow. A *continuous extraction apparatus* can be made of this percolator by enclosing the upper part in a suitable case and passing cold water between, arranging the apparatus like a Liebig's condenser (see page 140). A glass tube is connected with the top of the percolator and the mouth of the bottle by rubber tube connections, and if the receiving bottle is placed in a water bath and the water gently heated, the ether will evaporate from the percolate, and the vapors rising in the tube will condense in the upper part of the percolator.

A form of continuous extraction apparatus frequently used on the small scale for the extraction of drugs with volatile solvents is known as a Soxhlet apparatus (see page 133).

Oleoresins which have not been evaporated sufficiently are frequently found in commerce; they have a decided odor of the menstruum, sometimes of benzin, showing in the latter case that a menstruum which is an inferior solvent has been substituted for the one authorized by the Pharmacopœia. Commercial gasoline often contains appreciable quantities of kerosene, which does not volatilize, but permanently contaminates the oleoresins. It should never be used as a menstruum for oleoresins.

OLEORESINA ASPIDII. U.S. Oleoresin of Aspidium

[Oleores. Aspid.—Oleoresin of Male Fern]

Oleoresin of Aspidium yields not less than 24 per cent of crude filicin.

	Metric	Alternative
Aspidium, recently reduced to coarse powder	500 Gm.	16 oz. av.
Ether, a sufficient quantity.		

Place the aspidium in a cylindrical glass percolator provided with a stopcock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with ether added in successive portions until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining ether to evaporate spontaneously in a warm place, remote from a naked flame.

Description and Physical Properties—A dark green, thick liquid, usually depositing a granular, crystalline substance, which must be thoroughly mixed with the liquid portion before use.

Not less than 85 per cent of the Oleoresin is soluble in purified petroleum benzin.

Specific gravity: not less than 1.00 at 25° C.

Assay—Warm the Oleoresin on a water bath and stir until it is thoroughly mixed. Transfer about 5 Gm. accurately weighed, to a 200 cc. flask, dissolve in 40 Gm. of ether, add 100 Gm. of an aqueous solution of barium hydroxide (3 in 100), and shake vigorously for five minutes. Allow the liquids to separate, and filter off 86 Gm. of the aqueous fluid. Transfer this to a separator, add sufficient hydrochloric acid to produce a distinctly acid reaction, and extract with three successive portions of 30 cc., 20 cc. and 15 cc., of ether. Draw off and combine the ethereal solutions, filter, wash the filter with ether, evaporate, and dry the residue to constant weight at 100° C. This residue weighs not less than 0.96 Gm., corresponding to not less than 24 per cent of crude filicin.

Preserve in well-stoppered bottles.

Uses—A tenifuge. It must be used with caution, as it becomes a violent poison if allowed to remain in the alimentary canal until absorbed. It is usually administered after twelve to twenty-four hours of fasting and must be followed within a few hours by an active purge. Castor oil, however, should not be used, as it promotes absorption.

Average dose—Caution! Single dose, once a day, 1 drachm (4 Gm.).

OLEORESINA CAPSICI. U.S. Oleoresin of Capsicum

[Oleores. Capsic.]

	Metric	Alternative
Capsicum, in coarse powder	500 Gm.	32 oz. av.
Ether, a sufficient quantity.		

Place the capsicum in a cylindrical glass percolator provided with a stopcock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with ether, added in successive portions until the percolate measures 800 cc. [about 3 pints]. Recover the greater part of the ether from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining ether to evaporate spontaneously in a warm place, remote from a naked flame. Then pour off the liquid portion, transfer the remainder to a glass funnel provided with a pledget of cotton, and, when the separated fatty matter (which is to be rejected) has been completely drained, mix the liquid portions.

Oleoresin of Capsicum should meet the requirements of the following test: Dissolve 0.2 Gm. of the Oleoresin in 50 cc. of alcohol in a stoppered flask, dilute 0.1 cc. of the clear separated solution with 140 cc. of distilled water containing 10 per cent of sucrose: five cc. of this dilution, swallowed at one time, will produce a distinct sensation of pungency in the mouth and throat of at least two out of three individuals.

Preserve in well-stoppered bottles.

This organoleptic test is intended to distinguish between the true Cayenne pepper and other mild varieties more suited for seasoning purposes. No other variety of pepper will produce the rubefacient effect expected of this oleoresin when used externally in ointments.

Uses—Applied to the skin it is a powerful rubefacient. It is usually applied in ointments. Internally it is a stomachic, producing a warmth over the entire body. It is used on plaster for neuralgia and as a toothache pad.

Average dose—¼ grain (0.015 Gm.).

OLEORESINA CUBEBÆ. N. F. Oleoresin of Cubeb

(U. S. P. IX)

[Oleores. Cubeb.]

	Metric	Alternative
Cubeb, in moderately coarse powder	**500 Gm.**	16 oz. av.
Alcohol, a sufficient quantity.		

Place the cubeb in a cylindrical glass percolator, pack the powder firmly, and percolate slowly with alcohol, added in successive portions, until the drug is exhausted. Recover the greater part of the alcohol from the percolate by distillation on a water bath, and, having transferred the residue to a dish, allow the remaining alcohol to evaporate in a warm place, stirring frequently. Keep the Oleoresin in a well-stoppered bottle.

NOTE—Oleoresin of Cubeb, after standing for some time, deposits a waxy and crystalline precipitate, which should be rejected, the liquid portion only being used.

Uses—A urinary antiseptic and stimulant; also in the form of lozenges for throat troubles.

Average dose—8 grains (0.5 Gm.).

Table of Some Unofficial Oleoresins

Title	*Directions*
Oleoresina Lupulini (N. F. IV)	Percolate 500 Gm. of lupulin with ether to exhaustion; recover most of the ether by distillation on a water bath and allow the balance to evaporate spontaneously Dose: three grains (0.2 Gm.)
Petroselini (U. S. P. IX)	Prepare as directed under oleoresina lupulini. Set aside for several days and decant the clear liquid from any solid residue Dose: eight minims (0.5 cc.)
Piperis (U. S. P. IX)	Prepare as directed under oleoresina lupulini. Strain through cotton to remove the piperine which is deposited Dose: one half grain (0.03 Gm.)
Zingiberis (U. S. P. IX)	Prepare as directed under oleoresina lupulini Dose: one half grain (0.03 Gm.)

CHAPTER XXXV

OILY PREPARATIONS MADE BY MACERATION

Olea Infusa—*Infused Oils*

THESE consist of a solution in oil of the soluble constituents of plants, chiefly of those containing alkaloids or volatile oils, such as hyoscyamus, belladonna, calendula, etc. The compound Oil of Hyoscyamus closely resembles the *Baumé Tranquille* of the French Pharmacopœia and is extensively used for earache.

OLEA INFUSA. N. F. Infused Oils

[Ol. Inf.]

	Metric	Alternative
The Air Dried Drug, in moderately coarse powder	100 Gm.	3 oz. av. 148 gr.
Alcohol	100 cc.	3 fl. oz. 96 min.
Ammonia Water	2 cc.	31 min.
Sesame Oil	1000 cc.	2 pints
To make about	1000 cc.	2 pints

Moisten the drug with the alcohol and ammonia water, previously mixed, macerate for six hours in a covered vessel, and add the sesame oil. Warm this mixture on a water bath, at a temperature between 60° and 70° C. in an open vessel, stirring frequently, until the alcohol and ammonia water are dissipated. Then transfer the mixture to a strainer, express the residue and filter the strained oil.

Preserve infused oils in small, amber-colored bottles in a cool place.

OLEUM HYOSCYAMI COMPOSITUM. N. F. Compound Oil of Hyoscyamus

[Ol. Hyoscy. Co.—BALSAMUM TRANQUILLANS]

	Metric	Alternative
Oil of Lavender	2 cc.	31 min.
Oil of Peppermint	2 cc.	31 min.
Oil of Rosemary	2 cc.	31 min.
Oil of Thyme	2 cc.	31 min.
Infused Oil of Hyoscyamus (prepared by the general formula above), a sufficient quantity,		
To make	1000 cc.	2 pints

Mix them.

History—This preparation was first made by the Capucin Monk Aignan in the seventeenth century, whose monastery name was *Padre Tranquille.* At one time the formula called for one live frog to be boiled with each pound of oil before infusing the herbs therein.

Uses—A local anodyne, especially for earache.

CHAPTER XXXVI

ACETOUS LIQUIDS MADE BY PERCOLATION OR MACERATION

Aceta—*Vinegars*

This class of preparations is an old one, having been in use since the days of Hippocrates. Medicated vinegars are solutions of the active principles of drugs in diluted acetic acid, the latter being chosen as a menstruum because acetic acid is not only a good solvent but also possesses antiseptic properties.

Diluted acetic acid replaces the natural vinegar formerly used, cider vinegar having been discarded because of its variable quality and strength. Acetic acid may be obtained in all parts of the country very cheaply and of unexceptionable quality. The properties of acetic acid are noted in Part V of this book.

Only *one* vinegar is official at present in the U. S. P. X and *one* in the N. F. V. The medicated vinegars should not be made in larger quantities than can be used within a reasonable time, for, although possessed of most of the characteristics of permanent preparations, they are liable to deposit upon standing.

The official vinegars are uniform in strength (10 per cent) and are made by maceration.

ACETUM SCILLÆ. U. S. Vinegar of Squill

[Acet. Scill.]

	Metric	Alternative
Squill, in coarse powder	100 Gm.	3 oz. av. 148 gr.
Diluted Acetic Acid, a sufficient quantity,		
To make	1000 cc.	2 pints

Macerate the squill with 900 cc. [29 fl. oz.] of diluted acetic acid during seven days with frequent agitation. Then strain the mixture, and wash the mass on the strainer with enough diluted acetic acid to make the strained liquid measure nearly 1000 cc. [2 pints]. Heat this liquid to boiling, filter while hot, and when cold add sufficient diluted acetic acid to make the product measure 1000 cc. [2 pints.].

U. S. P. Preparation—Syrupus Scillæ.
N. F. Preparation—Oxymel Scillæ.

Uses—Used chiefly in the preparation of the syrup. It is diuretic.

Average dose—15 minims (1 cc.).

ACETUM AROMATICUM. N. F. Aromatic Vinegar

[Acet. Arom.]

	Metric	Alternative
Oil of Lavender	0.5 cc.	8 min.
Oil of Rosemary	0.5 cc.	8 min.
Oil of Juniper	0.5 cc.	8 min.
Oil of Peppermint	0.5 cc.	8 min.
Oil of Cinnamon	0.5 cc.	8 min.
Oil of Lemon	1.0 cc.	15 min.
Oil of Clove	1.0 cc.	15 min.
Alcohol	250.0 cc.	8 fl. oz.
Acetic Acid	260.0 cc.	8 fl. oz. 154 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the oils in the alcohol, add the acetic acid, and sufficient water to make the product measure 1000 cc. [2 pints]. Set the mixture aside for eight days, occasionally agitating it, and filter.

See page 1505 for the assay.

Approximate alcohol content, by volume, 23 per cent.

History—This preparation was known a little over a hundred years ago as *Vinegar of the Four Thieves* (*Vinaigre des quatre voleurs*) because it was alleged to have been used as a prophylactic against the plague in Marseilles by four thieves who robbed the dead and the dying.

Uses—Employed in the same way as smelling salts, as a restorative in faintness.

Table of Some Unofficial Vinegars

Title	*Directions*
Acetum Cantharidini (Br. 1914)	Dissolve 0.5 Gm. of cantharidin in 100 cc. of glacial acetic acid on a water bath and add enough acetic acid to make 1000 cc.
Opii (N. F. IV)	Macerate 100 Gm. of granulated opium, 30 Gm. powdered myristica and 200 Gm. sucrose in 500 cc. diluted acetic acid for seven days, transfer to a percolator and add enough diluted acetic acid to make 1000 cc. of percolate Dose: eight minims (0.5 cc.)
Urgineæ (Indian Squill) (Br. 1914)	Macerate 100 Gm. bruised urginea with 100 cc. acetic acid and 320 cc. distilled water for seven days and filter Dose: five minims (0.3 cc.)

CHAPTER XXXVII

SOLID PREPARATIONS MADE BY PERCOLATION, ETC.

Extracta—*Extracts*

Extracts are either pasty or semi-solid masses, or dry, solid or powdered products, prepared by exhausting drugs with appropriate solvents, carefully evaporating the solutions so obtained to the prescribed consistence and adjusting the products to the fixed standards. An extract is intended to preserve the useful constituents of the drug in a concentrated, relatively uniform, permanent condition, and in a form suitable for medication.

The solvent or menstruum to be employed in the preparation of an extract is dependent upon the physical characteristics of the drug and the nature of its constituents. The solvents commonly adopted are water or alcohol, or mixtures of these, in the proportions directed in the formulas. For the extraction of a few drugs, the addition of an acid or an alkali to the solvent is required. When alcohol is used as a solvent, it may be recovered by distillation. When a drug contains an oily constituent that is extracted by the menstruum, it becomes necessary to adopt in the process of manufacture some method for the separation of this oil so that a permanent product of the proper consistence, dryness, or powdered form may be obtained.

The proximate principles most commonly present in extracts are *gum*, *sugar*, *starch*, *tannin*, *extractive*, *chlorophyll*, *coloring-matter*, *inorganic salts*, and the *active principles of plants*, to which, when a spiritous solvent is employed, may usually be added, *resinous substances*, *fatty matter*, and frequently more or less *volatile oil*, gum and starch being excluded when the menstruum is strong alcohol. Inert fixed oil or fat is often removed from powdered drugs by previous percolation with ether or with petroleum benzin; these liquids do not, as a rule, extract the active principles, and thus a dry powdered extract can be made.

In the preparation of extracts, the concentration of the liquid extractions is to be completed without delay, and undue exposure to heat must be avoided. The limit of temperature for the evaporation, as stated in the formulas, should not be exceeded. In the manufacture of extracts on a large scale, apparatus for distilling and evaporating under reduced pressure should be used. It is also important that the residue be frequently stirred in order to hasten the evaporation and to obtain a uniformly smooth product.

In addition to extracts made by extracting drugs, sometimes the juices of fresh plants extracted by contusion and expression are evaporated, and such extracts are frequently called *succi spissati*, or *inspissated juices*.

Extractive—It has long been known that in most vegetable bodies there is a substance, soluble both in water and in alcohol, which, in the preparation of extracts, undergoes chemical change during the process of evaporation, imparting to the liquid, even if originally limpid, first, a greenish, then a yellowish-brown, and ultimately a deep brown color, and becoming itself insoluble. This substance has received the appropriate name of *extractive*, derived from its frequent presence in extracts. Its existence as a distinct principle is denied, or at least doubted, by some chemists, who consider the phenomena supposed to result from its presence as depending upon the mutual reaction of other principles. The most important property of extractive is its

disposition to become insoluble under the influence of atmospheric air at a high temperature. If a vegetable infusion or decoction is evaporated in the open air to the consistence of an extract, then diluted, filtered, and again evaporated, and the process repeated so long as any insoluble matter is formed, the whole of the extractive will be separated from the liquid, while the other ingredients may remain. If chlorine is passed through an infusion or decoction, a similar precipitate is formed with much greater rapidity. The change is usually ascribed to the absorption of oxygen by the extractive, which has, therefore, been called, in its altered condition, oxidized extractive; but De Saussure ascertained that, though oxygen is absorbed during the process, an equal measure of carbonic acid gas is given out, and the oxygen and hydrogen of the extractive unite to form water in such a manner as to leave the principle richer in carbon than it was originally. The name of oxidized extractive is, therefore, obviously incorrect; and Berzelius long ago proposed to substitute for it that of *apothem*, synonymous with deposit. According to Berzelius, apothem is not completely insoluble in water, but imparts a slight color to that liquid when cold, and is rather more soluble in boiling water, which becomes turbid upon cooling. It is still more soluble in alcohol, and is freely dissolved by solutions of the alkalies and alkaline carbonates, from which it is precipitated by acids. It has a great tendency, when precipitated from solutions, to unite with other principles and to carry them along with it, thus acquiring properties somewhat different, according to the source from which it is obtained. In this way, also, even when the extractive of a plant is itself medicinally inert, its conversion into apothem may be injurious by causing a precipitation of a portion of the active principle; in practical pharmaceutical operations this change should always, if possible, be avoided.

Variable Quality of Extracts—*It is evident that there must be great variation in the quality of extracts of pilular consistence as found in commerce*, for, whether made by any of the processes commonly employed, or by a special patented process, the lack of a fixed standard to determine the amount of moisture which is to remain in pilular extracts renders them very variable in strength. The Pharmacopœia is necessarily compelled to avoid specifying an exact limit in this respect, and the approximate standard of *"pilular consistence"* has been adopted. The powdered extracts are more stable and being adjusted through the addition of a diluent to an exact weight, they have a great advantage over pilular extracts. It should be said in addition that the variation in the strength of extracts of pilular consistence does not cease even after their manufacture. The exposure to the air to which they are subjected in dispensing, particularly if kept in the customary open queen's-ware or glass jars, causes loss of moisture and they become hard, and consequently stronger, in proportion to the quantity of moisture that is thus lost; this loss may in some cases amount to as much as 25 per cent. In moist climates, however, some extracts absorb moisture and become thinner. One of the advantages of powdered extracts is that they may be kept in tightly corked vials, and thus protected from moisture. The greatest variation in the commercial extracts, however, arises from the difference in the alcoholic strength of the menstruum employed. This may be best illustrated by taking the case of extract of jalap. Alcohol dissolves the active principles of jalap, while water is the best solvent for those that are inert. If a manufacturer in making extract of jalap uses equal parts of alcohol and water, he will obtain twice as much extract as the manufacturer who simply uses alcohol; but the alcohol extract or resin has twice the strength of the hydro-alcoholic extract, and is worth double the price, because it has been shown that the aqueous extract of jalap is absolutely inert even in doses of

240 grains. The difference between the relative merits of alcoholic and aqueous extracts does not so clearly appear in many of the extracts as in the instance just noted, but it is shown in such important extracts as those from belladonna, hyoscyamus, digitalis, etc., for the strength of these depends largely upon the menstrua used in exhausting them, water removing the inert principles, starch, gum, albumen, sugar, salt, etc. The relative value of commercial extracts must depend upon the amount of *active* principles present. When an extract is official, the menstruum directed should be employed and no other. The U. S. P. X permits the replacement of ethyl alcohol by specially denatured alcohol through the following provision:

"In the manufacture of pharmacopœial extracts and resins in which alcohol is used as a solvent only and does not remain in the finished product, it is permissible that alcohol made non-potable by the addition of from 5 to 10 per cent by volume of commercially pure methanol or of acetone be used in the place of ethyl alcohol in accordance with Federal Statutes and Regulations of the Internal Revenue Department, but the extracts and resins so made must be identical with those prepared by the processes in the monographs and must conform to the standards fixed by the tests of the U. S. Pharmacopœia, Tenth. This provision is not to be construed as permitting the use of specially denatured alcohol in the manufacture of any medicinal product other than extracts and resins."

It is now common practice for manufacturers to indicate on the labels of extracts not amenable to assay, the yield of the extract in relation to the drug from which it was prepared. Commercial extracts from most drugs will run from 1 to 4, to 1 to 6, *i. e.*, 1 pound of extract represents 4, or 5, or 6 parts of drug, but some drugs yield so great a proportion of extractive matter that their extracts run only 1 to 2 or 1 to 3. As examples might be mentioned solid extract of gentian, 1 to 2, and powdered extract cascara sagrada, 1 to 3.

Preparation of Extracts—The manipulations necessary to produce extracts have been considered under the various heads of Maceration, Expression, Percolation, Decoction, Infusion, Evaporation, Use of Steam Heat, Vacuum Apparatus, etc. The special precautions necessary for each extract will be noted in the official working formulas which follow. The details of the formulas vary so much that a general formula is of little value, except to serve as a type for the alcoholic extracts, which resemble one another.

Preservation of Extracts—Special care in the preservation of pilular extracts is rarely taken. This arises from the incorrect impression that they are permanent preparations and do not need it. The manufacturers seal the jars or bottles which contain them, because experience has compelled them to be very careful to avoid loss in transportation. The loosely fitting covers often used for the jars permit exposure which causes the variation noted, and it is impracticable for the pharmacist on every occasion to seal the jar immediately after he has used a portion of the extract. Several expedients have been suggested to overcome these difficulties. It is good practice to enclose the jar in a tightly fitting tin can, or to put the extract in a jar with a cover which clamps down tightly and is fitted with a thin cork disc in the top to aid in making a tight joint; many manufacturers are now marketing pilular extracts in jars fitted with covers of this character and several are using collapsible tin tubes to prevent evaporation or absorption of moisture.

Powdered extracts should be preserved in tightly-stoppered, small, wide-mouthed, amber-colored bottles, and stored in a cool, dry place.

Pilular Extracts—The pasty or semi-solid extracts are designated "pilular extracts" because they are extensively used in pill masses. They are also used

in ointments, and to facilitate their use in these preparations, the degree of concentration is directed to be that of a "pilular consistence". In these, an excess of moisture is to be avoided and the proper pliability and consistence may be maintained by the addition of a small amount of glucose or glycerin.

Powdered Extracts—Powdered extracts differ from pilular extracts in that they are dry and prepared either as fine or granular powders. They are more generally used than pilular extracts because they can be more accurately weighed, more easily dispensed, and more conveniently preserved. The difficulty in making them arises from the injurious influence of heat upon concentrated percolates of organic substances, but by the use of vacuum apparatus, suitable absorptive diluents, and care, they can be made successfully (pages 126 and 127). The limit of temperature as stated in the formulas should not be exceeded, and final drying of the soft extract can be greatly facilitated by spreading it upon plates of glass or tinned metal and exposing it to currents of warm, dry air, if vacuum apparatus is not available.

In the preparation of powdered extracts, it is necessary to use solvents that will extract the active principles of the drugs, and only a minimum amount of the inert substances. If the drug contains an oily constituent that would be extracted by the menstruum directed, it becomes necessary to adopt in the process of manufacture a method for the separation of this oil so that the product will retain a satisfactory, powdered form.

Assaying Extracts—When pilular extracts are assayed, the weight of the final product is adjusted by the addition of a sufficient amount of glucose except in the case of extract of cannabis when a resinous diluent must be used, as storax or a substandard extract of cannabis.

Dried starch is to be used as the diluent for powdered extracts, but it is permissible for the manufacturer to also use as inert diluents, a substandard extract of the same drug, or sucrose, lactose, powdered glycyrrhiza, magnesium carbonate, or the finely powdered, dried drug or marc from which the respective extract was made. Before admixture the diluent may be colored by the addition of chlorophyll, caramel or other harmless coloring to simulate the color of the extract. For the convenience of the prescriber, the standards of strength for the extracts have been adjusted wherever possible, so that each bears a definite relation to that of the respective drug of average strength. A statement of the standard adopted accompanies each formula.

Abstracts—A class of preparations known as abstracts was official in the U. S. P. 1880. These were powdered extracts bearing uniformly a definite relation to the drug, *i. e.*,—one part of abstract representing two parts of drug. The abstracts did not gain popularity and were not continued in the 1890 Pharmacopœia.

Inspissated Juices—The variation in the amount of extractive matter afforded by expressing fresh plants is so great that the quality of this class of extracts is necessarily very uncertain. Although alcoholic extracts are also subject to variations, experience has shown that they are much more reliable, when properly made, than extracts prepared from expressed juices. For this reason inspissated juices are not recognized in the U. S. Pharmacopœia. The inspissated juices most largely consumed in America are made in Great Britain, and the general formula of the British Pharmacopœia of 1898 is appended:

"Bruise the fresh plant in a mortar, press out the juice, and heat it gradually to 130° F. and separate the green colouring matter by means of a calico filter. Heat the strained liquid to 200° F. (to coagulate the albumen) and filter again. Evaporate the filtrate by a water-bath to the consistence of a thin

syrup; add to it the green colouring matter previously separated and passed through a hair-sieve, stir the whole together, and evaporate at a temperature not exceeding 140° F. to the consistence of a soft extract."

Two extracts from fresh plants or parts of plants are official in the 1914 British Pharmacopœia: extract of colchicum, and extract of taraxacum. In the British Pharmacopœia 1898 *two* additional extracts of this character were official: green extract of belladonna and green extract of hyoscyamus.

Professor Herrara proposed a plan for making extracts by freezing the juices. He finds that by compressing the frozen juice the expressed liquid, or mother-liquor, is greatly strengthened, the water being largely removed as ice, which remains in the press-cloth, and the concentrated juice is then dried by exposure on plates to the sun.

The following extracts are official:

EXTRACTUM BELLADONNÆ. U. S. Extract of Belladonna

[**Ext. Bellad.**—Extractum Belladonnæ Foliorum U. S. P. IX, Belladonnæ Extractum P. I.]

Extract of Belladonna yields not less than 1.18 per cent and not more than 1.32 per cent of the alkaloids of belladonna leaves. One Gm. of the Extract represents about 4 Gm. of belladonna leaves.

PILULAR EXTRACT OF BELLADONNA

	Metric	Alternative
Belladonna Leaves, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Glucose,		
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the drug with sufficient of a mixture of 3 volumes of alcohol and 1 volume of water, and pack it firmly in a cylindrical percolator, then add enough menstruum, using the same proportion of alcohol and water as before, to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum of the same strength, until the percolate measures 3000 cc. [6 pints] or until the drug is exhausted. Recover the alcohol from the percolate by distillation, and evaporate the residue with frequent stirring at a temperature not exceeding 70° C. to a pilular consistence. Mix the mass thoroughly and weigh it.

Assay a portion of this extract as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the mass, and to this add sufficient glucose to make the finished Extract contain 1.25 per cent of the alkaloids of belladonna leaves. Mix thoroughly.

Assay—Proceed by Type Process D, taking 2 Gm. of Extract of Belladonna, using chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02893 Gm. of the alkaloids of belladonna (Proximate Assays, page 1497).

POWDERED EXTRACT OF BELLADONNA

	Metric	Alternative
Belladonna Leaves, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Starch, dried at 100° C.		
Alcohol, each, a sufficient quantity.		

Moisten the drug with sufficient alcohol, and pack it in a cylindrical percolator, then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed very slowly, adding alcohol as required. Reserve the first 1000 cc. [2 pints] of percolate, and continue the percolation until the second percolate measures 1000 cc. [2 pints] or until the drug is exhausted. Transfer the second percolate to a suitable apparatus, and distil the alcohol at as low a temperature as practicable, until a residue measuring about 100 cc. [4 fl. oz.] remains, then add the reserved percolate, and continue distillation until the residue in the still is of syrupy consistence.

Transfer this syrupy residue to a shallow evaporating dish, rinse the flask or still with small portions of warm alcohol, adding the rinsings to the residue in the dish. Evaporate this to a soft extract, with frequent stirring, at a temperature not exceeding 70° C. Then add 50 Gm. [1 oz. av. 262 gr.] of the dried starch, and continue the heating at the same temperature, with frequent stirring until the mass is nearly dry. Now thoroughly incorporate an additional 20 Gm. [280 gr.] of dried starch, and set the product aside in a current of warm air until thoroughly dry. Reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the powder, and add to this sufficient of the dried starch to make the finished Extract contain 1.25 per cent of the alkaloids of belladonna leaves. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

Assay—Proceed as directed under the *Pilular Extract of Belladonna*.

U. S. P. Preparation—Unguentum Belladonnæ.

N. F. Preparations—Pilulæ Aloes et Podophylli Compositæ; Pilulæ Aloini Compositæ; Pilulæ Aloini, Strychninæ et Belladonnæ; Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ; Pilulæ Laxativæ Compositæ.

The U. S. P. has introduced both Pilular and Powdered Extracts of Belladonna Leaves under the one Latin title. This provides the powdered form for pills and capsules should the pharmacist prefer to use it and also the Pilular Extract, which contains no insoluble diluent, and consequently, much better adapted for the making of ointments or suppositories.

Uses—Used to check excessive secretions and to relax intestinal spasms; often combined with cathartics to prevent griping.

Average dose—¼ grain (0.015 Gm.).

EXTRACTUM CANNABIS. U. S. Extract of Cannabis

[Ext. Cannab.]

Extract of Cannabis, administered by the mouth to dogs, in doses not exceeding 0.004 Gm. for each kilogram of body weight of dog, produces a degree of incoördination equivalent to that caused by 0.03 cc. for each kilogram of body weight of dog, of the standard fluidextract of cannabis prepared as directed under *Cannabis*.

	Metric	Alternative
Cannabis, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Alcohol, a sufficient quantity.		

Moisten the drug with sufficient alcohol, pack it firmly in a cylindrical percolator, and add enough alcohol to saturate the powder and leave a stratum

above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol until the drug is exhausted. Recover the alcohol from the percolate by distillation, and evaporate the residue with frequent stirring, at a temperature not exceeding 70° C., to a pilular consistence. Mix the mass thoroughly and weigh it.

Assay a portion of this extract as directed under *Cannabis*, and from the result thus obtained adjust the weight of the finished Extract by the addition of either storax or a substandard Extract of Cannabis to conform to the required biological standard.

See page 1507 for the Assay.

N. F. Preparation—Mistura Chloralis et Potassii Bromidi Composita.

Uses—An anodyne and nerve sedative. The extract is an efficient form of cannabis.

Average dose—¼ grain (0.015 Gm.).

EXTRACTUM CASCARÆ SAGRADÆ. U.S. Extract of Cascara Sagrada

[**Ext. Casc. Sagr.**—Powdered Extract of Cascara Sagrada, Extract of Rhamnus Purshiana]

One Gm. of the Extract represents 3 Gm. of cascara sagrada.

	Metric	Alternative
Cascara Sagrada, in coarse powder	**900 Gm.**	30 oz. av.
Starch, dried at 100° C.		
Boiling Water, each, a sufficient quantity,		
To make	**300 Gm.**	10 oz. av.

Mix the cascara sagrada with 4000 cc. [8 pints] of boiling water, and macerate the mixture during three hours. Then transfer it to a metallic percolator, allow it to drain, and pour on boiling water until the percolate measures 5000 cc. [10 pints] or the drug is exhausted. Evaporate the percolate to dryness on a water or steam bath, reduce the extract to a fine powder, weigh it, and add sufficient of the dried starch to make the product weigh 300 Gm. [10 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

N. F. Preparations—Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ.

Uses—A laxative, especially valuable in habitual constipation.

Average dose—5 grains (0.3 Gm.).

EXTRACTUM COLCHICI. U.S. Extract of Colchicum

[**Ext. Colch.**—Extractum Colchici Cormi U.S.P. IX, Powdered Extract of Colchicum]

Extract of Colchicum yields not less than 1.25 per cent and not more than 1.55 per cent of colchicine. One Gm. of the Extract represents about 4 Gm. of colchicum corm.

	Metric	Alternative
Colchicum Corm, in fine powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Purified Petroleum Benzin,		
Starch, dried at 100° C., each, a sufficient quantity.		

Moisten the colchicum corm with sufficient alcohol, pack it in a cylindrical percolator, and add enough alcohol to saturate the drug and leave a stratum

above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding alcohol as required, until the percolate measures 2000 cc. [4 pints] or until the drug is exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable, until a residue measuring about 150 cc. [5 fl. oz.] remains in the still. Transfer this residue to a flask or separator, using small portions of warm alcohol to rinse the still, and add the rinsings to the residue in the flask. When it has cooled, add 250 cc. [8 fl. oz.] of purified petroleum benzin, and shake the mixture thoroughly for several minutes. Allow the liquids to separate, and decant the benzin layer as closely as possible, again add to the residue 150 cc. [5 fl. oz.] of purified petroleum benzin, agitate, decant the benzin layer as before, repeat the washing with 100 cc. [4 fl. oz.] of purified petroleum benzin, and reject the benzin washings.

Transfer the fat-free residue to a shallow evaporating dish, rinse the flask with small portions of warm alcohol, add the rinsings to the residue in the dish, and evaporate on a water bath to a thick extract. To this add 50 Gm. [1 oz. av. 262 gr.] of the dried starch, mix well, spread the mixture on glass plates, and continue the drying in a current of warm air at a temperature not exceeding 70° C. until thoroughly dry. Reduce the product to a fine powder, and weigh it.

Assay a portion of this product as directed below, and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloid in the remainder of the powder, and add to this sufficient of the dried starch to make the finished Extract contain 1.4 per cent of colchicine. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

Assay—Place 6 Gm. of Extract of Colchicum in a 500 cc. flask containing 290 cc. of distilled water, mix well, add 10 cc. of solution of lead subacetate, and agitate the mixture frequently during one hour. Filter off 200 cc. and proceed as directed under *Colchici Semen*, page 1497, fourth line of the assay, beginning with the word "Add".

Uses—Used in gout.

Average dose—1 grain (0.06 Gm.).

EXTRACTUM COLOCYNTHIDIS. U. S. Extract of Colocynth

[**Ext. Colocyn.**—Powdered Extract of Colocynth]

One Gm. of the Extract represents 4 Gm. of colocynth.

	Metric	Alternative
Colocynth, in coarse powder	**1000 Gm.**	32 oz. av.
Diluted Alcohol,		
Starch, dried at 100° C., each, a sufficient quantity,		
To make	**250 Gm.**	8 oz. av.

Moisten the drug with 2000 cc. [4 pints] of diluted alcohol, and macerate it in a closed vessel for twenty-four hours, then transfer the moist drug to a cylindrical percolator, shake it down evenly without packing, and gradually pour diluted alcohol upon it, allowing the percolation to proceed slowly until the percolate measures 5000 cc. [10 pints] or until the drug is practically exhausted. Recover the alcohol from the percolate by distillation, and evaporate the residue to dryness on a water or steam bath. Reduce the product to a fine powder, weigh it, and add sufficient of the dried starch to make

the product weigh 250 Gm. [8 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

U. S. P. Preparation—Extractum Colocynthidis Compositum.

Uses—A purgative, usually or nearly always combined with other drugs.

Average dose—½ grain (0.03 Gm.).

EXTRACTUM COLOCYNTHIDIS COMPOSITUM. U. S. Compound Extract of Colocynth

[Ext. Colocyn. Co.—Powdered Compound Extract of Colocynth]

	Metric	Alternative
Extract of Colocynth	160 Gm.	5 oz. av. 53 gr.
Aloe	500 Gm.	16 oz. av.
Cardamom Seed, in fine powder	50 Gm.	1 oz. av. 263 gr.
Resin of Ipomœa, in fine powder	140 Gm.	4 oz. av. 210 gr.
Soap, dried and in powder	150 Gm.	4 oz. av. 350 gr.
To make	1000 Gm.	32 oz. av.

Triturate the ingredients until the product is reduced to a fine powder. Pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

U. S. P. Preparation—Pilulæ Hydrargyri Chloridi Mitis Compositæ.

N. F. Preparations—Pilulæ Antidyspepticæ; Pilulæ Catharticæ Vegetabiles; Pilulæ Colocynthidis et Podophylli; Pilulæ Laxativæ Post Partum.

Uses—An active hydragogue purgative.

Average dose—4 grains (0.25 Gm.).

EXTRACTUM FELLIS BOVIS. U. S. Extract of Oxgall

[Ext. Fel. Bov.—Powdered Extract of Oxgall]

One Gm. of the Extract represents 8 Gm. of oxgall.

	Metric	Alternative
Oxgall	800 Gm.	32 oz. av.
Alcohol	1500 cc.	3¾ pints
Starch, dried at 100° C., a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Add 1000 cc. [2½ pints] of alcohol slowly and with agitation to the oxgall contained in a bottle of sufficient size. Allow the mixture to stand for two days, and then decant the liquid portion. Wash the residue in the bottle with an additional 500 cc. [20 fl. oz.] of alcohol, decant the liquid portion, mix it with the liquid first separated, and filter. Recover the alcohol from the filtrate by distillation, transfer the residue to a shallow dish, and evaporate it to a thick extract at a temperature between 75° and 80° C. Spread this extract on glass plates, and continue the drying by exposure to warm air at a temperature not exceeding 70° C. until thoroughly dry. Reduce the product to a fine powder, weigh it, and add sufficient of the dried starch to make the product weigh 100 Gm. [4 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly. The use of copper apparatus in the preparation of this Extract should be avoided.

This extract contains potassium and *sodium glycocholates* and *taurocholates* which exist naturally in oxgall and to which its therapeutic value is chiefly due. No official assay is provided but an assay method used by Hynson, Wescott and Dunning will be found under oxgall, page 1184.

Uses—Employed in certain types of intestinal indigestion.

Average dose—6 grains (0.4 Gm.).

EXTRACTUM GLYCYRRHIZÆ. U.S. Extract of Glycyrrhiza

[Ext. Glycyrrh.—Extract of Licorice Root]

The commercial Extract of Glycyrrhiza.

Description and Physical Properties—In flattened, cylindrical rolls or in masses, of a glossy black color externally; fracture brittle, sharp, smooth, conchoidal; taste characteristic and sweet. When pulverized it yields a brown powder.

Tests for Purity—Not less than 60 per cent of Extract of Glycyrrhiza is soluble in cold water. The yield of ash does not exceed 8 per cent.

This extract may be assayed for its glycyrrhizin content, by the unofficial method given under glycyrrhiza, page 900.

U. S. P. Preparation—Trochisci Ammonii Chloridi.
N. F. Preparation—Pilulæ Ferri Iodidi.

Uses—A flavoring agent.

EXTRACTUM GLYCYRRHIZÆ PURUM. U.S. Pure Extract of Glycyrrhiza

[Ext. Glycyrrh. Pur.—Pure Extract of Licorice Root]

	Metric	Alternative
Glycyrrhiza, in coarse powder	**1000 Gm.**	32 oz. av.
Boiling Water, a sufficient quantity.		

Moisten the drug with sufficient boiling water, transfer the moist drug to a metallic percolator, and percolate with boiling water until the glycyrrhiza is exhausted. Promptly evaporate the percolate to a pilular consistence on a water bath.

U. S. P. Preparation—Fluidextractum Cascaræ Sagradæ Aromaticum.

Uses—A flavoring agent.

EXTRACTUM HYOSCYAMI. U.S. Extract of Hyoscyamus

[Ext. Hyosc.—Extract of Henbane, Hyoscyami Extractum P. I.]

Extract of Hyoscyamus yields not less than 0.22 per cent and not more than 0.28 per cent of the alkaloids of hyoscyamus. One Gm. of the Extract represents about 4 Gm. of hyoscyamus.

Pilular Extract of Hyoscyamus

	Metric	Alternative
Hyoscyamus, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Glucose,		
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the drug with sufficient of a mixture of 3 volumes of alcohol and 1 volume of water, pack it firmly in a cylindrical percolator, and add enough menstruum, using the same proportion of alcohol and water as before, to

saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding more of the same menstruum until the drug is exhausted. Recover the alcohol by distillation, and evaporate the residue with frequent stirring, at a temperature not exceeding 70° C. until it is reduced to a pilular consistence. Mix the mass thoroughly, and weigh it.

Assay a portion of this extract as directed below, and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the mass, and to this add sufficient glucose to make the finished Extract contain 0.25 per cent of the alkaloids of hyoscyamus. Mix thoroughly.

Assay—Proceed by Type Process D, taking 5 Gm. of Extract of Hyoscyamus, using chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02893 Gm. of the alkaloids of hyoscyamus (Proximate Assays, page 1497).

Powdered Extract of Hyoscyamus

	Metric	Alternative
Hyoscyamus, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Starch, dried at 100° C.,		
Alcohol, each, a sufficient quantity.		

Moisten the drug with sufficient alcohol, and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed very slowly, adding alcohol as required. Reserve the first 1000 cc. [2 pints] of percolate, and continue the percolation until the drug is exhausted. Transfer the weaker percolate to a suitable apparatus, and distil the alcohol at as low a temperature as practicable until a residue measuring about 100 cc. [4 fl. oz.] remains, then add the reserved percolate and continue distillation until the residue in the still is of syrupy consistence.

Transfer this syrupy residue to a shallow evaporating dish, and rinse the flask or still with small portions of warm alcohol, adding the rinsings to the residue in the dish. Evaporate this to a soft extract, with frequent stirring, at a temperature not exceeding 70° C. Then add 50 Gm. [1 oz. av. 262 gr.] of the dried starch, and continue the heating at the same temperature, with frequent stirring, until the mass is nearly dry. Now thoroughly incorporate an additional 20 Gm. [280 gr.] of the dried starch, and set the product aside in a current of warm air, until thoroughly dry. Reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the powder, and add to this sufficient of the dried starch to make the finished Extract contain 0.25 per cent of the alkaloids of hyoscyamus. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

Assay—Proceed as directed under *Pilular Extract of Hyoscyamus.*

N. F. Preparations—Mistura Chloralis et Potassii Bromidi Composita; Pilulæ Catharticæ Vegetabiles.

Uses—Employed in intestinal spasms.

Average dose—5/6 grain (0.05 Gm.).

EXTRACTUM MALTI. U. S. Extract of Malt
[Ext. Malt.]

Extract of Malt is obtained by infusing malt with water at 60° C., concentrating the expressed liquid at a temperature not exceeding 60° C. and adding 10 per cent, by weight, of glycerin. It contains dextrin, maltose, a small amount of glucose, and an amylolytic enzyme.

Extract of Malt is capable of converting not less than five times its weight of starch into water-soluble sugars.

When freshly made, malt extract possesses much greater diastatic activity but deteriorates so rapidly that the U. S. P. has fixed a comparatively low requirement.

Description and Physical Properties—A sweet, viscous, light brown liquid extract having an agreeable, characteristic odor.

It is soluble in cold water, more readily soluble in warm water.

Specific gravity: not less than 1.350 and not more than 1.430 at 25° C.

Assay—Mix a quantity of potato starch, purified as directed under *Pancreatinum*, equivalent to 5 Gm. of dried starch, in a beaker with 10 cc. of cold, distilled water. Add 140 cc. of boiling distilled water, and heat on a water bath with constant stirring for two minutes, or until a translucent, uniform paste is obtained. Cool to 40° C. in a suitable bath previously adjusted to this temperature. Add 20 cc. of a fresh solution of Extract of Malt at 40° C., prepared by dissolving 5 Gm. of Extract of Malt in sufficient distilled water to make 100 cc. of solution at 40° C. Mix well, and maintain the same temperature for exactly thirty minutes, stirring frequently. A thin, nearly clear liquid is produced. Add at once 0.1 cc. of this liquid to a previously made mixture of 0.2 cc. of tenth-normal iodine and 60 cc. of distilled water. No blue or reddish color is produced.

N. F. Preparation—Emulsum Olei Morrhuæ cum Malto.

Uses—A nutrient and digestant; also as an emulsifying agent for cod liver oil.

Average dose—4 drachms (15 Gm.).

EXTRACTUM NUCIS VOMICÆ. U. S. Extract of Nux Vomica
[Ext. Nuc. Vom.—Powdered Extract of Nux Vomica, Nucis Vomicæ Extractum P. I.]

Extract of Nux Vomica yields not less than 15.2 per cent and not more than 16.8 per cent of the alkaloids of nux vomica.

	Metric	Alternative
Nux Vomica, in moderately coarse powder.....	**1000 Gm.**	32 oz. av.
Alcohol,		
Water,		
Acetic Acid,		
Purified Petroleum Benzin,		
Starch, dried at 100° C., each, a sufficient quantity.		

Moisten the drug with a sufficient quantity of a mixture of 75 volumes of alcohol, 1 volume of acetic acid and 24 volumes of water, pack it firmly in a cylindrical percolator, and add enough of this menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding more of the same menstruum as required until the drug is practically exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable and concentrate the liquid until the residue measures about 200 cc. [6½ fl. oz.]. Transfer this residue to a flask or separator, add 150 cc. [5 fl. oz.] of water and 200 cc. [6½ fl. oz.] of purified petroleum benzin, and shake the mixture thoroughly for several minutes. Allow the liquids to separate and decant the benzin layer as closely as possible, again add to the residue 100 cc. [3¼ fl. oz.] of purified petroleum benzin, agitate, and decant the benzin as before, and then reject the benzin solutions. Evaporate the fat-free residue to dryness on a water bath with frequent stirring.

Assay a portion of this product as directed below, and from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the product, and add sufficient of the dried starch to make the finished Extract contain 16 per cent of the alkaloids of nux vomica. Reduce the mixture to a fine powder, mix thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

Assay—Proceed by Type Process D, taking 1 Gm. of Extract of Nux Vomica, using chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.0364 Gm. of the alkaloids of nux vomica (Proximate Assays, page 1497).

N. F. Preparations—Pilulæ Aloes et Podophylli Compositæ; Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ.

Uses—A gastric stimulant.

Average dose—¼ grain (0.015 Gm.).

EXTRACTUM RHEI. U.S. Extract of Rhubarb

[Ext. Rhei—Powdered Extract of Rhubarb]

One Gm. of the Extract represents 2 Gm. of rhubarb.

	Metric	Alternative
Rhubarb, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Starch, dried at 100° C.,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**500 Gm.**	16 oz. av.

Moisten the drug with sufficient of a mixture of 4 volumes of alcohol and 1 volume of water, pack it in a cylindrical percolator, and add enough of this menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum of the same proportion of alcohol and water as before until the drug is exhausted. Recover the alcohol from the percolate by distillation at as low a temperature as practicable and continue distillation until a residue of syrupy consistence remains in the still. Transfer this to a shallow dish, rinse the still with small portions of warm menstruum, add the rinsings to the residue in the dish, and evaporate the mixture to dryness, with frequent stirring, at a temperature not exceeding 70° C. Weigh the dry product, and add sufficient of the dried starch to make the weight 500 Gm. [16 oz. av.]. Reduce the mixture to a fine powder, mix thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

Uses—Employed as a laxative.

Average dose—8 grains (0.5 Gm.).

EXTRACTUM STRAMONII. U.S. Extract of Stramonium

[Ext. Stramon.]

Extract of Stramonium yields not less than 0.9 per cent and not more than 1.1 per cent of the alkaloids of stramonium. One Gm. of the Extract represents about 4 Gm. of stramonium.

Pilular Extract of Stramonium

	Metric	Alternative
Stramonium, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Glucose,		
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the drug with sufficient of a mixture of 3 volumes of alcohol and 1 volume of water, and pack it in a cylindrical percolator; then add enough of this menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice and, having closely covered the percolator, macerate for forty-eight hours.

Then allow the percolation to proceed, gradually adding menstruum of the same strength until the drug is exhausted. Recover the alcohol from the percolate by distillation, and evaporate the residue with frequent stirring at a temperature not exceeding 70° C. to a pilular consistence. Mix the mass thoroughly and weigh it.

Assay a portion of this Extract as directed below, and from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the mass, and to this add sufficient glucose to make the finished Extract contain 1 per cent of the alkaloids of stramonium. Mix thoroughly.

Assay—Proceed by Type Process D, taking 2 Gm. of Extract of Stramonium, using chloroform as the solvent, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02893 Gm. of the alkaloids of stramonium (Proximate Assays, page 1498).

Powdered Extract of Stramonium

	Metric	Alternative
Stramonium, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Starch, dried at 100° C.,		
Alcohol, each, a sufficient quantity.		

Moisten the drug with sufficient alcohol, and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed very slowly, adding alcohol as required. Reserve the first 1000 cc. [2 pints] of percolate and continue the percolation until the second percolate measures 1000 cc. [2 pints] or until the drug is exhausted. Transfer the second percolate to a suitable apparatus and distil the alcohol at as low a temperature as practicable until a residue measuring about 100 cc. [4 fl. oz.] remains, then add the reserved percolate, and continue distillation until the residue in the still is of syrupy consistence.

Transfer this syrupy residue to a shallow evaporating dish, rinse the flask or still with small portions of warm alcohol, and add the rinsings to the contents of the dish. Evaporate this to a soft extract, with frequent stirring, at a temperature not exceeding 70° C. Then add 50 Gm. [1 oz. av. 262 gr.] of the dried starch, and continue the heating at the same temperature, with frequent stirring, until the mass is nearly dry. Now thoroughly incorporate an additional 20 Gm. [280 gr.] of dried starch, and set the product aside in a current of warm air until thoroughly dry. Reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and from the alkaloidal content thus determined ascertain by calculation the amount of alkaloids in the remainder of the powder, and add to this sufficient of the dried starch to make the finished Extract contain 1 per cent of the alkaloids of stramonium. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles, and stopper them tightly.

Assay—Proceed as directed under *Pilular Extract of Stramonium.*

N. F. Preparation—Unguentum Stramonii.

Uses—Employed to relax spasms, especially of the bowels.

Average dose—⅓ grain (0.02 Gm.).

EXTRACTUM CONII. N. F. Extract of Conium

[Ext. Conii]

Extract of Conium yields not less than 1.8 per cent and not more than 2.2 per cent of coniine.

	Metric	Alternative
Conium, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Diluted Hydrochloric Acid	**3 cc.**	44 min.
Glucose,		
Diluted Alcohol, each, a sufficient quantity.		

Moisten the powder with 300 cc. [9½ fl. oz.] of diluted alcohol and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the conium is exhausted. Reserve the first 900 cc. [28¾ fl. oz.] of the percolate, add the diluted hydrochloric acid to the remainder, and evaporate it to 100 cc. [3¼ fl. oz.] at a temperature not exceeding 50° C.; mix this with the reserved portion in a porcelain dish, and evaporate at or below 50° C. to a pilular consistence.

Assay 2 Gm. of this extract as directed below, and from the result thus obtained ascertain by calculation the amount of coniine in the remainder of the product, and add enough glucose to make the finished Extract contain 2 per cent of coniine.

Assay—Weigh accurately 2 Gm. of Extract of Conium and mix it intimately in a flask of about 50 cc. capacity with 2 cc. of diluted hydrochloric acid and 8 cc. of distilled water. Shake this mixture thoroughly with 20 cc. of purified petroleum benzin, allow the liquids to separate, and decant the benzin as closely as possible. Add a second portion of the benzin, shake well, and decant as before. Repeat the extraction with purified petroleum benzin, until the washings are nearly colorless and are free from fat, and reject the benzin washings. Then add to the aqueous liquid an excess of potassium carbonate, to render it alkaline, and extract the alkaline solution by shaking it with successive portions of purified petroleum benzin until the alkaloid is all removed as shown by shaking 5 cc. of the last washing with 1 cc. of diluted hydrochloric acid and adding a drop of iodine T.S. to the acid solution, when no precipitate should form in the acid liquor. Filter the benzin into a wide-mouthed flask or beaker and wash the funnel and filter with a little of the benzin. Then add 10 cc. of tenth-normal sulphuric acid and evaporate off the benzin at a gentle heat, with frequent stirring. Titrate the acid solution with fiftieth-normal potassium hydroxide, using cochineal T.S. or methyl red T.S. as indicator, and calculate the amount of coniine present, using the factor 0.0127 for the tenth-normal sulphuric acid consumed by the alkaloid and multiplying the result by 50 to obtain the percentage of coniine in the extract.

Uses—A nerve sedative.

Average dose—½ grain (0.03 Gm.).

EXTRACTUM ERGOTÆ AQUOSUM. N. F. Aqueous Extract of Ergot

[Ext. Ergot. Aq.—Ergotine P. I.]

	Metric	Alternative
Ergot, in moderately coarse powder	**200 Gm.**	8 oz. av.
Alcohol	**100 cc.**	4 fl. oz.
Choroform Water, a sufficient quantity.		

Moisten the ergot with 400 cc. [1 pint] of chloroform water and allow it to stand in a closely covered vessel for twenty-hour hours, then transfer it to a cylindrical percolator, pack the drug lightly, and percolate with chloroform water, regulating the flow to not over 20 drops per minute, until the percolate measures 1000 cc. [40 fl. oz.]. Evaporate the percolate in a tared dish on a water bath, at a moderate temperature, until reduced to 100 Gm. [4 oz. av.] and, when cold, incorporate the alcohol and allow the mixture to stand in a tightly-covered or closed vessel during three days. Then filter the liquid, and evaporate the filtrate on a water bath, at a temperature not exceeding 50° C., to a pilular consistence.

Uses—A uterine stimulant.

Average dose—3 grains (0.2 Gm.).

EXTRACTUM EUONYMI. N. F. Extract of Euonymus

[Ext. Euonymi.—Powdered Extract of Euonymus]

One Gm. of the Extract represents 4 Gm. of euonymus.

	Metric	Alternative
Euonymus, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Diluted Alcohol,		
Starch, dried at 100° C., each, a sufficient quantity,		
To make	**250 Gm.**	8 oz. av.

Moisten the drug with sufficient diluted alcohol and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding the menstruum as required until the drug is practically exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue to dryness, with frequent stirring, at a temperature not exceeding 70° C. Reduce the extract to a fine powder, weigh it and add sufficient of the dried starch to make the product weigh 250 Gm. [8 oz. av.]. Mix it thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Caution—It has been stated that the absorption of Euonymus in the gastro-intestinal tract is uncertain and irregular. To avoid possible toxic or cumulative action of the drug the physician should determine in each case the tolerance of the patient, and regulate the dosage accordingly.

Uses—A cathartic, but a dangerous drug.

Average dose—2 grains (0.125 Gm.).

EXTRACTUM FERRI POMATUM. N. F. Ferrated Extract of Apples

[Ext. Ferr. Pomat.—Ferri Malas Crudus, Crude Malate of Iron]

	Metric	Alternative
Reduced Iron	**40 Gm.**	2 oz. av.
Fresh Apple Juice	**1000 cc.**	3 pints
Water, a sufficient quantity.		

Mix the fresh apple juice with the iron in an enameled or porcelain vessel, and apply the heat of a water bath, until no more gas is given off, adding a little water from time to time to make up any loss by evaporation. Dilute the liquid with water to make 1000 cc. [3 pints] and set it aside for a few days. Then filter, and evaporate the filtrate on a water bath in an enameled or porcelain vessel to the consistence of a pilular extract.

N. F. Preparation—Tinctura Ferri Pomata.

Uses—As a hematinic.

Average dose—10 grains (0.65 Gm.).

EXTRACTUM GENTIANÆ. N. F. Extract of Gentian

(U. S. P. IX)

[Ext. Gentian.]

	Metric	Alternative
Gentian, in coarse powder	**1000 Gm.**	32 oz. av.
Water, a sufficient quantity.		

Moisten the powder with sufficient water, and allow it to macerate for twenty-four hours; then pack it in a conical percolator and extract it with water until the drug is exhausted. Reduce the liquid to 2000 cc. [4 pints] by boiling, strain it, and then evaporate it to a pilular consistence on a water bath.

N. F. Preparations—Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ Sine Aloe; Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ.

Uses—A gastric stimulant.

Average dose—4 grains (0.25 Gm.).

EXTRACTUM HÆMATOXYLI. N. F. Extract of Hematoxylon

[Ext. Hæmatox.]

	Metric	Alternative
Hematoxylon, rasped	**1000 Gm.**	32 oz. av.
Water,	**10000 cc.**	20 pints

Macerate the hematoxylon with the water for forty-eight hours. Then boil the mixture (avoiding the use of iron vessels) until one-half of the water has evaporated; strain the decoction while hot and evaporate the strained liquid to dryness.

Uses—An astringent for diarrhea.

Average dose—15 grains (1 Gm.).

EXTRACTUM HYDRASTIS. N. F. Extract of Hydrastis

(U. S. P. IX)

[Ext. Hydrast.—Extract of Golden Seal, Powdered Extract of Hydrastis]

Extract of Hydrastis yields not less than 9 per cent nor more than 11 per cent of the ether-soluble alkaloids of hydrastis. One Gm. of the Extract represents about 4 Gm. of hydrastis.

	Metric	Alternative
Hydrastis, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Tartaric Acid	**5 Gm.**	70 gr.
Alcohol,		
Magnesium Oxide,		
Starch, dried at 100° C., each, a sufficient quantity.		

Dissolve the tartaric acid in 1000 cc. [2 pints] of alcohol, moisten the drug with sufficient of this solution and pack in a cylindrical percolator; then add enough of the acidified alcohol, followed by alcohol if necessary, to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, adding alcohol as required, until the drug is exhausted. Recover the alcohol from the percolate by distillation, and evaporate the residue to a soft extract, with frequent stirring at a temperature not exceeding 70° C. Add 50 Gm. [1 oz. av. 263 gr.] of a mixture of one part of magnesium oxide and three parts of the dried starch, mix thoroughly and spread the mass in a thin layer on glass or tinned-metal plates or in a porcelain dish, and continue the drying in an air bath at a temperature not exceeding 70° C., until thoroughly dry. Then reduce the extract to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of alkaloids in the remainder of the powder and add to this enough of the mixture of magnesium oxide and dried starch, made in the same proportion as before, to make the finished Extract contain 10 per cent of the ether-soluble alkaloids of hydrastis. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small wide-mouthed bottles and stopper them tightly.

Assay—Assay 3 Gm. of Extract of Hydrastis by Type Process C (see page 1495), using 150 cc. of ether and the aliquot method, and determining the alkaloids in 100 cc. of the ether solution, representing 2 Gm. of extract. Use ether for the final extraction of the alkaloids and determine them gravimetrically, after drying at 100° C.

This assay is explained on page 1500.

Uses—A stomachic.

Average dose—8 grains (0.5 Gm.).

EXTRACTUM IGNATIÆ. N. F. Extract of Ignatia

[Ext. Ignat.—Powdered Extract of Ignatia]

Extract of Ignatia yields not less than 5.4 per cent and not more than 6.6 per cent of the alkaloids of ignatia.

	Metric	Alternative
Ignatia, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water,		
Starch, dried at 100° C., each, a sufficient quantity.		

Mix 3000 cc. [6 pints] of alcohol, with 1000 cc. [2 pints] of water, and, having moistened the powder with 500 cc. [1 pint] of the mixture, pack it firmly in a conical percolator, and add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding the remainder of the menstruum and continuing the percolation with a mixture of alcohol and water in the same proportions as before, until the drug is practically exhausted. Recover the alcohol from the percolate, evaporate the residue to dryness at a temperature not exceeding 100° C., and weigh the product.

Assay 3 Gm. of this extract as directed below, and, from the result thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the product and add enough starch, previously dried at 100° C., to make the finished Extract contain 6 per cent of the alkaloids of ignatia.

Assay—Assay Extract of Ignatia by Type Process C (see page 1495), using 3 Gm. of the Extract, 150 cc. of ether-chloroform mixture and decanting an aliquot of 100 cc. representing 2 Gm. of extract. Use chloroform for the final extraction of the alkaloids and determine them volumetrically. Each cc. of tenth-normal acid corresponds to 0.0364 Gm. of the total alkaloids of ignatia.

This assay is explained on page 1500.

Uses—A stomachic.

Average dose—½ grain (0.03 Gm.).

EXTRACTUM KRAMERIÆ. N. F. Extract of Krameria

[**Ext. Kramer.**—Powdered Extract of Krameria]

One Gm. of the Extract represents 5 Gm. of krameria.

	Metric	Alternative
Krameria, in moderately coarse powder	**1000 Gm.**	30 oz. av.
Starch, dried at 100° C.,		
Water, each, a sufficient quantity,		
To make	**200 Gm.**	6 oz. av.

Moisten the drug thoroughly with water and pack it in a conical glass percolator, and gradually pour water upon it, until the percolate passes but slightly imbued with the taste of the drug. Heat the percolate to the boiling point, strain, and evaporate the strained liquid to dryness, by means of a water bath, at a temperature not exceeding 70° C. Reduce the extract to a fine powder, and add sufficient starch, previously dried at 100° C., to make the product weigh 200 Gm. [6 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve and transfer it to small wide-mouthed bottles and stopper them tightly.

Uses—An astringent.

Average dose—8 grains (0.5 Gm.).

EXTRACTUM LEPTANDRÆ. N. F. Extract of Leptandra

[**Ext. Leptand.**—Powdered Extract of Leptandra]

One Gm. of the Extract represents 4 Gm. of leptandra.

	Metric	Alternative
Leptandra, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Starch, dried at 100° C.,		
Alcohol,		
Water, each, a sufficient quantity,		
To make	**250 Gm.**	8 oz. av.

Moisten the powdered drug with sufficient of a mixture of three volumes of alcohol and one volume of water, and macerate it in a closed vessel for twenty-four hours. Then pack in a cylindrical percolator and gradually percolate with a menstruum of alcohol and water, made in the same proportion as before, until the drug is practically exhausted. Recover the alcohol and evaporate the residue to dryness on a water bath at a temperature not exceeding 70° C. Reduce the extract to a fine powder and add sufficient starch, previously dried at 100° C., to make the product weigh 250 Gm. [8 oz. av.]. Mix the powders thoroughly, pass the Extract through a fine sieve and transfer it to small, wide-mouthed bottles and stopper them tightly.

N. F. Preparation—Pilulæ Catharticæ Vegetabiles.

Uses—As a cathartic.

Average dose—4 grains (0.25 Gm.).

EXTRACTUM OPII. N.F. Extract of Opium

(U. S. P. IX)

[**Ext. Opii.**—Powdered Extract of Opium, Extractum Opii Aquosum, P. I.]

Extract of Opium yields not less than 19.5 per cent and not more than 20.5 per cent of anhydrous morphine. One Gm. of the Extract represents about 2 Gm. of opium.

	Metric	Alternative
Opium, cut into small pieces	**100 Gm.**	4 oz. av.
Starch, dried at 100° C.,		
Water, each, a sufficient quantity.		

Macerate the opium with 300 cc. [11½ fl. oz.] of hot water until softened, then rub to a smooth paste. Add to this 100 Gm. [4 oz. av.] of clean, white sand and mix thoroughly. Transfer the mixture to a percolator and allow the percolation to proceed, gradually adding water until the opium is exhausted. Evaporate the percolate to dryness in a shallow evaporating dish, on a water bath, reduce the product to a fine powder and weigh it.

Assay a portion of this product as directed below, and, from the alkaloidal content thus determined, ascertain by calculation the amount of anhydrous morphine in the remainder of the powder, and add to this enough of the dried starch to make the finished Extract contain 20 per cent of anhydrous morphine. Mix the powders thoroughly, pass the Extract through a fine sieve, transfer it to small, wide-mouthed bottles and stopper them tightly.

Assay—Dissolve 4 Gm. of Extract of Opium in 5 cc. of distilled water, add gradually, with constant stirring, 25 cc. of distilled water, filter, and wash the filter and residue with sufficient distilled water to make the solution measure exactly 50 cc. Then proceed as directed under Tinctura Opii Crocata, page 395, fourth line of the Assay. The morphine obtained represents 2 Gm. of Extract of Opium.

Uses—A sedative and narcotic.

Average dose—½ grain (0.03 Gm.).

EXTRACTUM SUMBUL. N.F. Extract of Sumbul

(U. S. P. IX)

[**Ext. Sumbul**]

	Metric	Alternative
Sumbul, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with sufficient of a mixture of four volumes of alcohol and one volume of water and pack it in a cylindrical percolator; then add enough of this menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum of the same strength until the drug is exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue, with frequent stirring at a temperature not exceeding 70° C., to a pilular consistence.

Uses—In dysmenorrhea and a nerve sedative.

Average dose—4 grains (0.25 Gm.).

EXTRACTUM TARAXACI. N.F. Extract of Taraxacum

(U. S. P. IX)

[**Ext. Tarax.**]

	Metric	Alternative
Taraxacum, in moderately coarse powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity.		

Mix 125 cc. [4 fl. oz.] of alcohol with 875 cc. [28 fl. oz.] of water, and, having moistened the powder with a portion of the mixture, pack it in a cylindrical percolator, then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice and having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed, gradually adding menstruum of the same strength until the drug is exhausted. Recover the alcohol from the percolate by distillation and evaporate the residue on a water bath, with frequent stirring, to a pilular consistence.

Uses—A diuretic and alterative.

Average dose—15 grains (1 Gm.).

Table of Some Unofficial Extracts

Title	*Directions*
Extractum Aconiti (U. S. P. IX)	Assayed—It contains from 1.8 to 2.2 per cent of the ether-soluble alkaloids of aconite Dissolve 5 Gm. of tartaric acid in 500 cc. of alcohol, moisten 1000 Gm. of the drug with the mixture and percolate after forty-eight hours' maceration, using alcohol as the menstruum. Reserve the first 1000 cc. of percolate, recover the alcohol by distillation from the remaining percolate and when the residue measures 100 cc. add the reserved portion and again distil the alcohol until the residue is of syrupy consistence. Shake residue with two successive portions of petroleum benzin of 250 cc. each, incorporate 50 Gm. of dried starch with the washed residue, and evaporate on a water bath, at not over 70° C. Powder the product, weigh, assay and adjust the finished extract to the above standard by adding sufficient dried starch Dose: one sixth grain (0.01 Gm.)
Aloes (N. F. IV)	Thoroughly mix 1000 Gm. of aloes with 10,000 cc. of boiling water, stand for twelve hours, decant the clear liquid, strain the remainder and evaporate the mixed liquids to dryness on a water bath. Powder and add enough starch to make 500 Gm. Dose: two grains (0.125 Gm.)
Arnica (U. S. P. 1890)	Percolate 1000 Gm. of arnica root with diluted alcohol; reserve the first 900 cc. of percolate, evaporate the remainder to 100 cc. Mix it with the reserve and evaporate to pilular consistence at not over 50° C. Dose: fifteen grains (1 Gm.)
Cimicifugæ (U. S. P. IX)	Percolate 1000 Gm. of cimicifuga to exhaustion with alcohol, recover the alcohol by distillation, evaporate the residue to dryness at not over 70° C., powder and add enough starch to make 250 Gm. Dose: four grains (0.25 Gm.)
Cinchonæ (N. F. IV)	Assays not less than 22 per cent and not more than 26 per cent of combined alkaloids. Percolate 1000 Gm. of cinchona using 4000 cc. of 71 per cent alcohol as the first menstruum and diluted alcohol as the second menstruum. Collect 4000 cc. of percolate, reserve the first 900 cc., and evaporate first the remaining percolate to 100 cc., add to the reserve and evaporate at not over 80° C. until the product is of a pilular consistence. Assay and add glucose to make the product contain 24 per cent of combined alkaloids of cinchona Dose: four grains (0.25 Gm.)
Colchici (Br. 1914)	Crush fresh colchicum corms, deprived of their coats; press, set the liquid aside, decant clear portion, heat to 100° C., strain, and evaporate at not over 70° C. to a soft extract
Ergotæ (U. S. P. IX)	Extract 1000 Gm. of ergot with petroleum benzin, dry the drug and percolate to exhaustion, using first a mixture of 10 cc. of hydrochloric acid, 340 cc. of alcohol and 60 cc. of water, and then 80 per cent alcohol. Recover the alcohol by distillation and evaporate the residue at not over 70° C. to a pilular consistence Dose: four grains (0.25 Gm.)
Gelsemii (U. S. P. IX)	Percolate 1000 Gm. of gelsemium to exhaustion with alcohol, recover the alcohol by distillation until the residue in the still measures 500 cc., evaporate this in a dish, at not over 70° C., to a soft extract. Then incorporate 50 Gm. of a mixture of 1 part of magnesium oxide and 3 parts of dried starch and dry the mixture on plates, in an air bath, at not over 70° C. Powder the product and add enough of the same diluting material to make 250 Gm. Dose: one sixth grain (0.01 Gm.)
Jalapæ (N. F. IV)	Percolate 1000 Gm. of jalap to exhaustion with alcohol, reserve the first 900 cc. of percolate, evaporate first the remaining percolate to 100 cc. Add to the reserved portion and evaporate at not over 50° C. to a pilular consistence Dose: fifteen grains (1 Gm.)
Physostigmatis (U. S. P. IX)	It contains from 1.7 to 2.3 per cent of physostigma alkaloids. Percolate 1000 Gm. of physostigma to exhaustion, using first a mixture of 5 Gm. of tartaric acid dissolved in 1000 cc. of 70 per cent alcohol, and afterward 70 per cent alcohol. Recover the alcohol by distillation and evaporate the residue to about 200 cc. at not over 70° C. Transfer the concentrated liquid to a flask, add 100 cc. of water and wash the mixture with two successive portions of petroleum benzin, 250 and 200 cc. respectively. Discard the benzin and evaporate the washed liquid to pilular consistence at not over 70° C. Add 20 Gm. of dried starch and thoroughly dry by exposure to currents of warm air. Powder the product, assay, and add enough dried starch to make the finished extract contain 2 per cent of physostigma alkaloids Dose: one eighth grain (0.008 Gm.)
Podophylli (N. F. IV)	Prepare as directed under extractum jalapæ, using 75 per cent alcohol as the menstruum Dose: one fourth grain (0.015 Gm.)
Quassiæ (N. F. IV)	Percolate 1000 Gm. of quassia with water until exhausted, evaporate the percolate to three-fourths of its bulk by boiling, then strain, and evaporate the liquid to dryness on a water bath. Powder the product and add enough dried starch to make 100 Gm. Dose: one grain (0.06 Gm.)
Strophanthi (Br. 1914)	Exhaust 25 Gm. of strophanthus seeds with ether, dry the mass, and percolate with alcohol to make 250 cc. Evaporate the liquid until it thickens, and add enough lactose to make 50 Gm. Dose: one-eighth grain (0.080 Gm.)
Viburni Prunifolii (U. S. P. IX)	Percolate 1000 Gm. of viburnum prunifolium to exhaustion with diluted alcohol, recover the alcohol by distillation and evaporate the residue to a soft extract at not over 70° C. Add 5 Gm. of magnesium oxide, dry on glass plates in a current of warm air. Powder, and add enough dried starch to make 200 Gm. Dose: eight grains (0.5 Gm.)

Resinæ—*Resins*

The official resins are solid preparations consisting chiefly of the resinous principles from vegetable bodies. The officially prepared resins differ from alcoholic extracts in the fact that the latter contain all the principles in the drug which alcohol is capable of dissolving, while the resins contain only those principles which are soluble in alcohol and are insoluble in water. It is obvious that the resins prepared from those drugs that owe their activity exclusively to resinous principles, that are insoluble in water, are stronger preparations than the alcoholic extracts from such drugs.

RESINA. U. S. Rosin
[Resin.—Colophony]

The residue left after distilling the volatile oil from the oleoresin obtained from *Pinus palustris* Miller and from other species of *Pinus* (Fam. *Pinaceæ*).

Description and Physical Properties—Sharply angular, translucent, amber-colored fragments, frequently covered with a yellow dust, brittle at ordinary temperatures, the fracture shiny and shallow-conchoidal. The odor and taste are slightly terebinthinate.

Rosin is freely soluble in alcohol, ether, benzene, glacial acetic acid, and in fixed and volatile oils. It is also soluble in dilute solutions of the fixed alkali hydroxides.

Tests for Identity and Purity—Its alcoholic solution is acid to litmus paper.

Specific gravity: 1.07 to 1.09 at 25° C.

Rosin is easily fusible and burns with a dense yellowish smoke.

Ash: not more than 0.05 per cent.

Acid number: not less than 150, page 1512.

U. S. P. Preparations—Ceratum Cantharidis; Ceratum Resinæ.

N. F. Preparations—Ceratum Resinæ Compositæ; Solutio Resinæ Chloroformica.

RESINA IPOMŒÆ. U. S. Resin of Ipomea
[Res. Ipom.]

	Metric	Alternative
Ipomea, in coarse powder	**1000 Gm.**	**32 oz. av.**
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the Ipomea with sufficient alcohol, pack it in a cylindrical percolator, and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the percolate is reduced to the consistence of thin syrup, and pour this slowly, with constant stirring, into 1000 cc. [2 pints] of hot water. When the precipitate has subsided, decant the supernatant liquid, wash the precipitated resin twice by decantation with fresh portions of 1000 cc. [2 pints] each of hot water, drain off the water thoroughly, and dry the Resin on a water bath.

Description and Physical Properties—Translucent masses or fragments, of a brown color, breaking with a glossy, resinous fracture; odor characteristic.

Resin of Ipomea is soluble in alcohol and in chloroform; from 80 to 90 per cent is soluble in ether, and less than 5 per cent is soluble in petroleum benzin.

Tests for Purity—Ash: not more than 0.5 per cent.

Resin of Ipomea is slowly soluble in five times its weight of ammonia T.S. and in potassium hydroxide T.S., yielding a somewhat cloudy solution which does not become gelatinous on standing. When these solutions are acidified with hydrochloric acid, only a slight turbidity appears (*rosin, guaiac or other resins*).

Resin of Ipomea, dried at 100° C., loses not more than 1 per cent (*water*).

Triturate Resin of Ipomea with distilled water: the latter does not become colored, none of the resin dissolves (*soluble impurities*), and the water does not have a bitter taste (*aloin*).

Shake 0.02 Gm. of Resin of Ipomea with 5 cc. of ether, filter, and evaporate the filtrate on filter paper: no greenish-blue color is produced by the addition of a drop of ferric chloride T.S. to the filter paper (*guaiac*).

Dissolve 0.02 Gm. of Resin of Ipomea in 2 cc. of glacial acetic acid and add a few drops of sulphuric acid: the mixture does not acquire a pink color (*rosin*).

Acid number: not less than 25 and not more than 30.

Ester number: not less than 170 and not more than 185.

Saponification value: not less than 195 and not more than 215.

U. S. P. Preparation—Extractum Colocynthidis Compositum.

N. F. Preparation—Tinctura Jalapæ Composita.

Uses—A cathartic, usually combined with other drugs. It has been admitted to the U. S. P. to replace the true *resin of scammony* which is no longer commercially available. It is not chemically identical with resin of scammony but seems to possess practically the same therapeutic uses. It is sometimes called *Resin of Mexican Scammony.*

Average dose—3 grains (0.2 Gm.).

RESINÆ JALAPÆ. U. S. Resin of Jalap

[Res. Jalap.]

	Metric	Alternative
Jalap, in fine powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the powder with 500 cc. [1 pint] of alcohol, pack it in a cylindrical percolator, and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding alcohol, until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the percolate is reduced in weight to 250 Gm. [8 oz. av.] and add the latter slowly, with constant stirring, to 3000 cc. [6 pints] of water. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice by decantation with fresh portions of 1000 cc. [2 pints] each of hot water. After having drained off all of the liquid, transfer the Resin to a porcelain dish and heat it to dryness on a water bath.

Description and Physical Properties—Yellow to brown masses or fragments, breaking with a resinous, glassy fracture and translucent at the edges, or a yellowish-gray to yellowish-brown powder. It has a slight, peculiar odor, a somewhat acrid taste, and is permanent in the air.

Resin of Jalap is soluble in alcohol in all proportions; insoluble in carbon disulphide, benzene, and in fixed or volatile oils.

Test for Purity—Add 1 Gm. of the powdered Resin to 20 cc. of chloroform in a stoppered flask, shake the mixture occasionally during one hour, then filter, wash the flask and residue on the filter with three successive 5 cc. portions of chloroform, evaporate the combined filtrates in a tared dish, and dry the residue to constant weight at 100° C.: it weighs not more than 0.3 Gm.

Add 1 Gm. of the powdered Resin to 20 cc. of ether in a stoppered flask, shake the mixture occasionally during one hour, then filter, wash the flask and residue on the filter with three successive 5 cc. portions of ether, evaporate the combined filtrates in a tared dish, and dry the residue to constant weight at 100° C.: it weighs not more than 0.12 Gm. (*rosin or other resins*).

It is slowly but completely soluble in 5 times its weight of ammonia water, and the solution does not become gelatinous on standing. When this solution is acidified with hydrochloric acid, only a slight turbidity appears (*rosin, guaiac, or other resins*).

When Resin of Jalap is dried at 100° C., the loss in weight should not exceed 1 per cent (*water*).

When Resin of Jalap is triturated with distilled water, the latter does not become colored, none of the Resin dissolves (*soluble impurities*), and the water does not have a bitter taste (*aloin*).

Shake 0.02 Gm. of Resin of Jalap with 5 cc. of ether, filter, and evaporate the ethereal filtrate on filter paper: no greenish-blue color is produced by the application of a drop of ferric chloride T.S. to the filter paper (*guaiac*).

One Gm. of Resin of Jalap when dissolved in 50 cc. of alcohol containing 1 cc. of phenolphthalein T.S. requires not more than 0.5 cc. of half-normal alcoholic potassium hydroxide to produce a red color (*acid resins*).

Dissolve 0.02 Gm. of Resin of Jalap in 2 cc. of glacial acetic acid and add a few drops of sulphuric acid: the mixture does not acquire a pink color (*rosin*).

U. S. P. Preparation—Pilulæ Hydrargyri Chloridi Mitis Compositæ.

N. F. Preparation—Pilulæ Catharticæ Vegetabiles.

Uses—A purgative.

Average dose—2 grains (0.125 Gm.).

RESINA PODOPHYLLI. U.S. Resin of Podophyllum

[Res. Podoph.—PODOPHYLLIN]

	Metric	Alternative
Podophyllum, in fine powder	**1000 Gm.**	32 oz. av.
Hydrochloric Acid	**10 cc.**	2½ fl. dr.
Alcohol,		
Water, each, a sufficient quantity.		

Moisten the drug with 500 cc. [1 pint] of alcohol, pack it in a cylindrical percolator, and add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the percolate is reduced to the consistence of a thin syrup, and pour this slowly, with constant stirring, into 1000 cc. [2 pints] of water, mixed with the hydrochloric acid and cooled to a temperature below 10° C. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice by decantation with fresh portions of 1000 cc. [2 pints] of cold water. Spread it in a thin layer upon a strainer and dry the product by exposure to the air, in a cool place, protected from light. Should it coalesce during the drying or aggregate into lumps having a glossy surface, break it into pieces, and powder it in a mortar.

Description and Physical Properties—An amorphous powder, varying in color from light brown to greenish-yellow, turning darker when subjected to a temperature exceeding 25° C. or when exposed to light. It has a slight, peculiar and a faintly bitter taste. *It is very irritating to the eye, and to mucous membranes in general.*

Tests for Identity—Resin of Podophyllum is soluble in potassium or sodium hydroxide T.S., forming a deep yellow liquid, which gradually becomes darker on standing, and from which the resin is reprecipitated by acids.

A hot aqueous solution of Resin of Podophyllum deposits most of its contents on cooling, and if the cooled liquid is filtered, the filtrate has a bitter taste, and turns brown upon the addition of a few drops of ferric chloride T.S.

Tests for Purity—Ash: not more than 1.5 per cent.

Resin of Podophyllum is soluble in alcohol with only a slight opalescence and the solution is faintly acid to litmus paper.

Add 0.4 Gm. of Resin of Podophyllum to 3 cc. of 60 per cent alcohol, follow with 0.5 cc. of potassium hydroxide T.S., and shake gently: the mixture does not gelatinize (*difference from resin obtained from Podophyllum Emodi*).

Add 1 Gm. of the powdered Resin to 20 cc. of ether in a stoppered flask and shake the mixture occasionally during one hour. Filter, and wash the residue in the flask and on the filter with three successive 5 cc. portions of ether. Evaporate the combined ether solutions in a tared dish and dry the residue to constant weight at 100° C.: it weighs not less than 0.75 Gm.

Add 1 Gm. of the powdered Resin to 20 cc. of chloroform in a stoppered flask and shake the mixture occasionally during one hour. Filter, and wash the residue in the flask and on the filter with three successive 5 cc. portions of chloroform. Evaporate the combined filtrates in a tared dish and dry the residue to constant weight at 100° C.: it weighs not less than 0.65 Gm.

Preserve in well-closed containers protected from light.

N. F. Preparations—Pilulæ Aloes et Podophylli Compositæ; Pilulæ Aloes, Hydrargyri et Podophylli; Pilulæ Aloini Compositæ; Pilulæ Catharticæ Vegetabiles.

Uses—An active purgative; the basis of several proprietary "liver-pills".

Average dose—⅙ grain (0.01 Gm.).

Unofficial Resin

Title	*Directions*
Resinae Scammonii (U. S. P. IX)	Percolate 1000 Gm. of scammony root, in No. 30 powder, with alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol until the residue is reduced to the consistence of thin syrup, and pour this slowly and with consistent stirring into 1000 cc. of hot water, wash the precipitate with two portions of 1000 cc. each of hot water, and dry the resin on a water bath

CHAPTER XXXVIII

SOLID OFFICIAL PREPARATIONS MADE WITHOUT PERCOLATION OR MACERATION

It is not the intention in this chapter to consider in detail the classes of solid official preparations included in the above title, because their manufacture either belongs to the domain of magistral pharmacy or is intimately connected with it. They are more appropriately treated in the final chapters of the book, because their preparation generally demands a higher degree of skill, and a more intimate knowledge of the physical properties of medicinal substances, than are necessary in making those which have been heretofore considered. For these reasons it has been the custom, in lecturing upon the subjects treated of in this work, to reserve the consideration of the solid official preparations made without percolation, and those which are embraced under the general term "extemporaneous", until after the student has studied the physical and chemical properties of the various substances which compose the materia medica. It is well for the student to have sufficient knowledge of these preparations to be able to define each class, so that when they are incidentally mentioned in Parts IV and V he may be able to describe the use and appearance of a powder, troche, plaster, pill, etc. If it is considered desirable to deviate from this plan, the chapters on these subjects are so constructed that the student may easily turn to them and study them out of the order given here. They will be found in Part XI.

It will be well, however, in this place, in order to keep the classification in view, to enumerate them briefly. They are Artificial Salts, Effervescent Salts, Powders, Oil Sugars, Species, Dentifrices, Masses, Confections, Pills, Troches, Tablets, Ointments, Inunctions, Glycerogelatins, Dermatologic Pastes, Cerates, Cataplasms, Plasters, Mulls, Papers, Suppositories, and Pencils. In this group artificial and effervescent salts, powders, oil sugars, species and dentifrices are considered together. Masses and confections being used in the preparation of pills, troches, and tablets, are considered with them. Ointments, inunctions, glycerogelatins, dermatologic pastes, cerates, cataplasms, plasters, mulls, and papers form a natural group, being preparations that are used externally, while suppositories and pencils form another classification.

Salia Factitia—*Artificial Salts*

It has long been the custom to prepare a mixture of the more important chemical salts naturally present in several of the well-known mineral springs of Europe. These are properly labeled artificial, and if used to prepare effervescent salts or mineral waters they should be sold only as an imitation of the genuine.

SAL CAROLINUM FACTITIUM. N.F. Artificial Carlsbad Salt [Sal Carol. Fact.]

1. *In dry, amorphous form:*

	Metric	Alternative
Potassium Sulphate	**2 Gm.**	35 gr.
Sodium Chloride	**18 Gm.**	315 gr.
Sodium Bicarbonate	**36 Gm.**	1 oz. av. 193 gr.
Sodium Sulphate	**100 Gm.**	4 oz. av.
To make about	**100 Gm.**	4 oz. av.

Mix the sulphates and chloride and dry to constant weight at about 40° C., cool, add the sodium bicarbonate and mix thoroughly.

2. *In crystalline form:*

	Metric	Alternative
Potassium Sulphate, in crystals	2 Gm.	35 gr.
Sodium Chloride in crystals	18 Gm.	315 gr.
Monohydrated Sodium Carbonate	28 Gm.	1 oz. av. 53 gr.
Sodium Sulphate, in crystals	100 Gm.	4 oz. av.
Distilled Water	100 cc.	3 fl. oz. 362 min.
To make about	180 Gm.	7 oz. av. 88 gr.

Dissolve the potassium sulphate and sodium chloride in the distilled water, and add this solution to the other two salts, previously melted in a tared dish, at a gentle heat, in their own water of crystallization. Evaporate the mixture to 180 Gm. [7 oz. av. 88 gr.], set it aside in a cool place, and stir it frequently, to prevent the formation of large crystals, taking care, however, that none of the salt separates in a pulverulent form. Distribute any remaining mother liquor uniformly over the crystals, and dry the whole mixture sufficiently by exposure to air, so that it will retain its crystalline character.

NOTE—A solution of 1 Gm. of the dry or 1.75 Gm. of the crystalline salt in 200 cc. of water is similar to an equal volume of Carlsbad water (Sprudel) in its main constituents.

Preparation—Sal Carolinum Factitium Effervescens.

SAL KISSINGENSE FACTITIUM. N. F. Artificial Kissingen Salt

[Sal Kissingen. Fact.]

	Metric	Alternative
Potassium Chloride, in crystals	32 Gm.	56 gr.
Sodium Chloride, in crystals	660 Gm.	2 oz. av. 280 gr.
Magnesium Sulphate	220 Gm.	385 gr.
Sodium Bicarbonate, dried	198 Gm.	346 gr.
To make about	1000 Gm.	4 oz. av.

Dry the magnesium sulphate to constant weight at 110° C., cool, add the other ingredients and mix thoroughly.

NOTE—A solution of 1.5 Gm. of this preparation in 200 cc. of water is similar to an equal volume of Kissingen water (Rakoczi Spring) in its main constituents.

Preparation—Sal Kissingense Factitium Effervescens.

SAL VICHYANUM FACTITIUM. N. F. Artificial Vichy Salt

[Sal Vichy. Fact.]

	Metric	Alternative
Sodium Bicarbonate, dried	846.0 Gm.	3 oz. av. 168 gr.
Potassium Carbonate, dried	38.5 Gm.	1 oz. av. 236 gr.
Magnesium Sulphate	80.0 Gm.	140 gr.
Sodium Chloride	77.0 Gm.	135 gr.
To make about	1000 Gm.	4 oz. av.

Dry the magnesium sulphate to constant weight at 110° C., cool, add the other ingredients, and mix thoroughly.

NOTE—A solution of 1 Gm. of this preparation in 200 cc. of water is similar to an equal volume of Vichy water (Grande Grille Spring) in its main constituents.

Preparation—Sal Vichyanum Factitium Effervescens.

Salia Effervescentia—*Granular Effervescent Salts*

Granular effervescent salts were formerly made by mixing the dry powders with dry tartaric acid and sodium bicarbonate and moistening the mixture with strong alcohol. The pasty mass was passed through a sieve, and the granules dried quickly in a hot room, sifted, and filled into bottles, which were hermetically sealed to prevent the access of moist air.

The use of alcohol in making granulated effervescent salts is expensive, and an improvement was made by using citric acid to replace a part of the tartaric acid. The molecule of water of crystallization in citric acid is liberated when heated in contact with the sodium bicarbonate, and this furnishes just

sufficient water to make a pasty mass, without causing much loss of carbonic acid; by quickly drying the granules further chemical action is prevented.

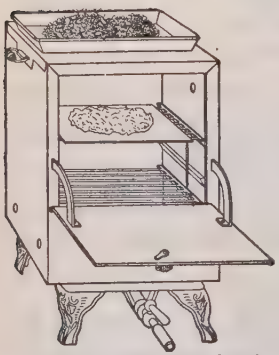
This method was greatly improved by mixing the powders in a flat enameled dish and heating in an oven to about 100° C., or by heating the mixture in a deep jacketed kettle or in a pill coating pan, heated, as it revolves, by a gas flame. When the mixture becomes moist, it is manipulated with a wooden spatula to make it uniform in consistence, and rubbed through a coarse tinned-iron sieve and the granules dried slowly, at a low heat, in an oven. Fig. 423*a* shows a convenient method for preparing effervescent salts on a small scale.

Acid sodium phosphate (Sodium Biphosphate, U. S. P. X) is now replacing citric and tartaric acids in many commercial effervescent salts, it being less costly.

The National Formulary gives the following general directions for the preparation of granular effervescent salts:

"The citric acid directed in the formulas should be uneffloresced crystals and be finely powdered just before using. All other ingredients should be well dried at a temperature not exceeding 50° C. until they cease to lose weight, and then finely powdered and passed through a No. 60 sieve. As atmospheric dampness, if present, will be absorbed by the finished salt and destroy the effervescent character of the product, it is important that these preparations be made in an atmosphere free from moisture.

FIG. 423*a*



Oven for making granulated effervescent salts

"*Directions for Granulating in an Oven*—Having prepared the citric acid and the other ingredients of the formula as directed above, intimately mix the powders, without trituration, adding the citric acid last, and spread the resulting product evenly, about 10 mm. thick, on a sheet of paper on a canvas tray, glass plate, or in a shallow porcelain or enameled dish, and place it in an oven, heated to a temperature between 95° and 105° C. Allow the powder to remain in the oven (see Fig. 423*a*), without stirring, until it becomes moist and acquires the proper consistence, about that of dough, then force the mass immediately through a No. 6 tinned-iron sieve and dry the product at a temperature not exceeding 50° C. When dry, again pass the granular powder through a No. 6 tinned-iron sieve, and immediately transfer it to dry bottles or containers, and tightly seal them.

"*Directions for Granulating on a Water Bath*—If a small quantity of the salt is to be prepared, the powders, mixed as directed above, may be transferred to a covered dish on a water bath or to a double boiler, heated by water actively boiling, the inner dish being in contact with the water, and the resulting pasty mass stirred until dry. The dry granules should be immediately passed through a No. 6 tinned-iron sieve and transferred to a dry container, which should then be tightly sealed."

In the manufacturing laboratory the mixture is usually heated in a shallow, enameled, jacketed steam kettle until moist, then forced through a No. 6 tinned-iron sieve by mechanical means and the moist granules dried in a vacuum dryer.

The title *Granulæ Effervescentes* (*Effervescent Granules*) is given by the B. P. Codex to this class of products, many formulas being offered.

POTASSII CITRAS EFFERVESCENS. U. S. P. **Effervescent Potassium Citrate** (see page 607).

SODII PHOSPHAS EFFERVESCENS. U. S. P. **Effervescent Sodium Phosphate** (see page 630).

PULVIS EFFERVESCENS COMPOSITUS. U. S. P. **Compound Effervescent Powder** (see page 478).

SAL CAROLINUM FACTITIUM EFFERVESCENS, N. F. Effervescent Artificial Carlsbad Salt

[Sal Carol. Fact. Eff.]

	Metric	Alternative
Artificial Carlsbad Salt, in the dry form	**266 Gm.**	1 oz. av. 28 gr.
Sodium Bicarbonate, dried and powdered	**400 Gm.**	1 oz. av. 262 gr.
Tartaric Acid, dried and powdered	**157 Gm.**	275 gr.
Citric Acid, unefflorescd crystals	**250 Gm.**	1 oz. av.
To make about	**1000 Gm.**	4 oz. av.

Prepare an effervescent salt as directed in the General Process (see page 476).

Average dose—60 grains (4 Gm.).

NOTE—A solution of 4 Gm. of this preparation in 200 cc. of water is similar to an equal volume of Carlsbad water (Sprudel) in its main constituents.

SAL KISSINGENSE FACTITIUM EFFERVESCENS. N. F. Effervescent Artificial Kissingen Salt

[Sal Kissingen. Fact. Eff.]

	Metric	Alternative
Artificial Kissingen Salt, dried and powdered	**400 Gm.**	1 oz. av. 262 gr.
Sodium Bicarbonate, dried and powdered	**406 Gm.**	1 oz. av. 273 gr.
Tartaric Acid, dried and powdered	**94 Gm.**	164.5 gr.
Citric Acid, in unefflorescd crystals	**250 Gm.**	1 oz. av.
To make about	**1000 Gm.**	4 oz. av.

Prepare an effervescent salt as directed in the General Process (see page 476).

Average dose—60 grains (4 Gm.).

NOTE—A solution of 3.75 Gm. of this preparation in 200 cc. of water is similar to an equal volume of Kissingen water (Rakoczi Spring) in its main constituents.

SAL LITHII CITRATIS EFFERVESCENS. N. F. **Effervescent Salt of Lithium Citrate** (see page 647)

SAL MAGNESII SULPHATIS EFFERVESCENS. N. F. **Effervescent Magnesium Sulphate** (see page 670)

SAL POTASSII BROMIDI EFFERVESCENS COMPOSITUM. N. F. **Compound Effervescent Salt of Potassium Bromide** (see page 603)

SAL VICHYANUM FACTITIUM EFFERVESCENS. N. F. Effervescent Artificial Vichy Salt

[Sal Vichy. Fact. Eff.]

	Metric	Alternative
Artificial Vichy Salt, dried and powdered	**250.0 Gm.**	1 oz. av.
Sodium Bicarbonate, dried and powdered	**485.5 Gm.**	1 oz. av. 412 gr.
Tartaric Acid, dried and powdered	**164.5 Gm.**	288 gr.
Citric Acid, unefflorescd crystals	**250.0 Gm.**	1 oz. av.
To make about	**1000 Gm.**	4 oz. av.

Prepare an effervescent salt as directed in the General Process (see page 476).

Average dose—60 grains (4 Gm.).

NOTE—A solution of 4 Gm. of this preparation in 200 cc. of water is similar to an equal volume of Vichy water (Grande Grille Spring) in its main constituents.

Some Unofficial Granular Effervescent Salts

Title	*Directions*
Sal Potassii Bromidi Effervescens (N. F. IV)	Prepare an effervescent salt by the general process, using 16.6 Gm. of potassium bromide, 53 Gm. of sodium bicarbonate, 20.4 Gm. of tartaric acid and 25 Gm. of citric acid
Sal Vichyanum Factitium Effervescens cum Lithio* (N. F. IV)	Prepare an effervescent salt by the general process, using 25 Gm. of artificial vichy salt, 8.33 Gm. of lithium citrate, 44.1 Gm. of sodium bicarbonate, 12.5 Gm. of tartaric acid and 25 Gm. of citric acid

Pulveres—*Powders*

The preparations considered here under this title are the official compound powders. They consist of intimate mixtures of substances which, in the majority of instances, have previously been reduced to a fine powder. Because some substances, especially those containing aromatic volatile oils, would be injured by preliminary powdering, these are usually mixed without grinding and the mixture reduced to a fine powder. They therefore call for a consideration of many of the principles and much of the apparatus described under comminution and trituration (see pages 151, etc.).

The extemporaneous preparation of powders in prescription filling, is discussed in Part XI.

The official compound powders are as follows:

PULVIS CRETÆ COMPOSITUS. U.S. Compound Chalk Powder

[Pulv. Cret. Co.]

	Metric	Alternative
Prepared Chalk	**30 Gm.**	1½ oz. av.
Acacia, in very fine powder	**20 Gm.**	1 oz. av.
Sucrose, in fine powder	**50 Gm.**	2½ oz. av.
To make	**100 Gm.**	5 oz. av.

Mix the powders intimately by trituration and pass the product through a No. 60 sieve.

U. S. P. Preparation—Mistura Cretæ.

Uses—A convenient form for the administration of chalk as an antacid.

Average dose—30 grains (2 Gm.).

PULVIS EFFERVESCENS COMPOSITUS. U.S. Compound Effervescing Powder

[Pulv. Eff. Co.—SEIDLITZ POWDER**]**

The mixture in a blue paper weighs not less than 9.5 Gm. and not more than 10.5 Gm., and contains not less than 23 per cent and not more than 27 per cent of sodium bicarbonate [$NaHCO_3$], and not less than 73 per cent and not more than 78 per cent of potassium and sodium tartrate [$KNaC_4H_4O_6.4H_2O$]. The white paper contains not less than 2 Gm. and not more than 2.4 Gm. of tartaric acid [$H_2C_4H_4O_6$].

	Metric	Alternative
Sodium Bicarbonate, dried and in fine powder	**30 Gm.**	1 oz. av. 26 gr.
Potassium and Sodium Tartrate, dried and in fine powder	**90 Gm.**	3 oz. av. 28 gr.
Tartaric Acid, dried and in fine powder	**26 Gm.**	401 gr.

Mix the sodium bicarbonate intimately with the potassium and sodium tartrate, divide the mixture into 12 equal parts, and wrap each part in a blue paper. Then divide the tartaric acid into 12 equal parts, and wrap each part in a white paper.

Tests for Identity—To 5 cc. of an aqueous solution of the mixture in a blue paper (1 in 20) add 5 cc. of acetic acid, and when effervescence has ceased, shake the solution vigorously: a white, crystalline precipitate, soluble in ammonia T.S., separates.

Assay for Sodium Bicarbonate—Mix thoroughly the contents of a blue paper, then dissolve 2 Gm. of it in 80 cc. of distilled water, add 20 cc. of half-normal sulphuric acid, boil the solution

until the volume is reduced to about 50 cc., and titrate the excess of acid with half-normal sodium hydroxide, phenolphthalein T.S. being used as indicator. Each cc. of half-normal sulphuric acid corresponds to 0.04201 Gm. of sodium bicarbonate.

Assay for Potassium and Sodium Tartrate—Proceed as directed under the assay for alkali salts of organic acids, page 1514, using 2 Gm. of the mixture taken from the blue paper used in the preceding assay. The difference between the number of cc. of half-normal sulphuric acid consumed in this assay and in the assay for sodium bicarbonate multiplied by 0.07056, represents the potassium and sodium tartrate.

The sum of the percentage of sodium bicarbonate and of the potassium and sodium tartrate is not less than 99 per cent.

Assay for Tartaric Acid—The contents of the white paper should meet the requirements of the tests and assay under *Acidum Tartaricum*.

This assay is explained on page 1453.

Preserve the powders in well-closed containers, in a dry place.

History—The name Seidlitz Powder was given to this preparation by the originator and patentee, Thomas Savory, in 1815. Although custom has established its use and its legality, the name is incorrect, as the patentee misrepresented when he claimed that the powders owed their value to the mineral properties of the Seidlitz Spring in Germany. The Seidlitz Spring owes its therapeutic properties to magnesium sulphate. The formula of this patent medicine, for such it was at that time, was exposed in a book of receipts published by the Philadelphia College of Pharmacy in 1824.

Uses—These powders are aperient and refrigerant. Dose, the contents of a white and of a blue paper, dissolved separately in water, and the solutions mixed.

PULVIS GLYCYRRHIZÆ COMPOSITUS. U.S. Compound Powder of Glycyrrhiza

[**Pulv. Glycyrrh. Co.**—Compound Licorice Powder]

	Metric	Alternative
Senna, in very fine powder	180 Gm.	315 gr.
Glycyrrhiza, in very fine powder	236 Gm.	413 gr.
Washed Sulphur	80 Gm.	140 gr.
Oil of Fennel	4 Gm.	5 min.
Sucrose, in fine powder	500 Gm.	2 oz. av.
To make	1000 Gm.	4 oz. av.

Mix the oil of fennel thoroughly with about one-half of the sucrose, then add the remainder of the sucrose and the other ingredients, and mix thoroughly. Finally, pass the powder through a No. 80 sieve, pulverize the residue if any should be left on the sieve, add it to the sifted powder, and mix thoroughly. Keep it in well-closed containers.

Description—Greenish-yellow to greenish-brown, with a fennel-like odor. The elements of identification are the tissues of glycyrrhiza and senna.

For further tests see the U. S. P. X.

History—This preparation first appeared in the Prussian Pharmacopœia of 1799, having been devised by a famous physician of Berlin, but which was based upon a similar preparation called *compound senna powder* which was recognized in the first London Pharmacopœia in 1618.

Uses—This powder is an agreeable laxative.

Average dose—60 grains (4 Gm.).

PULVIS IPECACUANHÆ ET OPII. U.S. Powder of Ipecac and Opium

[**Pulv. Ipecac. et Opii.**—Compound Powder of Ipecac, Dover's Powder, Opii et Ipecacuanhæ Pulvis Compositus P. I.]

	Metric	Alternative
Ipecac, in very fine powder	10 Gm.	175 gr.
Powdered Opium	10 Gm.	175 gr.
Lactose, in coarse powder	80 Gm.	3 oz. av. 87½ gr.
To make	100 Gm.	4 oz. av.

Triturate the ingredients together thoroughly until the mixture is reduced to a very fine, uniform powder.

Description—A grayish-white or very light brown powder.
For further description see the U. S. P. X.

History—This preparation was first introduced by Thomas Dover, an English physician of the early part of the 18th century. He originally called it *Pulvis Diaphoreticus* or *diaphoretic powder*, and gave it in doses from 60 to 100 grains. Dover is noted particularly for having rescued Alexander Selkirk in 1709, while engaged in privateering and Defoe immortalized the story in the classic Robinson Crusoe.

Uses—This powder is anodyne and diaphoretic.

Average dose—5 grains (0.3 Gm.).

PULVIS JALAPÆ COMPOSITUS. U. S. Compound Powder of Jalap

[**Pulv. Jalap. Co.**—PULVIS PURGANS]

	Metric	Alternative
Jalap, in very fine powder	**35 Gm.**	1 oz. av. 175 gr.
Potassium Bitartrate, in fine powder	**65 Gm.**	2 oz. av. 262 gr.
To make	**100 Gm.**	4 oz. av.

Mix the powders intimately by trituration and pass the product through a No. 60 sieve.

Description—A very light brown powder.
For further description see the U. S. P. X.

Uses—Compound Powder of Jalap is a hydragogue cathartic.

Average dose—30 grains (2 Gm.).

PULVIS RHEI COMPOSITUS. U. S. Compound Powder of Rhubarb

[**Pulv. Rhei. Co.**—GREGORY'S POWDER]

	Metric	Alternative
Rhubarb, in very fine powder	**25 Gm.**	1 oz. av.
Magnesium Oxide	**65 Gm.**	2 oz. av. 262 gr.
Ginger, in very fine powder	**10 Gm.**	175 gr.
To make	**100 Gm.**	4 oz. av.

Triturate the rhubarb and ginger together, gradually add the magnesium oxide, continuing the trituration until the ingredients are thoroughly mixed, and finally pass the product through a No. 60 sieve.

Description and Physical Properties—A pinkish-white, mobile powder, becoming darker on exposure to moisture.
For further description see the U. S. P. X.
Preserve in well-closed containers.

History—Gregory's Powder in its original form was a prescription frequently written by Dr. James Gregory of Edinburgh who practiced a little over a hundred years ago in that Scottish City.

Uses—A laxative and antacid.

Average dose—30 grains (2 Gm.).

PULVIS ACETANILIDI COMPOSITUS. N. F. Compound Acetanilid Powder

[Pulv. Acetanil. Co.]

	Metric	Alternative
Acetanilid	70 Gm.	2 oz. av. 350 gr.
Caffeine	10 Gm.	175 gr.
Sodium Bicarbonate	20 Gm.	350 gr.
To make	100 Gm.	4 oz. av.

Reduce the ingredients to a fine powder and mix them thoroughly.

Uses—An analgesic, often employed in the treatment of headaches

Average dose—5 grains (0.32 Gm.).

PULVIS ALOES ET CANELLÆ. N. F. Powder of Aloes and Canella

[Pulv. Aloe. et Canell.—Hiera Picra]

	Metric	Alternative
Aloe, in fine powder	80 Gm.	3 oz. av. 87½ gr.
Canella, in fine powder	20 Gm.	350 gr.
To make	100 Gm.	4 oz. av.

Mix the powders intimately.

History—Hiera Picra is one of the most ancient of pharmaceutical preparations. It dates from about 500 B. C. when a class of preparations known as Hieras came into existence. *Hiera picra* literally means sacred bitters, and the members of this class were complex preparations, frequently sold as nostrums or used as secret preparations by the early physicians, and always containing aloes or a similar purgative drug as the principal active constituent.

Uses—This is used as a laxative but is rarely employed today. It has gained some reputation as an abortifacient and therefore must be sold with caution. (See under Laws, Part VII.)

Average dose—5 grains (0.32 Gm.).

PULVIS ANTIMONIALIS. N. F. Antimonial Powder

[Pulv. Antimon.—James' Powder]

	Metric	Alternative
Antimony Oxide	33 Gm.	1 oz. av. 140 gr.
Precipitated Calcium Phosphate	67 Gm.	2 oz. av. 297½ gr.
To make	100 Gm.	4 oz. av.

Mix the powders intimately.

History—Under the name Dr. James's Fever Powder this preparation was patented in 1747. The patent specifications were very complicated and their integrity was questioned as others could not make the preparation satisfactorily even when directions were strictly followed.

Uses—James' powder has been used as a diaphoretic, but in large doses becomes emetic and purgative.

Average dose—3 grains (0.2 Gm.).

PULVIS ANTISEPTICUS. N. F. Antiseptic Powder

[Pulv. Antisept.—Soluble Antiseptic Powder, Pulvis Antisepticus Solubilis]

	Metric	Alternative
Salicylic Acid	5 Gm.	70 gr
Phenol	1 Gm.	14 gr.
Eucalyptol	1 Gm.	14 gr.
Menthol	1 Gm.	14 gr.
Thymol	1 Gm.	14 gr.
Zinc Sulphate	125 Gm.	4 oz. av.
Boric Acid, in impalpable powder	866 Gm.	27 oz. av. 311 gr.
To make	1000 Gm.	32 oz. av.

Triturate the salicylic acid and zinc sulphate to a very fine powder, add the phenol, eucalyptol, menthol and thymol, previously liquefied by trituration, add the boric acid and continue the trituration until a uniformly fine powder is obtained. Finally pass the powder through a very fine sieve.

Uses—An antiseptic.

PULVIS AROMATICUS. N.F. Aromatic Powder

(U.S.P. IX)

[Pulv. Arom.]

	Metric	Alternative
Cinnamon, in fine powder	35 Gm.	1 oz. av. 157½ gr.
Ginger, in fine powder	35 Gm.	1 oz. av. 157½ gr.
Cardamom Seed, in fine powder	15 Gm.	280 gr.
Myristica, freshly grated	15 Gm.	280 gr.
To make	100 Gm.	4 oz. av.

Triturate the cardamom seed and the myristica with a portion of the cinnamon until they are reduced to a fine powder; then add the remainder of the cinnamon and the ginger and rub them together until they are thoroughly mixed.

A light reddish-brown powder with a strong, distinctive aromatic odor.

For further description see the N. F. V.

Uses—Aromatic powder is used as a pleasant flavor and adjuvant in powders prepared extemporaneously; also as an aromatic and flavor in pills.

Average dose—15 grains (1 Gm.).

PULVIS AROMATICUS RUBEFACIENS. N.F. Rubefacient Spice Powder

[Pulv. Arom. Rubefac.—Replacing Emplastrum Aromaticum]

	Metric	Alternative
Clove, in moderately coarse powder	30 Gm.	1 oz. av. 87½ gr.
Cinnamon, in fine powder	30 Gm.	1 oz. av. 87½ gr.
Ginger, in moderately coarse powder	20 Gm.	350 gr.
Capsicum, in moderately coarse powder	20 Gm.	350 gr.
To make	100 Gm.	4 oz. av.

Mix the powders thoroughly and keep the product in a tightly-closed container.

Uses—This powder has been introduced for the purpose of making *Spice Poultice.* The required quantity should be placed in a flat muslin bag and moistened with either diluted alcohol, whisky, or vinegar, previously heated.

PULVIS CRETÆ AROMATICUS. N.F. Aromatic Powder of Chalk

[Pulv. Cret. Arom.]

	Metric	Alternative
Cinnamon	8 Gm.	140 gr.
Myristica	6 Gm.	105 gr.
Clove	3 Gm.	52 gr.
Cardamom Seed	2 Gm.	35 gr.
Prepared Chalk	25 Gm.	1 oz. av.
Sucrose	56 Gm.	2 oz. av. 105 gr.
To make	100 Gm.	4 oz. av.

Mix the ingredients and reduce them to a fine powder. Pass this through a fine sieve, and afterwards rub it lightly in a mortar. Preserve it in a stoppered bottle.

History—This simple preparation is all that is left of a complex confection devised by Sir Walter Raleigh during his imprisonment prior to his execution. It was introduced into the London Pharmacopœia in 1721 under the name *Confectio Raleighana,* which was later changed to *Confectio Cardiaca* and still later to *Confectio Aromatica.* Each time the formula was simplified until during the 19th century it changed from a confection to a powder and was included under the present official name in the British Pharmacopœia.

Uses—This powder combines the carminative effects of the aromatics with the antacid chalk and is employed in diarrhea involving superacidity.

Average dose—30 grains (2 Gm.).

PULVIS CRETÆ ET OPII AROMATICUS. N. F. Aromatic Powder of Chalk and Opium

[Pulv. Cret. et Opii Arom.—Pulvis Cretæ Aromaticus cum Opio]

	Metric	Alternative
Aromatic Powder of Chalk	97.5 Gm.	3 oz. av. 394 gr.
Powdered Opium	2.5 Gm.	44 gr.
To make	100 Gm.	4 oz. av.

Mix the powders intimately.

Uses—In this preparation the narcotic effect of opium is added to the aromatic chalk powder. It is used when diarrhea is accompanied with much pain.

Average dose—15 grains (1 Gm.).

One average dose contains about:

0.025 Gm. or ⅜ grain of Powdered Opium.

PULVIS HYDRARGYRI CHLORIDI MITIS ET JALAPÆ. N. F. Powder of Mild Mercurous Chloride and Jalap

[Pulv. Hydrarg. Chlor. Mit. et Jalap.—Calomel and Jalap]

	Metric	Alternative
Mild Mercurous Chloride	34 Gm.	1 oz. av. 157½ gr.
Jalap, in fine powder	66 Gm.	2 oz. av. 280 gr.
To make	100 Gm.	4 oz. av.

Mix them intimately.

Uses—It is a cathartic and cholagogue, but is not extensively used today.

Average dose—10 grains (0.65 Gm.).

PULVIS MYRICÆ COMPOSITUS. N. F. Compound Powder of Bayberry

[Pulv. Myric. Co.—Composition Powder]

	Metric	Alternative
Bayberry Bark	60 Gm.	2 oz. av. 175 gr.
Ginger	30 Gm.	1 oz. av. 87½ gr.
Capsicum	5 Gm.	87½ gr.
Clove	5 Gm.	87½ gr.
To make	100 Gm.	4 oz. av.

Reduce the substances to a moderately fine powder and mix them intimately.

Uses—It is used as a carminative and stimulant, chiefly as a home remedy.

Average dose—15 grains (1 Gm.).

PULVIS PANCREATINI COMPOSITUS. N. F. Compound Pancreatin Powder

[Pulv. Pancreat. Co.—Pulvis Pancreaticus Compositus, Peptonizing Powder]

	Metric	Alternative
Pancreatin	20 Gm.	350 gr.
Sodium Bicarbonate	80 Gm.	3 oz. av. 87½ gr.
To make	100 Gm.	4 oz. av.

Mix them by trituration.

Note—One and five-tenths Gm. [22 gr.] of this powder will peptonize 500 cc. [1 pint] of fresh milk when treated as follows: Dissolve 1.5 Gm. [22 gr.] of Compound Pancreatin Powder in 125 cc. [4 fl. oz.] of water, previously heated to 38° C., and add 500 cc. [1 pint] of fresh milk, also heated to 38° C. Maintain the mixture at this temperature during thirty minutes, then transfer it to a cool place, preferably a refrigerator.

Do not use peptonized milk which has been kept longer than twenty-four hours, or which has developed an unpleasant bitter taste.

Uses—For preparing predigested foods.

PULVIS RHEI ET MAGNESIÆ ANISATUS. N. F. Anisated Powder of Rhubarb and Magnesia

[Pulv. Rhei. et Magnes. Anis.—Compound Anise Powder]

	Metric	Alternative
Rhubarb, in fine powder	**35 Gm.**	1 oz. av. 103 gr.
Heavy Magnesium Oxide	**65 Gm.**	2 oz. av. 128 gr.
Anethol	**8 cc.**	130 min.
Alcohol	**10 cc.**	162 min.

Mix the powders, add the anethol, previously dissolved in the alcohol, and triturate until a uniform mixture results. Preserve it in well-stoppered bottles.

Uses—An antacid and carminative in diarrhea.

Average dose—Infants, 5 grains (0.32 Gm.).

PULVIS TALCI COMPOSITUS. N. F. Compound Powder of Talc

[Pulv. Talc. Co.—Pulvis Talci Salicylicus, Boro-Salicylated Powder of Talc]

	Metric	Alternative
Salicylic Acid, in fine powder	**30 Gm.**	420 gr.
Boric Acid, in fine powder	**100 Gm.**	3 oz. av. 87 gr.
Talc, in fine powder	**870 Gm.**	27 oz. av. 367 gr.
To make	**1000 Gm.**	32 oz. av.

Mix the salicylic acid and boric acid intimately and then add the talc in portions, thoroughly mixing after each addition.

Uses—This is a typical formula for a medicated talc to be used as a dusting powder. (See also talcum powders, Part VI.)

Some Unofficial Powders

Title	*Directions*
Pulvis Amygdalæ Compositus (Br. 1914)	Blanch 60 Gm. of sweet almonds, dry them thoroughly with the aid of a gentle heat, triturate in a mortar to a smooth paste, add 10 Gm. of powdered acacia and 30 Gm. of powdered sugar, and thoroughly mix
Buteæ Seminum	Macerate butea seed in distilled water. Carefully remove the integument, dry and powder the kernels
Catechu Compositus (Br. 1914)	Mix 40 Gm. of powdered catechu, 20 Gm. of powdered kino; 20 Gm. of powdered krameria root, 10 Gm. of powdered cinnamon bark, and 10 Gm. of powdered nutmeg
Cinnamomi Compositus (Br. 1914)	Mix 25 Gm. each of powdered cinnamon bark, cardamom seed, and ginger
Pepsini Compositus (Digestive Powder) (N. F. III)	Gradually add 15 min. of lactic acid and 30 min. of hydrochloric acid to 960 gr. of lactose and triturate thoroughly. Add 225 gr. of saccharated pepsin, 225 gr. of pancreatin, and 15 gr. of diastase and triturate thoroughly
Gambir Compositus (N. F. IV)	Mix 40 Gm. of powdered gambir, 20 Gm. of kino, 20 Gm. of krameria 10 Gm. of cinnamon, and 10 Gm. of myristica
Kaladanæ Compositus (Br. 1914)	Mix 30 Gm. of kaladana, 60 Gm. of acid potassium tartrate, and 10 Gm. of ginger
Kino et Opii Compositus (N. F. IV)	Mix 75 Gm. of powdered kino, 5 Gm. of powdered opium, and 20 Gm. of Saigon cinnamon
Morphinæ Compositus (Tully's Powder) (U. S. P. VIII)	Mix 1.5 Gm. of morphine sulphate intimately with 33.5 Gm. of precipitated calcium carbonate, and add 32 Gm. of camphor, previously powdered. Triturate thoroughly, add 33 Gm. of powdered glycyrrhiza, and mix
Opii Compositus (Br. 1914)	Mix 30 Gm. of opium, 40 Gm. of black pepper, 100 Gm. of ginger, 120 Gm. of caraway fruit, and 10 Gm. of tragacanth, all in powder
Scammoniæ Compositus (Br. 1914)	Mix 50 Gm. of resin of scammony, 35 Gm. of jalap, 15 Gm. of ginger, all in powder
Tragacanthæ Compositus (Br. 1914)	Mix 15 Gm. of tragacanth, 20 Gm. of acacia, 20 Gm. of starch, and 45 Gm. of sugar, all in powder

Oleosaccharæ—*Oil Sugars*

This class of preparations for which the N. F. gives a general formula, is offered as a convenient mode for the administration of medicines to children. They are sometimes called *Elæosacchara*. *Saccharures* are preparations made by saturating sucrose with a tincture, drying, and then reducing the mixture to a fine powder.

OLEOSACCHARA. N.F. Oil Sugars

[Elæosacchara]

	Metric	Alternative
The Prescribed Volatile Oil	**2 cc.**	32 min.
Sucrose, in fine powder	**100 Gm.**	3 oz. av. 231 gr.

Triturate the sucrose with the volatile oil until a homogeneous mixture is obtained.

Triturationes—*Triturations*

Only the general formula for triturations is now recognized by the Pharmacopœia. Triturates, however, are frequently prepared by the pharmacist for use at the prescription counter. Such poisonous substances as strychnine sulphate, arsenic, mercury bichloride, atropine, etc., in 10 per cent dilution are much more accurately dispensed by using this plan, ten times the quantity prescribed being weighed. Manufacturing pharmacists are now preparing such triturates in tablet form for use at the prescription counter.

TRITURATIONES. U.S. Triturations

Unless otherwise directed, Triturations are to be prepared according to the following formula:

	Metric	Alternative
The Substance	**10 Gm.**	6 gr.
Lactose, in moderately fine powder	**90 Gm.**	54 gr.
To make	**100 Gm.**	60 gr.

Weigh the medicinal substance and the lactose separately; then place the substance previously reduced, if necessary, to a moderately fine powder, in a mortar. Add about an equal measure of lactose, mix well by means of a spatula, and triturate the powders thoroughly together. Then add fresh portions of the lactose, from time to time, until the whole is added, and continue the trituration after each addition until the substance is intimately mixed with the lactose and reduced to a fine powder.

Species—*Species*

This is a class of preparations, usually consisting of dried herbs, and intended for the making of medicinal teas or poultices. Similar teas, from home-grown herbs, are common household remedies. Three species are recognized in the National Formulary, as follows:

SPECIES EMOLLIENTES. N.F. Emollient Species

[Spec. Emoll.—Emollient Cataplasm]

	Metric	Alternative
Althea Leaves	**20 Gm.**	350 gr.
Mallow Leaves	**20 Gm.**	350 gr.
Melilot	**20 Gm.**	350 gr.
Matricaria	**20 Gm.**	350 gr.
Linseed	**20 Gm.**	350 gr.
To make	**100 Gm.**	4 oz. av.

Reduce the drugs to a coarse powder, and mix them uniformly.

Note—To prepare an *Emollient Poultice,* add a suitable quantity of hot water to this powder.

SPECIES LAXATIVÆ. N. F. Laxative Species

[**Spec. Lax.**—SPECIES LAXANTES, ST. GERMAIN TEA]

	Metric	Alternative
Senna, cut	40.0 Gm.	1 oz. av. 263 gr.
Sambucus	25.0 Gm.	1 oz. av.
Fennel, bruised	12.5 Gm.	219 gr.
Anise, bruised	12.5 Gm.	219 gr.
Potassium Bitartrate, in fine powder	10.0 Gm.	175 gr.
To make	100 Gm.	4 oz. av.

Moisten the senna with a small quantity of water; then sprinkle the potassium bitartrate over it as uniformly as possible. When the senna so treated has become dry, mix it lightly and uniformly with the other ingredients.

Uses—A laxative tea.

Average dose—20 grains (1.3 Gm.).

SPECIES PECTORALES. N. F. Pectoral Species

[**Spec. Pect.**—SPECIES AD INFUSUM PECTORALE, BREAST TEA]

	Metric	Alternative
Althea	40 Gm.	1 oz. av. 263 gr.
Coltsfoot	20 Gm.	350 gr.
Glycyrrhiza, peeled	15 Gm.	263 gr.
Anise	10 Gm.	175 gr.
Mullein Flowers	10 Gm.	175 gr.
Orris	5 Gm.	88 gr.
To make	100 Gm.	4 oz. av.

Cut, bruise, and intimately mix the ingredients.

Uses—Employed in the form of a tea for a catarrhal condition of the respiratory tract.

Average dose—1 drachm (4 Gm.).

Dentifricia—*Dentifrices*

Under this title many preparations are popularly sold for the cleansing of the teeth. They may take the form of powders, pastes, washes, or medicated soaps and are applied with a tooth brush. They are usually flavored with aromatic oils, frequently contain soap, and almost always some form of chalk. Typical formulas for a tooth powder and for a tooth wash (see page 339) are official in the N. F. Many unofficial formulas will be found in general formularies.

DENTIFRICIUM. N. F. Dentifrice

[**Dentif.**—TOOTH POWDER, OXIDIZING TOOTH POWDER]

	Metric	Alternative
Sodium Perborate	50.00 Gm.	1 oz. av. 334 gr.
Soap, in fine powder	50.00 Gm.	1 oz. av. 334 gr.
Sucrose, in fine powder	100.00 Gm.	3 oz. av. 231 gr.
Prepared Chalk	400.00 Gm.	14 oz. av. 48 gr.
Precipitated Calcium Carbonate	400.00 Gm.	14 oz. av. 48 gr.
Oil of Clove	0.50 cc.	8 min.
Oil of Cinnamon	1.75 cc.	28 min.
Menthol	1.75 Gm.	27 gr.
Methyl Salicylate	8.75 cc.	140 min.
Fluidextract of Baptisia	8.75 cc.	140 min.
To make about	1000 Gm.	35 oz. av. 120 gr.

Dissolve the menthol in the methyl salicylate, mix this solution with the oil of clove and oil of cinnamon, add this mixture and the fluidextract of baptisia to the sucrose, and

triturate until thoroughly mixed. Then add the soap and sodium perborate, mix well, and add the prepared chalk and precipitated calcium carbonate. Mix all together thoroughly.

Preserve the Powder in well-stoppered bottles or containers.

Other Flavors: Other flavors may be used in the preceding if preferred. The following combinations are suggested as suitable, but these may be varied as desired.

Flavor No. 1—	**Oil of Cinnamon**	**1.6 cc.**
	Oil of Clove	**0.4 cc.**
	Methyl Salicylate	**8.0 cc.**
Flavor No. 2—	**Oil of Spearmint**	**0.8 cc.**
	Menthol	**0.7 cc.**
	Methyl Salicylate	**8.0 cc.**
Flavor No. 3—	**Oil of Peppermint**	**2.0 cc.**
	Oil of Cinnamon	**1.6 cc.**
	Methyl Salicylate	**6.4 cc.**
Flavor No. 4—	**Oil of Cinnamon**	**2.0 cc.**
	Oil of Peppermint	**2.0 cc.**
	Oil of Clove	**4.0 cc.**

Massæ—*Masses*

Pill masses are official in the U. S. Pharmacopœia under the title of "Massa". As the official preparations are usually kept in bulk by pharmacists, and are permanent preparations, there is a manifest propriety in making a distinct class of them. Masses represent the preliminary treatment of materials for the making of pills, and their characteristics and method of manufacture are discussed under pills, Part XI. There are *two* official masses.

MASSA FERRI CARBONATIS. U. S. Mass of Ferrous Carbonate

[**Mass. Ferr. Carb.**—VALLET'S MASS]

Mass of Ferrous Carbonate contains not less than 35 per cent of $FeCO_3$ (115.85).

	Metric	Alternative
Ferrous Sulphate	**100 Gm.**	8 oz. av.
Monohydrated Sodium Carbonate	**46 Gm.**	3 oz. av. 298 gr.
Honey	**38 Gm.**	3 oz. av.
Sucrose, in coarse powder	**25 Gm.**	2 oz. av.
Syrup,		
Distilled Water, each, a sufficient quantity,		
To make	**100 Gm.**	8 oz. av.

Dissolve the ferrous sulphate and monohydrated sodium carbonate, each, separately, in 200 cc. [1 pint] of boiling distilled water, and, having added 20 cc. [1½ fl. oz.] of syrup to the solution of the iron salt, filter both solutions, and cool. Place the solution of sodium carbonate in a bottle having a capacity of about 500 cc. [3 pints] and gradually add the solution of the iron salt, rotating the bottle frequently, until carbon dioxide no longer escapes. Add sufficient distilled water to fill the bottle, stopper tightly, and set it aside so that the ferrous carbonate may subside. Pour off the supernatant liquid, and, having mixed syrup and distilled water in the proportion of 1 volume of syrup to 19 volumes of distilled water, wash the precipitate with the mixture by decantation until the washings no longer have a saline taste. Drain the precipitate on a muslin strainer, and express as much of the water as possible. Then mix the precipitate at once with the honey and sucrose in a tared dish, and by means of a water bath evaporate the mixture with constant stirring until it is reduced to 100 Gm. [8 oz. av.].

The tests, assay, and uses will be found on page 713.

MASSA HYDRARGYRI. U.S. Mass of Mercury

[Mass. Hydrarg.—Blue Mass, Blue Pill]

Mass of Mercury contains not less than 32 per cent and not more than 34 per cent of Hg (200.6).

	Metric	Alternative
Mercury	**33 Gm.**	5 oz. av. 122 gr.
Oleate of Mercury	**1 Gm.**	70 gr.
Glycyrrhiza, in very fine powder	**10 Gm.**	1 oz. av. 263 gr.
Althea, in very fine powder	**15 Gm.**	2 oz. av. 175 gr.
Glycerin	**9 Gm.**	1 oz. av. 193 gr.
Honey of Rose	**32 Gm.**	5 oz. av. 53 gr.
To make	**100 Gm.**	16 oz. av.

Triturate the oleate of mercury in a warm mortar, gradually add the mercury, then introduce a small amount of honey of rose, and triturate the mixture until globules of mercury are no longer visible under a lens magnifying ten diameters. Incorporate the remainder of the honey of rose and the glycerin, gradually add the glycyrrhiza and althea, and continue the trituration until the mass is homogeneous.

The tests, assay, and uses will be found on page 749.

MASSA COPAIBÆ. N.F. Mass of Copaiba

[Mass. Copaib.—Solidified Copaiba]

	Metric	Alternative
Copaiba	**94 Gm.**	3 oz. av. 332½ gr.
Magnesium Oxide	**6 Gm.**	105 gr.
To make about	**100 Gm.**	4 oz. av.

Triturate the magnesium oxide with a little water, in a dish until the powder is uniformly dampened throughout. Then gradually incorporate the copaiba with it so that a uniform mixture results, place the dish on a water bath and heat during half an hour, frequently stirring. Lastly, transfer the mixture to a suitable vessel, and set it aside until the mass has acquired a pilular consistence.

To prepare this mass a special Copaiba, high in resin content, is preferable. In ordering, specify that it is for "making the mass", if desired for this purpose.

Uses—Similar to copaiba; see page 997, dose, fifteen grains (1 Gm.).

Confectiones—*Confections*

Confections are saccharine, soft solids, in which one or more medicinal substances are incorporated with the object of providing an agreeable form for their administration, and a convenient method for their preservation. Under the old names of *conserves* and *electuaries*, these preparations have been in use for centuries. In the preparation of confections the basis is finely powdered sugar, and the medicinal ingredients must be brought to the condition of a smooth paste or introduced as a fine powder or liquid. Two confections are official in the N. F. Similar preparations, intended for administration by licking from a spoon or by sipping and swallowing slowly to form a protecting or remedial coating to the throat and bronchial region, are known as *linctuses* or *lohochs*.

CONFECTIO ROSÆ. N. F. Confection of Rose

[Confect. Ros.]

	Metric	Alternative
Rose, in fine powder	**80 Gm.**	2 oz. av. 245 gr.
Sucrose, in fine powder	**640 Gm.**	20 oz. av. 210 gr.
Honey	**120 Gm.**	3 oz. av. 367 gr.
Stronger Rose Water	**160 cc.**	5 fl. oz. 52 min.
To make about	**1000 Gm.**	32 oz. av.

Rub the rose with the stronger rose water, previously heated to 65° C., gradually add the sucrose and honey, and knead the mixture until a uniform mass is obtained.

Uses—An excipient for pills.

CONFECTIO SENNÆ. N. F. Confection of Senna

[Confect. Senn.]

	Metric	Alternative
Senna, in fine powder	**100 Gm.**	3 oz. av. 87½ gr.
Cassia Fistula, bruised	**160 Gm.**	5 oz. av. 52 gr.
Tamarind	**100 Gm.**	3 oz. av. 87½ gr.
Prune, sliced	**70 Gm.**	2 oz. av. 105 gr.
Fig, bruised	**120 Gm.**	3 oz. av. 368 gr.
Sucrose, in fine powder	**555 Gm.**	17 oz. av. 333 gr.
Oil of Coriander	**5 Gm.**	70 gr.
Water, a sufficient quantity,		
To make	**1000 Gm.**	32 oz. av.

Digest the cassia fistula, tamarind, prune and fig with 500 cc. [1 pint] of water in a covered vessel, on a water bath, for three hours. Rub the pulpy mass, first through a coarse sieve and then through a muslin cloth. Mix the residue with 150 cc. [4 fl. oz. 384 min.] of water, digest the mixture for a short time, then treat it as before, and add the strained product to the pulpy mass first obtained. Then, by means of a water bath, dissolve the sucrose in the mixture, and evaporate it, in a tared vessel, until it weighs 895 Gm. [29 oz. av. 384 gr.]. Lastly, add the senna and the oil of coriander, and incorporate them thoroughly with the other ingredients while they are yet warm.

History—This preparation was recognized in the first edition of the London Pharmacopœia in 1618, and at that time contained a number of additional ingredients. The formula has changed many times in the intervening centuries.

Uses—A laxative.

Average dose—60 grains (4 Gm.).

Unofficial Confections

Title	*Directions*
Confectio Guaiaci Composita (B. P. C.)	Mix 1 Gm. of guaiac resin, 2 Gm. of rhubarb powdered, 7.5 Gm. of acid potassium tartrate, 1 Gm. of powdered nutmeg, 14.5 Gm. of sublimed sulphur, and 74 Gm. of purified honey, and form a mass
Piperis, Br.	Mix 100 Gm. of black pepper, 150 Gm. of caraway fruit, and 750 Gm. of purified honey, and form into a mass
Sulphuris, Br.	Mix 450 Gm. of precipitated sulphur, 110 Gm. of acid potassium tartrate, 5 Gm. of tragacanth, 210 cc. of syrup, 55 cc. of tincture of orange and 170 cc. of glycerin, and form into a mass

Pilulæ—*Pills*

Pill making was one of the "arts" of the old-time pharmacist but, as an extemporaneous process at the prescription counter, it is today greatly reduced in importance. Pills manufactured on the large scale by machines and the modern compressed tablets have largely replaced freshly made pills as a form of medication. The general methods of manufacture and a discussion of pill making at the prescription counter will be found in Part XI. The formulas of the U. S. P. and N. F. are largely introduced for the purpose of establishing standards of strength for many well-known pills.

PILULÆ ALOES. U.S. Pills of Aloe

[Pil. Aloes]

	Metric	Alternative
Aloe, in fine powder	13 Gm.	201 gr.
Soap, in fine powder	13 Gm.	201 gr.
Water, a sufficient quantity,		
To make	100 Pills	100 Pills

Mix the powders intimately, then incorporate sufficient water to form a mass, and divide it into 100 pills.

Average dose—2 pills.

PILULÆ ASAFŒTIDÆ. U.S. Pills of Asafetida

[Pil. Asafœt.]

	Metric	Alternative
Asafetida	20 Gm.	309 gr.
Soap, in fine powder	6 Gm.	93 gr.
Water, a sufficient quantity,		
To make	100 Pills	100 Pills

Intimately incorporate the solids, using sufficient water to form a mass, and divide it into 100 pills.

Average dose—2 pills.

PILULÆ FERRI CARBONATIS. U.S. Pills of Ferrous Carbonate

[Pil. Ferr. Carb.—Chalybeate Pills, Blaud's Pills, Ferruginous Pills]

Each Pill contains not less than 0.06 Gm. of $FeCO_3$.

	Metric	Alternative
Granulated Ferrous Sulphate	16 Gm.	247 gr.
Potassium Carbonate	8 Gm.	124 gr.
Sucrose	4 Gm.	62 gr.
Tragacanth, in fine powder	1 Gm.	15 gr.
Althea, in fine powder	1 Gm.	15 gr.
Glycerin,		
Water, each, a sufficient quantity,		
To make	100 Pills	100 Pills

Triturate the potassium carbonate in a mortar with a sufficient quantity (about 5 drops each) of glycerin and water, then add the ferrous sulphate and sucrose, previously triturated together to a uniform, fine powder, and mix the mass thoroughly until it assumes a greenish color. When the reaction is complete, incorporate the tragacanth and althea, and add more water, if necessary, to obtain a mass of pilular consistence. Divide into 100 pills.

Assay—Dissolve three Pills in 15 cc. of diluted sulphuric acid and dilute the solution with distilled water to about 100 cc. Immediately titrate with tenth-normal potassium dichromate, potassium ferricyanide T.S. being used as indicator. Each cc. of tenth-normal potassium dichromate corresponds to 0.01159 Gm. of $FeCO_3$.

This assay is explained on page 1472.

Preserve in tightly-closed containers.

History—These pills were introduced in 1831 by Dr. J. Blaud, a French practitioner of medicine, as a remedy for chlorosis. Various excipients have been used in order to increase the stability of these pills which should not be dispensed if they are reddish brown in color within. When properly made and protected they are very stable.

Average dose—2 pills.

PILULÆ HYDRARGYRI CHLORIDI MITIS COMPOSITÆ. U.S. Compound Pills of Mild Mercurous Chloride

[Pil. Hydrarg. Chlor. Mit. Co.—Pilulæ Catharticæ Compositæ U.S.P. IX, Compound Cathartic Pills, Compound Pills of Calomel]

	Metric	Alternative
Compound Extract of Colocynth	80 Gm.	2 oz. av. 230 gr.
Mild Mercurous Chloride	60 Gm.	2 oz. av. 51 gr.
Resin of Jalap, in fine powder	20 Gm.	309 gr.
Gamboge, in fine powder	15 Gm.	231 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Pills	1000 Pills

Mix the powders intimately, then incorporate a sufficient quantity of diluted alcohol to form a mass, and divide it into 1000 pills.

Average dose—2 pills.

PILULÆ PHOSPHORI. U.S. Pills of Phosphorus

[Pil. Phosphor.]

	Metric	Alternative
Phosphorus	0.06 Gm.	1 gr.
Althea, in fine powder	6.00 Gm.	93 gr.
Acacia, in fine powder	3.00 Gm.	46 gr.
Chloroform,		
Glycerin,		
Water,		
Tolu,		
Ether, each, a sufficient quantity,		
To make	100 Pills	100 Pills

Dissolve the phosphorus in a test tube in 5 cc. [81 min.] of chloroform, with the aid of a very gentle heat, replacing from time to time any of the chloroform which may be lost by evaporation. Mix the althea and acacia in a mortar, next add the solution of phosphorus, then immediately afterwards a sufficient quantity (about 4 cc. [65 min.]) of a mixture of 2 volumes of glycerin and 1 volume of water, and quickly form a mass. Divide it into 100 pills.

Dissolve 10 Gm. [154 gr.] of tolu in 15 cc. [243 min.] of ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated and put them on a plate to dry, occasionally rolling them about until the drying is completed.

Preserve in a well-stoppered bottle.

Average dose—1 pill.

PILULÆ ALOES ET ASAFŒTIDÆ. N.F. Pills of Aloe and Asafetida

[Pil. Aloe. et Asafœt.]

	Metric	Alternative
Aloe, in fine powder	9 Gm.	139 gr.
Asafetida	9 Gm.	139 gr.
Soap	9 Gm.	139 gr.
Water, a sufficient quantity,		
To make	100 Pills	100 Pills

Mix the ingredients intimately, form a mass and divide it into 100 pills.

Average dose—1 pill.

PILULÆ ALOES ET FERRI. N. F. Pills of Aloe and Iron

[Pil. Aloe. et Ferr.]

	Metric	Alternative
Aloe, in fine powder	7 Gm.	108 gr.
Exsiccated Ferrous Sulphate	7 Gm.	108 gr.
Aromatic Powder	7 Gm.	108 gr.
Confection of Rose, a sufficient quantity,		
To make	**100 Pills**	100 Pills

Mix the powders intimately, then incorporate sufficient confection of rose to form a mass and divide it into 100 pills.

History—These pills are in close resemblance in composition to the celebrated Hooper's Pills which attained fame as a patent medicine more than a century ago.

Average dose—2 pills.

PILULÆ ALOES ET MASTICHES. N. F. Pills of Aloe and Mastic

[Pil. Aloe. et Mastich.—Lady Webster Dinner Pill]

	Metric	Alternative
Aloe, in fine powder	13 Gm.	201 gr.
Mastic, in fine powder	4 Gm.	62 gr.
Rose, in fine powder	3 Gm.	46 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**100 Pills**	100 Pills

Mix the powders intimately, then incorporate sufficient diluted alcohol to form a mass, and divide it into 100 pills.

History—Lady Webster's Dinner Pills were first official in the 1758 edition of the Paris Pharmacopœia, under the name *Pilulæ Stomachicæ* or *Pilulæ ante cibum.*

Average dose—2 pills.

PILULÆ ALOES ET MYRRHÆ. N. F. Pills of Aloe and Myrrh

[Pil. Aloe. et Myrrh.]

	Metric	Alternative
Aloe, in fine powder	13 Gm.	201 gr.
Myrrh, in fine powder	6 Gm.	93 gr.
Aromatic Powder	4 Gm.	62 gr.
Syrup, a sufficient quantity,		
To make	**100 Pills**	100 Pills

Mix the powders intimately, then incorporate sufficient syrup to form a mass and divide it into 100 pills.

History—These were originally known as *Pilulæ Rufi,* a pilular form of a Hiera invented by Rufus of Ephesus who lived in the second century A. D. Avicenna, an Arabian physician and pharmacist of the eleventh century, called them *Pilulæ Pestilentiales,* and in the early Edinburgh Pharmacopœias they were called *Pilulæ Communes.*

Average dose—2 pills.

PILULÆ ALOES ET PODOPHYLLI COMPOSITÆ. N. F. Compound Pills of Aloe and Podophyllum

[Pil. Aloe. et Podoph. Co.—Janeway's Pills]

	Metric	Alternative
Aloe	6.50 Gm.	100 gr.
Resin of Podophyllum	3.25 Gm.	50 gr.
Pilular Extract of Belladonna	1.60 Gm.	24½ gr.
Extract of Nux Vomica	1.60 Gm.	24½ gr.
To make	**100 Pills**	100 Pills

Uniformly mix the several ingredients, form a mass and divide it into 100 pills.

Average dose—1 pill.

PILULÆ ALOES, HYDRARGYRI ET PODOPHYLLI. N. F. Pills of Aloe, Mercury and Podophyllum

[Pil. Aloe. Hydrarg. et Podoph.—Pilulæ Triplices, Triplex Pills, Pilula Triplex]

	Metric	Alternative
Aloe	13.0 Gm.	201 gr.
Mass of Mercury	6.5 Gm.	100 gr.
Resin of Podophyllum	1.6 Gm.	24½ gr.
To make	100 Pills	100 Pills

Uniformly mix the several ingredients, form a mass and divide it into 100 pills.

Average dose—1 pill.

PILULÆ ALOINI COMPOSITÆ. N. F. Compound Pills of Aloin

[Pil. Aloin. Co.]

	Metric	Alternative
Aloin	3.25 Gm.	50 gr.
Resin of Podophyllum	0.80 Gm.	12 gr.
Pilular Extract of Belladonna	1.60 Gm.	24½ gr.
To make	100 Pills	100 Pills

Uniformly mix the several ingredients, form a mass and divide it into 100 pills.

Average dose—1 pill.

PILULÆ ALOINI, STRYCHNINÆ ET BELLADONNÆ. N. F. Pills of Aloin, Strychnine and Belladonna

[Pil. A. S. et B.]

	Metric	Alternative
Aloin	1.30 Gm.	20 gr.
Strychnine	0.05 Gm.	¾ gr.
Pilular Extract of Belladonna	0.80 Gm.	12 gr.
To make	100 Pills	100 Pills

Uniformly mix the several ingredients, form a mass and divide it into 100 pills.

Average dose—1 pill.
One pill contains about:
0.0005 Gm. or $\frac{1}{125}$ grain of Strychnine.

PILULÆ ALOINI, STRYCHNINÆ ET BELLADONNÆ COMPOSITÆ. N. F. Compound Pills of Aloin, Strychnine and Belladonna

[Pil. A. S. et B. Co.]

	Metric	Alternative
Aloin	1.30 Gm.	20 gr.
Strychnine	0.05 Gm.	¾ gr.
Pilular Extract of Belladonna	0.80 Gm.	12 gr.
Extract of Cascara Sagrada	3.25 Gm.	50 gr.
To make	100 Pills	100 Pills

Uniformly mix the several ingredients, form a mass and divide it into 100 pills.

Average dose—1 pill.
One pill contains about:
0.0005 Gm. or $\frac{1}{125}$ grain of Strychnine.

PILULÆ ANTIPERIODICÆ. N. F. Antiperiodic Pills

[Pil. Antiperiod.—Warburg's Pills]

	Metric	Alternative
Aloe, in fine powder	13.0 Gm.	201 gr.
Rhubarb, in fine powder	3.2 Gm.	49 gr.
Angelica Fruit, in fine powder	3.2 Gm.	49 gr.
Inula, in fine powder	1.6 Gm.	24½ gr.
Saffron, in fine powder	1.6 Gm.	24½ gr.
Fennel, in fine powder	1.6 Gm.	24½ gr.
Zedoary, in fine powder	0.8 Gm.	12¼ gr.
Cubeb, in fine powder	0.8 Gm.	12¼ gr.
Myrrh, in fine powder	0.8 Gm.	12¼ gr.
Agaric, in fine powder	0.8 Gm.	12¼ gr.
Camphor, in fine powder	0.8 Gm.	12¼ gr.
Quinine Sulphate	9.0 Gm.	139 gr.
Extract of Gentian, a sufficient quantity,		
To make	100 Pills	100 Pills

Mix the powders and quinine sulphate uniformly, make into a mass with the extract of gentian and divide it into 100 pills.

Average dose—1 pill.

PILULÆ ANTIPERIODICÆ SINE ALOE. N. F. Antiperiodic Pills without Aloe

[Pil. Antiperiod. s. Aloe—Warburg's Pills without Aloe]

Prepare the Pills as directed under Pilulæ Antiperiodicæ, omitting the Aloe.

Average dose—1 pill.

PILULÆ CATHARTICÆ VEGETABILES. N. F. Vegetable Cathartic Pills

[Pil. Cathart. Veget.]

	Metric	Alternative
Compound Extract of Colocynth	6.0 Gm.	93 gr.
Extract of Hyoscyamus	3.0 Gm.	46 gr.
Resin of Jalap, in fine powder	2.0 Gm.	31 gr.
Extract of Leptandra	1.5 Gm.	23 gr.
Resin of Podophyllum	1.5 Gm.	23 gr.
Oil of Peppermint	0.8 cc.	13 min.
Diluted Alcohol, a sufficient quantity,		
To make	100 Pills	100 Pills

Mix the compound extract of colocynth intimately with the resin of podophyllum, resin of jalap and extract of leptandra, and then add the oil of peppermint and the extract of hyoscyamus, form a mass with sufficient diluted alcohol and divide into 100 pills.

Average dose—2 pills.

PILULÆ DIGITALIS, SCILLÆ ET HYDRARGYRI. N. F. Pills of Digitalis, Squill and Mercury

[Pil. Digit. Scill. et Hydrarg.—Niemeyer Pills for Dropsy, Guy's Pills]

	Metric	Alternative
Digitalis, in fine powder	6.5 Gm.	100 gr.
Squill, in fine powder	6.5 Gm.	100 gr.
Mass of Mercury	6.5 Gm.	100 gr.
Honey, a sufficient quantity,		
To make	100 Pills	100 Pills

Uniformly mix the solid ingredients, form a mass with the aid of the honey and divide it into 100 pills.

Average dose—1 pill.

PILULÆ FERRI IODIDI. N.F. Pills of Ferrous Iodide

(U.S.P. IX)

[Pil. Ferr. Iod.]

	Metric	Alternative
Reduced Iron	4 Gm.	62 gr.
Iodine	5 Gm.	77 gr.
Glycyrrhiza, in fine powder	4 Gm.	62 gr.
Sucrose, in fine powder	4 Gm.	62 gr.
Extract of Glycyrrhiza, in fine powder	1 Gm.	15 gr.
Acacia, in fine powder	1 Gm.	15 gr.
Water,		
Tolu,		
Ether, each, a sufficient quantity,		
To make	100 Pills	100 Pills

Add 6 cc. [97 min.] of water to the reduced iron, contained in a small mortar, and then gradually add the iodine, stirring constantly until the liquid ceases to have a reddish tint. Then add the remaining powders, previously well triturated together, and mix the whole thoroughly. Transfer the mass to a porcelain dish, evaporate the excess of moisture on a water bath, with constant stirring, and when the mass has acquired a pilular consistence, divide it into 100 pills.

Dissolve 10 Gm. [150 gr.] of tolu in 15 cc. [½ fl. oz.] of ether, and proceed as directed under Tolu coating (Part XI).

Preserve the pills in a well-stoppered bottle.

Triturate a few of the pills with water, and filter the liquid; the filtrate does not assume more than a light blue tint upon the addition of starch T.S. (absence of more than traces of *free iodine*).

Pills of Ferrous Iodide are free from odor of iodine.

Average dose—2 pills.

PILULÆ FERRI, QUININÆ, ALOES ET NUCIS VOMICÆ. N.F. Pills of Iron, Quinine, Aloe and Nux Vomica

[Pil. Ferr. Quin. Aloe. et Nuc. Vom.—PILULÆ QUADRUPLICES, QUADRUPLEX PILLS, PILULÆ FERRI ET QUININÆ COMPOSITÆ]

	Metric	Alternative
Exsiccated Ferrous Sulphate	6.5 Gm.	100 gr.
Quinine Sulphate	6.5 Gm.	100 gr.
Aloe	6.5 Gm.	100 gr.
Extract of Nux Vomica	1.6 Gm.	24½ gr.
Extract of Gentian, a sufficient quantity,		
To make	100 Pills	1000 Pills

Mix the extract of nux vomica with the aloe, thoroughly incorporate the ferrous sulphate and quinine sulphate, then form a mass with the extract of gentian and divide it into 100 pills.

Average dose—1 pill.

PILULÆ FERRI, QUININÆ, STRYCHNINÆ ET ARSENI FORTIORES. N.F. Stronger Pills of Iron, Quinine, Strychnine and Arsenic

[Pil. Fer. Quin. Strych. et Arsen. Fort.—PILULÆ METALLORUM, METALLIC PILLS, PILULÆ METALLORUM AMARÆ, BITTER METALLIC PILLS]

	Metric	Alternative
Reduced Iron	6.50 Gm.	100 gr.
Quinine Sulphate	6.50 Gm.	100 gr.
Strychnine	0.32 Gm.	4 9/10 gr.
Arsenic Trioxide	0.32 Gm.	4 9/10 gr.
Honey, a sufficient quantity,		
To make	100 Pills	100 Pills

Mix the ingredients intimately, form a mass and divide it into 100 pills.

Average dose—1 pill.

One pill contains about:

0.0032 Gm. or 1/20 grain of Strychnine.

0.0032 Gm. or 1/20 grain of Arsenic Trioxide.

PILULÆ FERRI, QUININÆ, STRYCHNINÆ ET ARSENI MITES. N.F. Mild Pills of Iron, Quinine, Strychnine and Arsenic

[Pil. Ferr. Quin. Strych. et Arsen. Mit.—AITKEN TONIC PILLS]

	Metric	Alternative
Reduced Iron	4.50 Gm.	69½ gr.
Quinine Sulphate	6.50 Gm.	100 gr.
Strychnine	0.13 Gm.	2 gr.
Arsenic Trioxide	0.13 Gm.	2 gr.
Honey, a sufficient quantity, To make	100 Pills	100 Pills

Mix the ingredients intimately, form a mass and divide it into 100 pills.

Average dose—1 pill.

One pill contains about:

0.0013 Gm. or 1/50 grain of Strychnine.

0.0013 Gm. or 1/50 grain of Arsenic Trioxide.

PILULÆ LAXATIVÆ COMPOSITÆ. N.F. Compound Laxative Pills

[Pil. Lax. Co.]

	Metric	Alternative
Aloin	1.30 Gm.	20 gr.
Strychnine	0.05 Gm.	¾ gr.
Pilular Extract of Belladonna	0.80 Gm.	12 gr.
Ipecac, in fine powder	0.40 Gm.	6 gr
Glycyrrhiza, in fine powder	4.60 Gm.	71 gr.
Syrup, a sufficient quantity, To make	100 Pills	100 Pills

Triturate the aloin, strychnine, ipecac, and glycyrrhiza together thoroughly, so as to produce a uniform powder. Incorporate with this the extract of belladonna leaves and sufficient syrup to form a mass and divide it into 100 pills.

Average dose—2 pills.

One pill contains about:

0.0005 Gm. or 1/125 grain of Strychnine.

PILULÆ OPII, DIGITALIS ET QUININÆ. N.F. Pills of Opium, Digitalis and Quinine

[Pil. Opii, Digit. et Quin.—NIEMEYER'S PILLS FOR PHTHISIS]

	Metric	Alternative
Powdered Opium	1.0 Gm.	15 gr.
Digitalis, in fine powder	6.5 Gm.	100 gr.
Quinine Sulphate	6.5 Gm.	100 gr.
Honey, a sufficient quantity, To make	100 Pills	100 Pills

Mix the ingredients intimately, form a mass and divide it into 100 pills.

Average dose—1 pill.

One pill contains about:

0.010 Gm. or ⅙ grain of Powdered Opium.

PILULÆ OPII ET CAMPHORÆ. N.F. Pills of Opium and Camphor

[Pil. Opii et Camph.]

	Metric	Alternative
Powdered Opium	6.5 Gm.	100 gr.
Camphor	13.0 Gm.	200 gr.
Honey, a sufficient quantity, To make	100 Pills	100 Pills

Mix the ingredients intimately, form a mass and divide it into 100 pills.

Average dose—1 pill.

One pill contains about:

0.065 Gm. or 1 grain of Powdered Opium.

PILULÆ OPII ET PLUMBI. N. F. Pills of Opium and Lead

[Pil. Opii et Plumb.]

	Metric	Alternative
Powdered Opium	6.5 Gm.	100 gr.
Lead Acetate	6.5 Gm.	100 gr.
Honey, a sufficient quantity,		
To make	100 Pills	100 Pills

Mix the ingredients intimately, form a mass and divide it into 100 pills.

Average dose—1 pill.

One pill contains about: 0.065 Gm. or 1 grain of Powdered Opium.

PILULÆ RHEI. N. F. Pills of Rhubarb

[Pil. Rhei.]

	Metric	Alternative
Rhubarb, in very fine powder	20 Gm.	309 gr.
Soap, in fine powder	6 Gm.	93 gr.
Water, a sufficient quantity,		
To make	100 Pills	100 Pills

Form a mass and divide it into 100 pills. *Average dose*—1 pill.

PILULÆ RHEI COMPOSITÆ. N. F. Compound Pills of Rhubarb

(U. S. P. IX)

[Pil. Rhei Co.]

	Metric	Alternative
Rhubarb, in fine powder	13.0 Gm.	200 gr.
Aloe, in fine powder	10.0 Gm.	154 gr.
Myrrh, in fine powder	6.0 Gm.	93 gr.
Oil of Peppermint	0.5 cc.	8 min.
Water, a sufficient quantity,		
To make	100 Pills	100 Pills

Mix the oil of peppermint intimately with the powders, then incorporate sufficient water to form a mass; divide it into 100 pills. *Average dose*—2 pills.

Some Unofficial Pills

Pilulæ Ad Prandium (N. F. IV) (Chapman's Dinner Pills)	Prepare a mass from 9.7 Gm. aloe, 9.7 Gm. mastic, 6.5 Gm. ipecac, and 1.5 cc. of fennel; divide into 100 pills
Ad Prandium (Coles's Dinner Pills)	Prepare a mass from 7.8 Gm. aloe, 7.8 Gm. mass of mercury, 7.8 Gm. jalap and 0.13 Gm. antimony and potassium tartrate; divide into 100 pills
Ad Prandium (Hall's Dinner Pills)	Prepare a mass from 6.5 Gm. aloe, 6.5 Gm. extract of glycyrrhiza, and 6.5 Gm. soap; divide into 100 pills
Aloes, Hydrargyri et Scammonii Compositæ (N. F. IV)	Prepare a mass, with the aid of tincture of aloe and myrrh, from 5.5 Gm. aloe, 5.5 Gm. resin of scammony, 5.5 Gm. mass of mercury, 0.32 Gm. croton oil, and 1.6 cc. oil of caraway; divide into 100 pills
Antidyspepticæ (N. F. IV)	Prepare a mass from 0.16 Gm. strychnine, 0.65 Gm. ipecac, 0.65 Gm. extract of belladonna leaves, 13 Gm. mass of mercury, and 13 Gm. compound extract of colocynth; divide into 100 pills
Antimonii Compositæ (N. F. IV)	Prepare a mass, with the aid of castor oil from 4 Gm. of sulphurated antimony, 4 Gm. mild mercurous chloride, and 8 Gm. guaiac; divide into 100 pills
Colocynthidis Compositæ (N. F. IV)	Prepare a mass with the aid of diluted alcohol, from 1.1 Gm. extract of colocynth, 13 Gm. aloe, 13 Gm. resin of scammony, and 1.5 cc. oil of clove; divide into 100 pills
Colocynthidis et Hyoscyami (N. F. IV)	Prepare a mass from 0.65 Gm. extract of colocynth, 9.7 Gm. aloe, 9.7 Gm. resin of scammony, 9.7 Gm. extract of hyoscyamus, and 1 cc. oil of clove; divide into 100 pills
Colocynthidis et Podophylli (N. F. IV)	Prepare a mass from 16.2 Gm. compound extract of colocynth, and 1.6 Gm. resin of podophyllum; divide into 100 pills
Glycerylis Nitratis (N. F. IV)	Mix 6.5 Gm. spirit of glyceryl trinitrate with 6.5 Gm. althea, expose to the air to evaporate the alcohol, mass with confection of rose and divide into 100 pills
Pilulæ Ipecacuanhæ cum Scillæ (Br. 1914)	Prepare a mass from 30 Gm. compound powder of ipecac, 10 Gm. squill, 10 Gm. ammoniac, with the aid of syrup of glucose Dose: 4 to 8 grains (0.25 to 0.50 Gm.)
Ipecacuanhæ cum Urgineæ (Br. 1914)	Prepare a mass from 30 Gm. compound powder of ipecac, 10 Gm. urginea and 10 Gm. ammoniac, with the aid of syrup of glucose Dose: 4 to 8 grains (0.25 to 0.50 Gm.)
Laxativæ Post Partum (N. F. IV)	Prepare a mass from 11 Gm. compound extract of colocynth, 5.5 Gm. aloe, 2.5 Gm. extract of nux vomica, 0.5 Gm. resin of podophyllum, 0.5 Gm. ipecac, and 8 Gm. extract of hyoscyamus; divide into 100 pills
Quininæ Sulphatis (Br. 1914)	Prepare a mass from 82 Gm. of quinine sulphate, 3 Gm. of tartaric acid, 12 Gm. glycerin, and 3 Gm. tragacanth Dose: 2 to 8 grains (0.125 to 0.50 Gm.)

Some Unofficial Pills—*Continued*

Saponis Compositæ (Br. 1914)	Prepare a mass from 20 Gm. opium, 60 Gm. hard soap, and 20 Gm. syrup of glucose Dose: 2 to 4 grains (0.125 to 0.25 Gm.)
Scillæ Compositæ (Br. 1914)	Prepare a mass from 20 Gm. each of ginger and ammoniac, 15 Gm. hard soap, and 20 Gm. syrup of glucose Dose: 4 to 8 grains (0.25 to 0.50 Gm.)
Urgineæ Compositæ (Br. 1914)	Prepare a mass from 25 Gm. urginea, 20 Gm. ginger, 15 Gm. hard soap, and 20 Gm. syrup of glucose Dose: 4 to 8 grains (0.25 to 0.50 Gm.)

Trochisci—*Troches*

Troches or *lozenges* are forms of medication suitable for dissolving in the mouth, usually for the medication of the throat and bronchial area. Their manufacture and extemporaneous preparation are discussed in Part XI. Formulas are given here.

TROCHISCI ACIDI TANNICI. U.S. Troches of Tannic Acid
[Troch. Acid. Tann.]

	Metric	Alternative
Tannic Acid	6 Gm.	93 gr.
Sucrose, in fine powder	65 Gm.	2 oz. av. 128 gr.
Tragacanth, in fine powder	2 Gm.	31 gr.
Orange Flower Water, a sufficient quantity, To make	100 Troches	100 Troches

Triturate the powders until they are thoroughly mixed, form a mass with orange flower water, and divide it into 100 troches.

TROCHISCI AMMONII CHLORIDI. U.S. Troches of Ammonium Chloride
[Troch. Ammon. Chlor.]

	Metric	Alternative
Ammonium Chloride, in fine powder	10 Gm.	154 gr.
Extract of Glycyrrhiza, in fine powder	20 Gm.	309 gr.
Tragacanth, in fine powder	2 Gm.	31 gr.
Sucrose, in fine powder	40 Gm.	1 oz. av. 180 gr.
Syrup of Tolu, a sufficient quantity, To make	100 Troches	100 Troches

Triturate the powders until they are thoroughly mixed; form a mass with syrup of tolu, and divide it into 100 troches.

TROCHISCI EUCALYPTI GUMMI. N.F. Troches of Eucalyptus Gum
[Troch. Eucalypt. Gum.—Troches of Red Gum]

	Metric	Alternative
Eucalyptus Gum, in fine powder	6.0 Gm.	93 gr.
Tragacanth, in fine powder	6.0 Gm.	93 gr.
Acacia, in fine powder	12.0 Gm.	185 gr.
Sucrose, in fine powder	40.0 Gm.	1 oz. av. 180 gr.
Oil of Orange	0.3 cc.	5 min.
Fluidextract of Rose	3.0 cc.	49 min.
Water, a sufficient quantity, To make	100 Troches	100 Troches

Triturate the powders together until well mixed, then incorporate the oil and fluidextract and form a mass with water. Divide this into 100 troches and dry them in a current of warm air.

TROCHISCI ULMI. N.F. Troches of Elm
[Troch. Ulmi]

	Metric	Alternative
Elm, in very fine powder	20.0 Gm.	309 gr.
Tragacanth, in fine powder	1.0 Gm.	15 gr.
Sucrose, in fine powder	79.0 Gm.	2 oz. av. 344 gr.
Methyl Salicylate	0.2 cc.	3 min.
Water, a sufficient quantity, To make	100 Troches	100 Troches

Triturate the powders together until uniformly mixed, then incorporate the methyl salicylate and form a mass with water. Divide this into 100 troches and dry them in a current of warm air. *Average dose*—1 troche.

Some Unofficial Troches

Trochisci Acidi Benzoici (Br. 1914)	Mix 0.03 Gm. benzoic acid with fruit basis[4] to form a lozenge
Acidi Carbolici (Br. 1914)	Mix 15 Gm. phenol, 500 Gm. sugar, 45 Gm. acacia, 15 Gm. tragacanth, and 45 cc. lemon juice; make into 500 troches and dry
Antacidi (B. P. C.)	Mix 22.68 Gm. precipitated calcium carbonate, 16.2 Gm. magnesium carbonate, 6.48 Gm. sodium chloride, with simple basis[1] to form a mass; divide into 100 troches
Bismuthi Compositi (Br. 1914)	Mix 0.15 Gm. each of bismuth oxycarbonate and heavy magnesium carbonate, and 0.30 Gm. of precipitated calcium carbonate with rose basis[3] to form a troche
Carbonis Ligni (N. F. IV)	Prepare a mass from 30 Gm. wood charcoal, 4 Gm. tragacanth, 66 Gm. powdered sugar, 0.3 Gm. vanillin, and divide into 100 troches
Catechu (Br. 1914)	Mix 0.06 Gm. catechu with fruit basis[4] to form a troche
Cubebæ (U. S. P. IX)	Prepare a mass with the aid of syrup of tolu from 25 Gm. extract of glycyrrhiza, and 12 Gm. of acacia with which 2 Gm. of oleoresin of cubeb and 1 cc. of oil of sassafras have been thoroughly incorporated; divide it into 100 troches
Ferri Redacti (Br. 1914)	Mix 0.06 Gm. reduced iron with simple basis[1] to form a troche
Gambir (N. F. IV)	Prepare a mass from 6 Gm. gambir, 91 Gm. sugar, 0.3 Gm. tragacanth, and 0.2 cc. oil of cinnamon; divide it into 100 troches
Guaiaci Resinæ (Br. 1914)	Mix 0.2 Gm. guaiacum resin with fruit basis[4] to form a troche
Kino Eucalypti (Br. 1914)	Mix 0.06 Gm. of eucalyptus kino with fruit basis[4] to form a troche
Krameriæ (Br. 1914)	Mix 0.06 Gm. of extract of krameria with fruit basis[4] to form a troche
Krameriæ et Cocainæ (Br. 1914)	Mix 0.06 Gm. of extract of krameria and 0.003 Gm. of cocaine hydrochloride with fruit basis[4] to form a troche
Menthæ Piperitæ (N. F. IV)	Prepare a mass with the aid of mucilage of tragacanth from 1 cc. of oil of peppermint and 100 Gm. of sugar; divide it into 100 troches
Mentholis Compositi (B. P. C.)	Mix 4.86 Gm. potassium chlorate, 1.62 Gm. menthol, and 0.16 Gm. benzamine (betaeucaine) hydrochloride with fruit basis[4]; divide into 100 troches
Morphinæ (Br. 1914)	Mix 0.002 Gm. morphine hydrochloride with tolu basis[2] to form a troche
Morphinæ et Ipecacuanhæ (Br. 1914)	Mix 0.002 Gm. morphine hydrochloride and 0.006 Gm. ipecac, with tolu basis[2] to form a troche
Phenolphthaleini (N. F. IV)	Prepare a mass from 6 Gm. phenolphthalein, 10 Gm. acacia, 84 Gm. sugar, 0.3 Gm. vanillin, and 0.1 Gm. carmine; divide it into 100 troches
Potassii Chloratis (U. S. P. IX)	Prepare a mass from 15 Gm. of potassium chlorate, 60 Gm. sugar, and 3 Gm. of tragacanth; divide it into 100 troches
Santonini (N. F. IV)	Prepare a mass from 3 Gm. of santonin, 54 Gm. sugar, 40 Gm. cocoa, 0.1 Gm. vanillin, and 3 Gm. tragancath; divide into 100 troches
Trochisci Santonini Compositi (N. F. IV)	Prepare a mass from 3 Gm. santonin, 3 Gm. mild mercurous chloride, 3 Gm. tragacanth, 51 Gm. sugar, 40 Gm. cocoa, and 0.1 Gm. vanillin; divide into 100 troches
Sodii Bicarbonatis (U. S. P. IX)	Prepare a mass with the aid of mucilage of tragacanth, from 18 Gm. sodium bicarbonate, 54 Gm. sugar, and 1 Gm. myristica; divide it into 100 troches
Sulphuris (Br. 1914)	Mix 150 Gm. precipitated sulphur, 30 Gm. acid potassium tartrate; 275 Gm. of sugar, and 30 Gm. of acacia. Thoroughly incorporate 30 cc. of tincture of orange and form a mass with the aid of mucilage of acacia and divide it into 500 troches
Sulphuris et Potassii Bitartratis (N. F. IV)	Prepare a mass from 30 Gm. washed sulphur, 6 Gm. of potassium bitartrate, 4 Gm. of tragacanth, 60 Gm. sugar, and 0.5 cc. oil of orange; divide into 100 troches

Tabellæ—*Tablets*

Tablets are small, disk-shaped forms of medication, either molded or compressed in a special machine. Their manufacture is discussed in Part XI. The following formulas are official in the U. S. P. and N. F.:

---

1. *Preparation of Lozenges with Simple Basis*—(Br. 1914)—Mix 500 times the quantity of drug ordered for one lozenge with 496 Gm. of powdered sugar and 19.5 Gm. of powdered gum acacia. Form a mass with the aid of 35 cc. of mucilage of acacia and sufficient distilled water, and divide it into 500 lozenges. Dry.

2. *Preparation of Lozenges with Tolu Basis*—(Br. 1914)—Take 500 times the quantity of drug ordered for one lozenge, dissolve alkaloids, if present, in 10 cc. of water, mixing the solution thoroughly with 482 Gm. of powdered sugar and 19.5 Gm. of powdered gum acacia, then incorporate any other ingredients ordered and 10 cc. of tincture of balsam of tolu, form into a mass with 35.5 cc. of mucilage of acacia and sufficient distilled water, and divide it into 500 lozenges. Dry them.

3. *Preparation of Lozenges with Rose Basis*—(Br. 1914)—Mix 500 times the quantity of drug ordered for one lozenge with 496 Gm. of powdered sugar and 19.5 Gm. of powdered gum acacia, form into a mass with the aid of 35 cc. of mucilage of acacia and 0.025 cc. of oil of rose, and divide into 500 lozenges. Dry.

4. *Preparation of Lozenges with Fruit Basis*—(Br. 1914)—Mix 500 times the quantity of drug ordered for one lozenge with 26 Gm. of powdered sugar and 6.5 Gm. of tragacanth, form into a mass with the aid of sufficient black-currant paste of commerce, to make 650 Gm., and divide into 500 lozenges. Dry them.

TOXITABELLÆ HYDRARGYRI CHLORIDI CORROSIVI U. S. Poison Tablets of Corrosive Mercuric Chloride

[Toxitabel. Hydrarg. Chlor. Corr.—Corrosive Sublimate Tablets, Bichloride Tablets]

Tablets of an angular shape, not discoid, each having the word "POISON" and the skull and cross bones design distinctly stamped upon it. Each tablet weighs about 1 Gm. and contains not less than 0.45 Gm. and not more than 0.55 Gm. of corrosive mercuric chloride ($HgCl_2$), the remainder consisting chiefly of either sodium chloride [NaCl] or ammonium chloride [NH_4Cl]. The tablets are to be colored blue, preferably with sodium indigotindisulphonate. Poison Tablets of Corrosive Mercuric Chloride are to be dispensed in securely stoppered glass containers on the exterior of which is placed a red label bearing the word "POISON" and a statement indicating that the Tablets contain the required amount of corrosive mercuric chloride.

Assay—Proceed as directed under *Hydrargyri Chloridum Corrosivum*, pages 752 and 1479, using one tablet and washing the sulphide with distilled water until the filtrate is colorless and until a 5 cc. portion of the washings, acidulated with nitric acid, yields no turbidity on the addition of a few drops of silver nitrate T.S. The weight of the mercuric sulphide obtained, multiplied by 1.167, indicates its equivalent in corrosive mercuric chloride. Tablets of Corrosive Mercuric Chloride may also be assayed as directed under the electrolytic method, page 1515.

TABELLÆ CARBONIS ANIMALIS. N. F. Tablets of Animal Charcoal

(Replacing Trochisci Carbonis Ligni, N. F. IV)

[Tab. Carb. Anim.—Tablets of Charcoal]

	Metric	Alternative
Purified Animal Charcoal, in coarse powder	**30.0 Gm.**	1 oz. av. 26 gr.
To make	**100 Tablets**	100 Tablets

Compress in a tablet machine, using a 9.5 mm. (3/8 inch) die and punch to make 100 tablets.

Each tablet contains about 0.30 Gm. or 4 9/10 grains of Purified Animal Charcoal.

Average dose—1 tablet.

TABELLÆ HYDRARGYRI CHLORIDI MITIS. N. F. Tablets of Mild Mercurous Chloride

[Tab. Hydrarg. Chlor. Mit.—Calomel Tablets]

	Metric	Alternative
Mild Mercurous Chloride	**0.65 Gm.**	10 gr.
Carmine	**0.05 Gm.**	⅘ gr.
Light Liquid Petrolatum	**1.40 cc.**	23 min.
Starch, in fine powder	**4.00 Gm.**	62 gr.
Sucrose, in fine powder	**12.00 Gm.**	185 gr.
To make	**100 Tablets**	100 Tablets

Thoroughly triturate the mild mercurous chloride with the sucrose, add the carmine and triturate until the color of the mixture is uniform. Separately mix the starch and liquid petrolatum, then add this mixture to the calomel mixture and mix by gentle trituration. Compress in a tablet machine, using 8 mm. (5/16 inch) die and punch to make 100 tablets.

Average dose—10 tablets, usually taken at fifteen to thirty minute intervals.

TABELLÆ PHENOLPHTHALEINI. N. F. Tablets of Phenolphthalein

(Replacing Trochisci Phenolphthaleini, N. F. IV)

[Tab. Phenolphthal.]

	Metric	Alternative
Phenolphthalein, in fine powder	**6.00 Gm.**	93 gr.
Gluside	**0.15 Gm.**	2¼ gr.
Spirit of Cinnamon	**0.15 cc.**	2¼ min.
Cocoa, in fine powder	**6.00 Gm.**	93 gr.
Sucrose, in fine powder	**18.00 Gm.**	278 gr.
To make	**100 Tablets**	100 Tablets

Mix the phenolphthalein and gluside and add the spirit of cinnamon. Gradually add the sucrose and cocoa and mix thoroughly by trituration in a mortar.

Compress in a tablet machine, using a 9.5 mm. (⅜ inch) die and punch to make 100 tablets.

Average dose—1 tablet.

Each tablet contains about:

0.06 Gm. or 1 grain of Phenolphthalein.

TABELLÆ SANTONINI, N. F. Tablets of Santonin

(Replacing Trochisci Santonini, N. F. IV)

[Tab. Santonin.]

	Metric	Alternative
Santonin, in fine powder	**3.00 Gm.**	46 gr.
Gluside	**0.06 Gm.**	1 gr.
Tincture of Vanilla	**1.50 cc.**	25 min.
Cocoa, in fine powder	**6.00 Gm.**	93 gr.
Sucrose, in fine powder	**21.00 Gm.**	324 gr.
To make	**100 Tablets**	100 Tablets

Mix the gluside with the tincture of vanilla in a mortar, add the santonin and allow the alcohol to partially evaporate. Then gradually add the cocoa and sucrose and mix by thorough trituration.

Compress in a tablet machine, using a 9.5 mm. (⅜ inch) die and punch to make 100 tablets.

Caution—Because of the pleasant flavor of these tablets and the possibility of their being mistaken for candy, it is advisable to order only a very few at a time, preferably not more than three, since 0.13 Gm. of Santonin has caused the death of a child.

Average dose—1 tablet.

Each tablet contains about:

0.03 Gm. or ½ gr. of Santonin.

TABELLÆ SANTONINI COMPOSITÆ. N. F. Compound Tablets of Santonin

(Replacing Trochisci Santonini Compositi, N. F. IV)

[Tab. Santonin. Co.—TABLETS OF SANTONIN AND CALOMEL]

	Metric	Alternative
Santonin, in fine powder	**3.00 Gm.**	46 gr.
Mild Mercurous Chloride	**3.00 Gm.**	46 gr.
Gluside	**0.06 Gm.**	1 gr.
Tincture of Vanilla	**1.50 cc.**	25 min.
Cocoa, in fine powder	**6.00 Gm.**	93 gr.
Sucrose, in fine powder	**18.00 Gm.**	278 gr.
To make	**100 Tablets**	100 Tablets

Mix the santonin, mild mercurous chloride and gluside, add the tincture of vanilla and allow the alcohol to partially evaporate. Then gradually add the sucrose and cocoa, and mix thoroughly by trituration in a mortar.

Compress in a tablet machine, using a 9.5 mm. (⅜ inch) die and punch to make 100 tablets.

Caution—Because of the pleasant flavor of these tablets and the possibility of their being mistaken for candy, it is advisable to order only a very few at a time, preferably not more than three, since 0.13 Gm. of Santonin has caused the death of a child.

Average dose—1 tablet.

Each tablet contains about:

0.03 Gm. or ½ gr. of Santonin.

TABELLÆ SODII BICARBONATIS. N. F. Tablets of Sodium Bicarbonate

(Replacing Trochisci Sodii Bicarbonatis, U. S. P. IX)

[Tab. Sod. Bicarb.—SODA-MINT TABLETS]

	Metric	Alternative
Sodium Bicarbonate	**25.0 Gm.**	1 oz. av. 48 gr.
Oil of Peppermint	**0.3 cc.**	5 min.
Light Liquid Petrolatum	**1.0 cc.**	16 min.
Starch, in fine powder	**4.0 Gm.**	62 gr.
To make	**100 Tablets**	100 Tablets

Mix the oil of peppermint and liquid petrolatum with the starch, add the sodium bicarbonate and mix thoroughly by gentle trituration.

Compress in a tablet machine, using 8 mm. (5/16 inch) die and punch to make 100 tablets.

Average dose—1 tablet, repeated as required.

TABELLÆ SULPHURIS ET POTASSII BITARTRATIS. N.F. Tablets of Sulphur and Potassium Bitartrate

(Replacing Trochisci Sulphuris et Potassii Bitartratis, N.F. IV)

[Tab. Sulphur. et Pot. Bitart.—Tablets of Sulphur and Cream of Tartar]

	Metric	Alternative
Washed Sulphur	**20.0 Gm.**	309 gr.
Potassium Bitartrate	**6.0 Gm.**	93 gr.
Oil of Orange	**0.3 cc.**	5 min.
Starch	**4.0 Gm.**	62 gr.
To make	**100 Tablets**	100 Tablets

Triturate the washed sulphur, potassium bitartrate and starch together until thoroughly mixed, then incorporate the oil.

Compress in a tablet machine, using an 8 mm. (5/16 inch) die and punch to make 100 tablets.

Average dose—Several tablets.

Unguenta—*Ointments*

Ointments or *salves* are soft, fatty preparations intended for external application. They are discussed more fully in Part XI. The official formulas are given below.

UNGUENTUM. U.S. Ointment

[Ung.—Simple Ointment]

	Metric	Alternative
Yellow Wax	**200 Gm.**	1 oz. av.
Benzoinated Lard	**800 Gm.**	4 oz. av.
To make about	**1000 Gm.**	5 oz. av.

Melt the yellow wax, add the benzoinated lard, heat gently until liquefied, and stir the mixture until it congeals.

Note—For use in southern latitudes and during the warm season in other localities, 50 Gm. [109 gr.] of the benzoinated lard (or more if necessary) may be replaced by an equal quantity of yellow wax.

U.S.P. Preparations—Unguentum Acidi Tannici; Unguentum Gallæ.
N.F. Preparations—Unguentum Calaminæ; Unguentum Hydrargyri Chloridi Mitis.

Uses—Emollient, also a vehicle for other ointments.

UNGUENTUM ACIDI BORICI. U.S. Ointment of Boric Acid

[Ung. Acid. Bor.]

	Metric	Alternative
Boric Acid, in fine powder	**100 Gm.**	44 gr.
Yellow Wax	**50 Gm.**	22 gr.
Petrolatum	**850 Gm.**	372 gr.
To make about	**1000 Gm.**	1 oz. av.

Melt the yellow wax, add the petrolatum, and heat gently until liquefied. Gradually add the warm liquid to the boric acid, contained in the warm mortar, triturating thoroughly, and stir the mixture until it congeals.

Uses—A mild antiseptic dressing and an application for burns.

UNGUENTUM ACIDI TANNICI. U.S. Ointment of Tannic Acid
[Ung. Acid. Tan.]

	Metric	Alternative
Tannic Acid	20 Gm.	88 gr.
Glycerin	20 Gm.	88 gr.
Ointment	60 Gm.	262 gr.
To make about	100 Gm.	1 oz. av.

Dissolve the tannic acid in the glycerin with the aid of a gentle heat, and mix the solution thoroughly with the ointment, avoiding the use of iron utensils.

Uses—An application for hemorrhoids.

UNGUENTUM AQUÆ ROSÆ. U.S. Ointment of Rose Water
[Ung. Aq. Ros.]

	Metric	Alternative
Spermaceti	125 Gm.	2 oz. av.
White Wax	120 Gm.	1 oz. av. 403 gr.
Expressed Oil of Almond	560 Gm.	8 oz. av. 420 gr.
Sodium Borate, in fine powder	5 Gm.	35 gr.
Stronger Rose Water	190 Gm.	3 oz. av. 17 gr.
To make about	1000 Gm.	16 oz. av.

Reduce the spermaceti and the white wax to fine pieces and melt them on a water bath, add the expressed oil of almond, and stir, continuing the heat until the mixture is uniformly melted. Dissolve the sodium borate in the stronger rose water warmed on a water bath to the temperature of the melted wax and fat, and add the warm solution gradually to the melted mixture, stirring rapidly and continuously until it congeals and becomes of uniform consistence.

Ointment of Rose Water must be free from rancidity. If the ointment has been chilled, warm it slightly before attempting to incorporate other ingredients with it.

NOTE—The official requirement to keep and dispense only in tin tubes is based upon the evidence that this ointment will not decompose or dry under such conditions. It will rapidly lose its neutrality and consistence in an open container.

Preserve in pure tin, collapsible tubes.

History—This was originated by Galen, the famous Roman physician-pharmacist of the first century A.D., and was known for many centuries by the name of *Unguentum* or *Ceratum Refrigerans*. It has changed but little in proportions or method of preparation throughout many centuries.

Uses—An emollient and ointment base.

UNGUENTUM BELLADONNÆ. U.S. Belladonna Ointment
[Ung. Bellad.]

	Metric	Alternative
Pilular Extract of Belladonna	10 Gm.	44 gr.
Diluted Alcohol	5 cc.	30 min.
Wool Fat	30 Gm.	131 gr.
Yellow Wax	5 Gm.	22 gr.
Petrolatum	50 Gm.	219 gr.
To make about	100 Gm.	1 oz. av.

Triturate the extract with the diluted alcohol until a smooth mixture is obtained, add the wax, wool fat, and petrolatum, which have been melted together on a water bath, and mix thoroughly.

Uses—An anodyne.

UNGUENTUM CHRYSAROBINI. U. S. Chrysarobin Ointment

[Ung. Chrysarob.]

	Metric	Alternative
Chrysarobin	6 Gm.	26 gr.
Hydrous Wool Fat	94 Gm.	412 gr.
To make about	100 Gm.	1 oz. av.

Triturate the chrysarobin with the hydrous wool fat, previously melted, heat the mixture on a water bath for twenty minutes, with occasional stirring, strain and stir until the Ointment congeals.

Uses—An antiparasitic.

UNGUENTUM GALLÆ. U. S. Nutgall Ointment

[Ung. Gall.]

	Metric	Alternative
Nutgall, in very fine powder	20 Gm.	88 gr.
Ointment	80 Gm.	350 gr.
To make about	100 Gm.	1 oz. av.

Rub the nutgall with the ointment, gradually added, until they are thoroughly mixed. Avoid the use of iron utensils.

Uses—An application for hemorrhoids.

UNGUENTUM HYDRARGYRI AMMONIATI. U. S. Cintment of Ammoniated Mercury

[Ung. Hydrarg. Ammon.—White Precipitate Ointment]

	Metric	Alternative
Ammoniated Mercury, in very fine powder	10 Gm.	44 gr.
Liquid Petrolatum	10 Gm.	44 gr.
Hydrous Wool Fat	40 Gm.	175 gr.
White Petrolatum	40 Gm.	175 gr.
To make about	100 Gm.	1 oz. av.

Triturate the ammoniated mercury with the liquid petrolatum until the mixture is smooth, add the white petrolatum, previously melted, mix thoroughly with the hydrous wool fat, and stir the mixture until it congeals.

Uses—A stimulant and parasiticide in cutaneous eruptions.

UNGUENTUM HYDRARGYRI FORTIUS. U. S. Stronger Mercurial Ointment

[Ung. Hydrarg. Fort.—Unguentum Hydrargyri U. S. P. IX]

Stronger Mercurial Ointment contains not less than 49 per cent and not more than 51 per cent of Hg.

	Metric	Alternative
Mercury	500 Gm.	219 gr.
Oleate of Mercury	20 Gm.	9 gr.
Prepared Suet	230 Gm.	101 gr.
Benzoinated Lard	250 Gm.	109 gr.
To make about	1000 Gm.	1 oz. av.

Triturate the oleate of mercury in a warm mortar, with the mercury added gradually, and when the globules are completely divided and distributed, set it aside for about fifteen minutes. Melt the lard and suet, allow the mixture to partially cool, add about 25 Gm. [11 gr.] of it to the mercurial mixture, and continue the trituration until globules of mercury are no longer visible under a lens magnifying ten diameters. Then add the remainder of the lard and suet, and mix thoroughly.

Assay—Mix about 1 Gm. of Stronger Mercurial Ointment, accurately weighed, in a suitable flask with 20 cc. of water and 20 cc. of nitric acid, and warm the mixture gently until red fumes cease to be evolved and the solution is colorless. Cool, add 100 cc. of distilled water and 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate until a permanent reddish color is produced. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01003 Gm. of Hg.

This assay is explained on page 1462.

U. S. P. Preparation—Unguentum Hydrargyri Mite.

Uses—An antisyphilitic by inunction.

UNGUENTUM HYDRARGYRI MITE. U. S. Mild Mercurial Ointment

[**Ung. Hydrarg. Mit.**—Unguentum Hydrargyri Dilutum U. S. P. IX., Diluted Mercurial Ointment, Blue Ointment, Hydrargyri Unguentum P. I.]

Mercurial Ointment contains not less than 29 per cent and not more than 31 per cent of Hg.

	Metric	Alternative
Stronger Mercurial Ointment	600 Gm.	263 gr.
Petrolatum	200 Gm.	88 gr.
Ointment	200 Gm.	88 gr.
To make about	1000 Gm.	1 oz. av.

Mix the ingredients thoroughly.

Assay—Proceed as directed under *Unguentum Hydrargyri Fortius.*

Uses—An antiparasitic.

UNGUENTUM HYDRARGYRI OXIDI FLAVI. U. S. Ointment of Yellow Mercuric Oxide

[**Ung. Hydrarg. Oxid. Flav.**]

Note—The strength of this Ointment has been reduced from 10 per cent of Yellow Mercuric Oxide to 1 per cent.

	Metric	Alternative
Yellow Mercuric Oxide, in very fine powder	1 Gm.	4 gr.
Liquid Petrolatum	1 Gm.	4 gr.
Hydrous Wool Fat	10 Gm.	44 gr.
Petrolatum	88 Gm.	286 gr.
To make about	100 Gm.	1 oz. av.

Triturate the yellow mercuric oxide with the liquid petrolatum until the mixture is smooth, add the hydrous wool fat in divided portions, and incorporate the mixture thoroughly with the petrolatum. All contact with iron utensils or containers must be avoided.

Uses—A stimulant and antiseptic, chiefly in inflammation of the eye-lids.

UNGUENTUM IODI. U. S. Iodine Ointment

[**Ung. Iodi**]

	Metric	Alternative
Iodine	4 Gm.	17½ gr.
Potassium Iodide	4 Gm.	17½ gr.
Glycerin	12 Gm.	53 gr.
Wool Fat	80 Gm.	350 gr.
To make about	100 Gm.	1 oz. av.

Triturate the iodine and potassium iodide, preferably in a glass mortar, with the glycerin until dissolved, gradually incorporate the wool fat, and mix thoroughly. All contact with metallic utensils or containers must be avoided.

Uses—A counterirritant.

UNGUENTUM IODOFORMI. U. S. Iodoform Ointment

[Ung. Iodof.]

	Metric	Alternative
Iodoform	**10 Gm.**	44 gr.
Wool Fat	**20 Gm.**	88 gr.
Petrolatum	**70 Gm.**	306 gr.
To make about	**100 Gm.**	1 oz. av.

Triturate the Iodoform with the previously melted petrolatum until dissolved, incorporate the wool fat, and mix thoroughly.

Uses—An antiseptic dressing for wounds.

UNGUENTUM PHENOLIS. U. S. Ointment of Phenol

[Ung. Phenol.—Ointment of Carbolic Acid]

	Metric	Alternative
Phenol	**2 Gm.**	9 gr.
Yellow Wax	**5 Gm.**	22 gr.
Petrolatum	**93 Gm.**	407 gr.
To make about	**100 Gm.**	1 oz. av.

Melt the yellow wax and phenol on a water bath, add the petrolatum, and stir the mixture until it congeals.

Uses—An antiseptic dressing.

UNGUENTUM PICIS PINI. U. S. Tar Ointment

[Ung. Pic. Pin.—Unguentum Picis Liquidæ U. S. P. IX]

	Metric	Alternative
Pine Tar	**50 Gm.**	219 gr.
Yellow Wax	**15 Gm.**	66 gr.
Petrolatum	**35 Gm.**	153 gr.
To make about	**100 Gm.**	1 oz. av.

Melt the yellow wax, add the petrolatum, and to the melted mixture add the pine tar, previously warmed, and incorporate thoroughly. Strain the mixture through muslin, and stir until it congeals.

Uses—A stimulant application.

UNGUENTUM PLUMBI OLEATIS. U. S. Ointment of Lead Oleate

[Ung. Plumb. Ol.—Unguentum Diachylon U. S. P. IX]

	Metric	Alternative
Lead Oleate Plaster	**50 Gm.**	219 gr.
Oil of Lavender	**1 Gm.**	5 min.
White Petrolatum	**49 Gm.**	214 gr.
To make about	**100 Gm.**	1 oz. av.

Melt together the lead oleate plaster and the white petrolatum by applying a gentle heat, strain the mixture, allow it to cool but not congeal, add the oil of lavender, and stir the Ointment until it is cold.

Uses—Used in eczema and other skin diseases.

UNGUENTUM SULPHURIS. U. S. Sulphur Ointment

[Ung. Sulphur.]

	Metric	Alternative
Sublimed Sulphur	**15 Gm.**	66 gr.
Benzoinated Lard	**85 Gm.**	372 gr.
To make about	**100 Gm.**	1 oz. av.

Rub the sublimed sulphur, which must be free from gritty particles, with a small portion of the benzoinated lard until smooth, and incorporate uniformly the remainder of the benzoinated lard with the sulphur mixture.

Uses—An antiparasitic.

UNGUENTUM ZINCI OXIDI. U.S. Ointment of Zinc Oxide

[Ung. Zinc. Ox.—Zinc Ointment]

	Metric	Alternative
Zinc Oxide, in very fine powder	20 Gm.	88 gr.
Paraffin	15 Gm.	66 gr.
White Petrolatum	65 Gm.	284 gr.
To make about	100 Gm.	1 oz. av.

Rub the zinc oxide, which must be free from gritty particles, with about one-fourth of the melted paraffin and white petrolatum in a previously warmed container, and with this incorporate the remainder of the melted mixture. If necessary, strain the Ointment while warm, and stir until it congeals.

Uses—A mildly antiseptic and astringent dressing.

UNGUENTUM BITUMINIS SULPHONATI. N.F. Ointment of Sulphonated Bitumen

[Ung. Bitum. Sulphon.]

	Metric	Alternative
Sulphonated Bitumen	10 Gm.	175 gr.
Petrolatum	90 Gm.	3 oz. av. 263 gr.
To make	100 Gm.	4 oz. av.

Thoroughly incorporate the sulphonated bitumen with the petrolatum.

Uses—An antiseptic and emollient.

UNGUENTUM CALAMINÆ. N.F. Calamine Ointment

[Ung. Calamin.—Unguentum Calaminare, Turner's Cerate]

	Metric	Alternative
Prepared Calamine, in very fine powder	17 Gm.	298 gr.
Ointment	83 Gm.	3 oz. av. 140 gr.
To make	100 Gm.	4 oz. av.

Mix the prepared calamine intimately with the ointment, by trituration, so as to produce a smooth and homogeneous product.

History—This preparation was introduced about 200 years ago by Dr. Daniel Turner of Devonshire, England, under the name of *Ceratum de Lapide Calaminari*. It was official for many years under the name *Ceratum Calaminæ* or *calaminare*.

Uses—A protective dressing.

UNGUENTUM CAMPHORÆ. N.F. Camphor Ointment

[Ung. Camph.]

	Metric	Alternative
Camphor, in coarse powder	22 Gm.	385 gr.
White Wax	11 Gm.	192 gr.
Lard	67 Gm.	2 oz. av. 297 gr.
To make	100 Gm.	4 oz. av.

Melt the white wax and lard on a water bath, then dissolve the camphor in the melted mixture without further heating and stir the ointment until it is cold.

Uses—An anodyne and counterirritant.

UNGUENTUM CAPSICI. N.F. Capsicum Ointment

[Ung. Capsic.]

	Metric	Alternative
Oleoresin of Capsicum	5 Gm.	87 gr.
Paraffin	10 Gm.	175 gr.
Petrolatum	85 Gm.	3 oz. av. 176 gr.
To make	100 Gm.	4 oz. av.

Melt the paraffin, add the petrolatum and continue the heat until the whole is liquefied. Then remove from the heat, add the oleoresin of capsicum, mix thoroughly, and stir frequently until the ointment congeals.

Uses—A rubefacient.

UNGUENTUM FUSCUM. N. F. Brown Ointment

[Ung. Fusc.—Unguentum Matris, Mother's Salve]

	Metric	Alternative
Camphorated Brown Plaster	50 Gm.	2 oz. av.
Olive Oil	25 Gm.	1 oz. av.
Prepared Suet	25 Gm.	1 oz. av.
To make	100 Gm.	4 oz. av.

Melt together the several ingredients and stir the ointment until it congeals.

History—Under the name of *Mother's Ointment* an empiric preparation for promoting suppuration was made by a nun named *La Mere Thecle* at the *Hotel Dieu*, Paris, during the 18th century. The formula was simplified after the preparation received official recognition.

Uses—An antiphlogistic.

UNGUENTUM HYDRARGYRI CHLORIDI MITIS. N. F. Ointment of Mild Mercurous Chloride

[Ung. Hydrarg. Chlor. Mit.—Prophylactic Ointment, Calomel Ointment]

	Metric	Alternative
Mild Mercurous Chloride	30 Gm.	1 oz. av. 88 gr.
White Petrolatum	70 Gm.	2 oz. av. 350 gr.
To make	100 Gm.	4 oz. av.

Mix them intimately.

Uses—A prophylactic.

UNGUENTUM HYDRARGYRI NITRATIS. N. F. Ointment of Mercuric Nitrate (U. S. P. IX)

Ung. Hydrarg. Nit.—Citrine Ointment]

	Metric	Alternative
Mercury	7.0 Gm.	123 gr.
Nitric Acid	17.5 Gm.	306 gr.
Lard, free from water	76.0 Gm.	3 oz. av. 17 gr.
To make about	100 Gm.	4 oz. av.

Warm the lard in a capacious porcelain dish until it has just melted, or to about 45° C. Add 7 Gm. [123 gr.] of the nitric acid all at once and continue the heat until the characteristic reaction is complete. Hold an inverted glass funnel over the dish during the reaction. Withdraw the heat immediately after the rapid rise of froth which accompanies the end reaction and cool the treated lard, stirring it until it assumes a bright citrine color. Dissolve the mercury in the remainder of the nitric acid, warming it if necessary to prevent crystallizing, and mix the solution with the previously prepared lard. All contact with metallic utensils or containers must be avoided.

History—The first preparation under this name appeared in the London Pharmacopœia of 1650. It contained no mercury however, but was made from a number of mineral ingredients including coral, quartz, sea shells, marble, white lead, and tragacanth incorporated with lard, suet, and chicken fat. The first ointment of record containing mercuric nitrate was in the Edinburgh Pharmacopœia of 1722. Other formulas for a similar product appeared later in the London, the Dublin, and the Paris Pharmacopœias and a variety of ingredients and processes have appeared in the many revisions down to the present time.

Uses—An antiparasitic.

UNGUENTUM HYDRARGYRI OXIDI RUBRI. N. F. Ointment of Red Mercuric Oxide

[Ung. Hydrarg. Oxid. Rub.]

	Metric	Alternative
Red Mercuric Oxide, in very fine powder	10 Gm.	175 gr.
Water	10 cc.	175 min.
Hydrous Wool Fat	40 Gm.	1 oz. av. 262 gr.
Petrolatum	40 Gm.	1 oz. av. 262 gr.
To make	100 Gm.	4 oz. av

Triturate the red mercuric oxide with the water until the mixture is smooth and absolutely free from gritty particles, then add the hydrous wool fat in divided portions, and finally incorporate thoroughly with the petrolatum. Contact with metallic utensils must be avoided.

Uses—A stimulant and antiparasitic.

UNGUENTUM IODI DENIGRESCENS. N. F. Stainless Iodine Ointment

[Ung. Iod. Denig.]

	Metric	Alternative
Iodine, in moderately coarse powder	50 Gm.	87½ gr.
Paraffin	50 Gm.	87½ gr.
Oleic Acid	200 Gm.	350 gr.
Petrolatum	700 Gm.	2 oz. av. 350 gr.
To make about	1000 Gm.	4 oz. av.

Dissolve the iodine in the oleic acid by aid of heat, not exceeding 70° C. Add the paraffin and continue the heat until the iodine is absorbed, as shown by the absence of a reddish color, and the paraffin is melted, then add the petrolatum, and when all is liquefied remove from the heat and stir frequently until it congeals.

Uses—An alterative.

UNGUENTUM PICIS COMPOSITUM. N. F. Compound Tar Ointment

[Ung. Pic. Co.]

	Metric	Alternative
Rectified Oil of Tar	40 Gm.	70 gr.
Tincture of Benzoin	20 Gm.	35 gr.
Zinc Oxide	30 Gm.	52 gr.
Yellow Wax	250 Gm.	1 oz. av.
Lard	320 Gm.	1 oz. av. 122 gr.
Cottonseed Oil	340 Gm.	1 oz. av. 158 gr.
To make	1000 Gm.	4 oz. av.

Melt the yellow wax and lard with the cottonseed oil at a gentle heat, and add the tincture of benzoin. Then withdraw the heat, add the rectified oil of tar, and finally the zinc oxide, and incorporate the latter thoroughly, so that, on cooling, a smooth, homogeneous ointment results.

Uses—An antiparasitic.

UNGUENTUM PLUMBI IODIDI. N. F. Ointment of Lead Iodide

[Ung. Plumb. Iod.]

	Metric	Alternative
Lead Iodide, in very fine powder	10 Gm.	175 gr.
Benzoinated Lard	90 Gm.	3 oz. av. 262 gr.
To make	100 Gm.	4 oz. av.

Rub the lead iodide with the benzoinated lard, gradually added, until they are thoroughly mixed.

Uses—An alterative.

UNGUENTUM POTASSII IODIDI. N. F. Ointment of Potassium Iodide

[Ung. Pot. Iod.]

	Metric	Alternative
Potassium Iodide	10 Gm.	175 gr.
Sodium Thiosulphate	1 Gm.	17 gr.
Water	9 Gm.	158 gr.
Benzoinated Lard	80 Gm.	3 oz. av. 87 gr.
To make	100 Gm.	4 oz. av.

Dissolve the potassium iodide and sodium thiosulphate in the water, then add the benzoinated lard and incorporate thoroughly. This ointment should not be dispensed unless it has been freshly prepared.

Uses—An alterative.

UNGUENTUM RESORCINOLIS COMPOSITUM. N. F. Compound Resorcinol Ointment

[Ung. Resorcin. Co.—Unguentum Resorcini Compositum]

	Metric	Alternative
Resorcinol	60 Gm.	105 gr.
Zinc Oxide	60 Gm.	105 gr.
Bismuth Subnitrate	60 Gm.	105 gr.
Rectified Oil of Birch Tar	60 Gm.	105 gr.
Yellow Wax	100 Gm.	175 gr.
Petrolatum	250 Gm.	1 oz. av.
Wool Fat	280 Gm.	1 oz. av. 52 gr.
Glycerin	130 Gm.	227 gr.
To make	1000 Gm.	4 oz. av.

Melt the yellow wax and wool fat in a dish on a water bath. Rub the zinc oxide and bismuth subnitrate with the petrolatum until smooth and add it to the melted mixture. Dissolve the resorcinol in the glycerin, incorporate the solution with the warm mixture just prepared, then add the oil and stir the ointment until it congeals.

Uses—An antiseptic and astringent.

UNGUENTUM SINAPIS. N. F. Mustard Ointment

[Ung. Sinap.—Ointment of Oil of Mustard]

	Metric	Alternative
Volatile Oil of Mustard	2 Gm.	35 gr.
White Wax	15 Gm.	262 gr.
Lard	83 Gm.	3 oz. av. 140 gr.
To make	100 Gm.	4 oz. av.

Melt the white wax, add the lard and heat gently until liquefied. Remove from the heat, stir the mixture until it begins to congeal, then add the volatile oil of mustard and continue the stirring until the ointment congeals.

Uses—A counterirritant.

UNGUENTUM STRAMONII. N. F. Stramonium Ointment

(U. S. P. IX)

[Ung. Stramon.]

	Metric	Alternative
Pilular Extract of Stramonium	10 Gm.	175 gr.
Diluted Alcohol	5 cc.	87 min.
Hydrous Wool Fat	20 Gm.	350 gr.
Benzoinated Lard	65 Gm.	2 oz. av. 262 gr.
To make	100 Gm.	4 oz. av.

Triturate the extract with the diluted alcohol until a smooth mixture is obtained; with this incorporate the hydrous wool fat, then add the benzoinated lard, and mix thoroughly.

Uses—An anodyne; for painful ulcers, hemorrhoids, etc.

UNGUENTUM SULPHURIS ALKALINUM. N. F. Alkaline Sulphur Ointment

[Ung. Sulphur. Alk.]

	Metric	Alternative
Sublimed Sulphur	20 Gm.	350 gr.
Potassium Carbonate	10 Gm.	175 gr.
Water	5 cc.	87 min.
Benzoinated Lard	65 Gm.	2 oz. av. 267 gr.
To make	100 Gm.	4 oz. av.

Rub the sulphur with the potassium carbonate and the water, until a smooth, homogeneous mixture results, then gradually add the benzoinated lard, and mix thoroughly.

Uses—An antiparasitic and to relieve itching.

UNGUENTUM SULPHURIS COMPOSITUM. N. F. Compound Sulphur Ointment

[Ung. Sulphur. Co.—Wilkinson's Ointment, Hebra's Itch Ointment]

	Metric	Alternative
Precipitated Calcium Carbonate	10 Gm.	175 gr.
Sublimed Sulphur	15 Gm.	262 gr.
Oil of Cade	15 Gm.	262 gr.
Soft Soap	30 Gm.	1 oz. av. 87 gr.
Lard	30 Gm.	1 oz. av. 87 gr.
To make	100 Gm.	4 oz. av.

Melt the lard with the soft soap and oil of cade, then gradually incorporate the sublimed sulphur and precipitated calcium carbonate and rub the ointment until it is smooth.

Uses—An antiparasitic and to relieve itching.

UNGUENTUM VERATRINÆ. N. F. Veratrine Ointment

[Ung. Veratrin.]

	Metric	Alternative
Veratrine	4 Gm.	70 gr.
Expressed Oil of Almond	6 Gm.	105 gr.
Benzoinated Lard	90 Gm.	3 oz. av. 262 gr.
To make	100 Gm.	4 oz. av.

Rub the veratrine with the expressed oil of almond, then gradually add the benzoinated lard, and mix thoroughly.

Uses—An anodyne and counterirritant.

UNGUENTUM ZINCI STEARATIS. N. F. Ointment of Zinc Stearate

[Ung. Zinc. Stear.]

	Metric	Alternative
Zinc Stearate, in fine powder	500 Gm.	2 oz. av.
White Petrolatum	500 Gm.	2 oz. av.
To make	1000 Gm.	4 oz. av.

Rub the zinc stearate with the white petrolatum until a smooth ointment is produced.

Uses—An antiseptic, emollient and protective.

Some Unofficial Ointments

Title	*Directions*
Unguentum Acidi Salicylici (Br. 1914)	Mix 2 Gm. salicylic acid with 98 Gm. paraffin ointment
Aconitinæ (Br. 1914)	Dissolve 2 Gm. aconitine in 16 Gm. of oleic acid, with the aid of a gentle heat, and mix the solution with 82 Gm. of lard
Atropinæ (Br. 1914)	Dissolve 2 Gm. of atropine in 8 Gm. of oleic acid, with the aid of a gentle heat, and mix the solution with 90 Gm. of lard
Cantharidini (Br. 1914)	Dissolve 0.1 Gm. cantharidin in 10 cc. chloroform, add the solution to 290 Gm. melted benzoinated lard, and stir until cool
Capsici (Br. 1914)	Digest on a water bath, stirring occasionally, 25 Gm. of capsicum fruit, 10 Gm. hard paraffin, 75 Gm. soft paraffin, and 10 Gm. prepared lard, strain, and cool without stirring
Cetacei (Br. 1914)	Melt together 20 Gm. spermaceti, 8 Gm. white wax, and 72 Gm. liquid paraffin, and stir until cold
Chaulmoogræ (Br. 1914)	Melt together 40 Gm. hard paraffin and 50 Gm. soft paraffin, add 10 Gm. chaulmoogra oil, and stir until cold
Cocainæ (Br. 1914)	Dissolve 4 Gm. cocaine in 16 Gm. oleic acid, with the aid of a gentle heat, and mix the solution with 80 Gm. of prepared lard
Creosoti (Br. 1914)	Melt 40 Gm. hard paraffin and 50 Gm. of soft white paraffin together, add 10 Gm. creosote, and stir until cold
Eucalypti (Br. 1914)	Melt 40 Gm. hard paraffin and 50 Gm. soft white paraffin together, add 10 Gm. oil of eucalyptus, and stir until cold
Gallæ cum Opio (Br. 1914)	Thoroughly mix 92.5 Gm. gall ointment, 7.5 Gm. opium, in powder
Hamamelidis (Br. 1914)	Mix 10 cc. liquid extract of hamamelis with 60 Gm. wool fat, and 30 Gm. soft paraffin
Hydrargyri Compositum (Br. 1914)	Mix 24 Gm. yellow wax, 24 Gm. olive oil, and 40 Gm. mercury ointment, with the aid of heat. Add 12 Gm. camphor and stir until cold
Hydrargyri Iodidi Rubri (Br. 1914)	Mix 4 Gm. mercuric iodide with 96 Gm. benzoinated lard
Hydrargyri Nitratis Dilutum (Br. 1914)	Mix 20 Gm. mercuric nitrate ointment with 80 Gm. soft paraffin

Some Unofficial Ointments—*Continued*

Title	*Directions*
Unguentum Hydrargyri Oleatis (Br. 1914)	Mix 25 Gm. mercuric oleate with 75 Gm. benzoinated lard
Hydrargyri Subchloridi (Br. 1914)	Mix 20 Gm. mercurous chloride with 80 Gm. benzoinated lard
Lanæ Compositum (Br. 1914)	Melt together 40 Gm. prepared lard, 40 Gm. wool fat, and 20 Gm. paraffin ointment, and stir until cold
Myrobalani (Br. 1914)	Mix 20 Gm. myrobalans and 80 Gm. benzoinated lard by trituration, until a smooth mixture results
Myrobalani cum Opio (Br. 1914)	Triturate 7.5 Gm. powdered opium with 92.5 Gm. myrobalans ointment until a smooth mixture results
Paraffini (Br. 1914)	Melt 27 Gm. hard paraffin, 70 Gm. soft paraffin, and 3 Gm. white wax, and stir constantly during the cooling. White soft paraffin may replace the yellow if desired
Plumbi subacetatis (Br. 1914)	Melt 25 Gm. wool fat, 21.5 Gm. hard paraffin, and 50 Gm. soft paraffin. Cool, add 12.5 Gm. strong solution lead subacetate, and stir until cold
Resinæ (Br. 1914)	Melt 26 Gm. resin, 26 Gm. yellow wax, 26 Gm. olive oil, 22 Gm. prepared lard, strain, and stir until cold
Staphisagriæ (Br. 1914)	Digest 20 Gm. crushed stavesacre seeds in 85 Gm. benzoinated lard, on a water bath, during two hours, strain, add 10 Gm. yellow wax, heat until uniform, and stir during cooling
Zinci Oleatis (Br. 1914)	Dissolve 30 Gm. zinc sulphate in 60 cc. distilled water, and 90 Gm. of hard soap in 600 cc. of distilled water. Mix the solution, heat to boiling, allow the melted zinc oleate thus formed to rise to the surface, cool, pour off the aqueous solution, and boil the zinc oleate with successive portions of distilled water. Then reduce the product to a fine powder and mix with an equal weight of melted white soft paraffin

Inuncta—*Inunctions*

The N. F. has introduced two preparations, under this class name. They are really ointments and are intended for local application and quick absorption.

INUNCTUM MENTHOLIS. N. F. Menthol Inunction

[Inunct. Menthol.]

	Metric	Alternative
Menthol	**5 Gm.**	87 gr.
Hydrous Wool Fat	**95 Gm.**	3 oz. av. 350 gr.
To make	**100 Gm.**	4 oz. av.

Rub the menthol with a portion of the hydrous wool fat until a perfectly smooth mixture is obtained, then thoroughly incorporate the remainder of the hydrous wool fat.

Menthol inunction should be stored in collapsible metal tubes, well sealed, or in small, tightly-stoppered, wide-mouthed bottles.

INUNCTUM MENTHOLIS COMPOSITUM. N. F. Compound Menthol Inunction

[Inunct. Menthol. Co.]

	Metric	Alternative
Menthol	**5 Gm.**	87 gr.
Methyl Salicylate	**10 Gm.**	175 gr.
Hydrous Wool Fat	**85 Gm.**	3 oz. av. 175 gr.
To make	**100 Gm.**	4 oz. av.

Dissolve the menthol in the methyl salicylate and thoroughly incorporate the mixture in the hydrous wool fat.

Compound Menthol Inunction should be stored in collapsible metal tubes, well sealed, or in small, tightly stoppered, wide-mouthed bottles.

Cerata—*Cerates*

Cerates are unctuous substances of such consistence that they may be easily spread, at ordinary temperatures, upon muslin or similar material with a spatula, and yet not so soft as to liquefy and run when applied to the skin. They are mostly used as dressings for inflamed surfaces, and are generally made with oil, lard, or petrolatum for a basis, with sufficient wax to give the desired consistence. Owing to the presence of wax (*Cera*) they are

called *Cerates*. Paraffin, spermaceti, and resin are also used to raise the melting points of oils and fats.

Cerates are made either by *fusion* or by *incorporation*. In the first method, the ingredients are melted together, and the mixture strained, to separate mechanical impurities, and stirred until cold, to render it homogeneous. By incorporation is meant the process which consists in placing the fatty ingredients upon an ointment slab or pill tile, or in a mortar, and gradually mixing in the other ingredients, with a spatula or pestle, until a uniform preparation results.

The following cerates are official:

CERATUM. U.S. Cerate

[Cerat.—Simple Cerate]

	Metric	Alternative
White Wax	300 Gm.	3 oz. av.
Benzoinated Lard	700 Gm.	7 oz. av.
To make	1000 Gm.	10 oz. av.

Melt the white wax by the heat of a water bath, add the benzoinated lard, continue the heat until the mixture is liquefied, strain if necessary, and stir constantly until it congeals.

For use in southern latitudes and during the heated season in other localities, 50 Gm. [219 gr.] of benzoinated lard (or more, if necessary) may be replaced by an equal quantity of white wax.

CERATUM CANTHARIDIS. U.S. Cantharides Cerate

[Cerat. Canthar.—Blistering Cerate]

	Metric	Alternative
Cantharides, in very fine powder	350 Gm.	5 oz. av. 263 gr.
Glacial Acetic Acid	25 cc.	182 min.
Oil of Turpentine	150 cc.	2 fl. oz. 182 min.
Yellow Wax	175 Gm.	2 oz. av. 350 gr.
Rosin	175 Gm.	2 oz. av. 350 gr.
Benzoinated Lard	200 Gm.	3 oz. av. 88 gr.
To make	1000 Gm.	16 oz. av.

Moisten the cantharides with the oil of turpentine and the glacial acetic acid, previously mixed, and set the mixture aside in a well-covered container in a warm place for forty-eight hours. Melt together the rosin, yellow wax, and benzoinated lard, strain the mixture through muslin, add the macerated cantharides, and keep the mixture in a liquid condition by heating it on a water bath with occasional stirring until it is reduced in weight to 1000 Gm. [16 oz. av.]. Then withdraw the heat, and stir the Cerate until it becomes firm.

U. S. P. Preparation—Emplastrum Cantharidis.

CERATUM RESINÆ. U.S. Rosin Cerate

[Cerat. Res.—Basilicon Ointment]

	Metric	Alternative
Rosin	350 Gm.	3½ oz. av.
Yellow Wax	150 Gm.	1½ oz. av.
Lard	500 Gm.	5 oz. av.
To make	1000 Gm.	10 oz. av.

Melt the rosin, add the yellow wax and lard, and continue the heat until liquefied, then strain the liquid through muslin, and allow it to congeal, stirring occasionally.

NOTE—In cold weather 530 Gm. [5 oz. av. 132 gr.] of lard and 120 Gm. [1 oz. av. 87 gr.] of yellow wax may be used.

CERATUM CAMPHORÆ. N.F. Camphor Cerate

[Cerat. Camph.]

	Metric	Alternative
Camphor Liniment	**100 Gm.**	1 oz. av. 262 gr.
White Wax	**350 Gm.**	5 oz. av. 262 gr.
White Petrolatum	**150 Gm.**	2 oz. av. 175 gr.
Benzoinated Lard	**400 Gm.**	6 oz. av. 175 gr.
To make	**1000 Gm.**	16 oz. av.

Melt the white wax, add the white petrolatum, then the benzoinated lard, and continue the heat until the mixture is liquefied. Add the camphor liniment and stir the mixture until it congeals.

CERATUM PLUMBI SUBACETATIS. N.F. Cerate of Lead Subacetate

[Cerat. Plumb. Subacet.—GOULARD'S CERATE]

	Metric	Alternative
Solution of Lead Subacetate	**20 Gm.**	350 gr.
Wool Fat	**20 Gm.**	350 gr.
White Wax	**20 Gm.**	350 gr.
White Petrolatum	**38 Gm.**	1 oz. av. 227 gr.
Camphor	**2 Gm.**	35 gr.
To make	**100 Gm.**	4 oz. av.

Melt the white petrolatum and white wax in a dish on a water bath, remove the heat and dissolve the camphor in the warm mixture. Add the wool fat, mix thoroughly and then gradually incorporate the solution of lead subacetate by continuous stirring.

CERATUM RESINÆ COMPOSITUM. N.F. Compound Rosin Cerate

[Cerat. Resin. Co.—DESHLER'S SALVE]

	Metric	Alternative
Rosin	**225 Gm.**	3 oz. av. 262 gr.
Yellow Wax	**225 Gm.**	3 oz. av. 262 gr.
Prepared Suet	**300 Gm.**	4 oz. av. 350 gr.
Turpentine	**115 Gm.**	1 oz. av. 367 gr.
Linseed Oil	**135 Gm.**	2 oz. av. 70 gr.
To make about	**1000 Gm.**	16 oz. av.

Melt the rosin, yellow wax, turpentine, and prepared suet, add the linseed oil, and continue the heat until the mixture is liquefied. Strain it through coarse muslin, stirring until it begins to congeal.

Glycerogelatina—*Glycerogelatins*

Glycerogelatins are soft masses, melting at the body temperature, composed of gelatin, glycerin, water, and a medicament suitable for application in dermatological practice, such as salicylic acid, iodoform, resorcinol, chrysarobin, etc., either by themselves, or with the addition of zinc oxide. They are prepared with Glycerinated Gelatin (U. S. P.) as the vehicle. The formulas which follow serve as types of Glycerogelatins modified to produce masses of different consistence and melting points. Glycerogelatins are usually molded into small blocks for dispensing and are to be softened with heat before the

medication is applied. Under the title *gelatinum* the B. P. Codex includes preparations some of which are similar to glycerogelatins, others more closely resembling dermatologic pastes, and still others intended for internal administration. The latter are called *jellies*.

GLYCEROGELATINUM ACIDI SALICYLICI. N. F. Salicylic Acid Glycerogelatin

[Glycerogel. Acid. Salicyl.]

	Metric	Alternative
Glycerinated Gelatin	20 Gm.	350 gr.
Glycerin	35 Gm.	1 oz. av. 175 gr.
Distilled Water	35 cc.	1 fl. oz. 175 min.
Salicylic Acid, in very fine powder	10 Gm.	175 gr.
To make	100 Gm.	4 oz. av.

Mix the salicylic acid thoroughly with the glycerin, add the distilled water, and incorporate this mixture with the glycerinated gelatin previously melted on a water bath. Continue the heat, with stirring, until a homogeneous mixture is obtained, then pour it into chilled molds and allow it to congeal.

GLYCEROGELATINUM IODOFORMI. N. F. Iodoform Glycerogelatin

[Glycerogel Iodof.]

	Metric	Alternative
Glycerinated Gelatin	10 Gm.	175 gr.
Glycerin	15 Gm.	262 gr.
Distilled Water	65 cc.	2 fl. oz. 262 min.
Iodoform, in very fine powder	10 Gm.	175 gr.
To make	100 Gm.	4 oz. av.

Mix the iodoform thoroughly with the glycerin, add the distilled water and incorporate this mixture with the glycerinated gelatin, previously melted on a water bath. Continue the heat with stirring, until a homogeneous mixture is obtained, then pour it into chilled molds and allow it to congeal.

GLYCEROGELATINUM ZINCI DURUM. N. F. Firm Zinc Glycerogelatin

[Glycerogel. Zinc. Dur.]

	Metric	Alternative
Glycerinated Gelatin	30 Gm.	1 oz. av. 87 gr.
Glycerin	25 Gm.	1 oz. av.
Distilled Water	35 cc.	1 fl. oz. 175 min.
Zinc Oxide, in fine powder	10 Gm.	175 gr.
To make	100 Gm.	4 oz. av.

Mix the zinc oxide thoroughly with the glycerin, add the water and incorporate this mixture with the glycerinated gelatin, previously melted on a water bath. Continue the heat, with stirring, until a homogeneous mixture is obtained, then pour it into chilled molds and allow it to congeal.

GLYCEROGELATINUM ZINCI MOLLE. N. F. Soft Zinc Glycerogelatin

[Glycerogel. Zinc. Mol.]

	Metric	Alternative
Glycerinated Gelatin	20 Gm.	350 gr.
Glycerin	35 Gm.	1 oz. av. 175 gr.
Distilled Water	35 cc.	1 fl. oz. 175 min.
Zinc Oxide, in fine powder	10 Gm.	175 gr.
To make	100 Gm.	4 oz. av.

Mix the zinc oxide thoroughly with the glycerin, add the water and incorporate this mixture with the glycerinated gelatin, previously melted on a water bath. Continue the heat, with stirring, until a homogeneous mixture is obtained, then pour it into chilled molds and allow it to congeal.

Pastæ Dermatologicæ—*Dermatologic Pastes*

Dermatologic Pastes are medicaments for external use, employed in the practice of dermatologists. They are ointment-like mixtures of starch, dextrin, zinc oxide, sulphur, calcium carbonate or other medicinal substances made into a smooth paste with glycerin, soft soap, petrolatum, lard or other fats, medicated with antiseptic or astringent agents. Dermatologic Pastes should be free from gritty particles. The formulas which follow serve as examples.

PASTA BETANAPHTHOLIS. N.F. Betanaphthol Paste

[**Past. Betanaphth.**—Pasta Naphtholis, Lassar; Lassar's Naphthol Paste]

	Metric	Alternative
Betanaphthol, in very fine powder	**10 Gm.**	175 gr.
Precipitated Sulphur	**50 Gm.**	2 oz. av.
Petrolatum	**20 Gm.**	350 gr.
Soft Soap	**20 Gm.**	350 gr.
To make	**100 Gm.**	4 oz. av.

Triturate the betanaphthol and sulphur with the petrolatum and incorporate the soft soap with the mixture.

PASTA DEXTRINATA. N.F. Dextrinated Paste

[**Past. Dextrin.**]

	Metric	Alternative
White Dextrin	**33 Gm.**	1 oz. av. 140 gr.
Glycerin	**33 Gm.**	1 oz. av. 140 gr.
Water, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Dissolve the dextrin in the glycerin and 33 cc. [1 fl. oz. 27 min.] of water, in a tared dish with the aid of heat, and add sufficient water to make the product weigh 100 Gm.

PASTA RESORCINOLIS FORTIS. N.F. Strong Resorcinol Paste

[**Past. Resorcin. Fort.**—Lassar's Stronger Resorcinol Paste]

	Metric	Alternative
Resorcinol	**20 Gm.**	350 gr.
Zinc Oxide	**20 Gm.**	350 gr.
Starch	**20 Gm.**	350 gr.
Light Liquid Petrolatum	**40 Gm.**	1 oz. av. 262 gr.
To make	**100 Gm.**	4 oz. av.

Thoroughly triturate the zinc oxide with sufficient of the liquid petrolatum to make a thin, smooth paste. Reduce the resorcinol to a very fine powder, mix it with the starch, add the mixture to the zinc oxide paste and triturate until a uniformly smooth product is obtained. Then gradually incorporate the remainder of the liquid petrolatum.

PASTA RESORCINOLIS MITIS. N.F. Mild Resorcinol Paste

[**Past. Resorcin. Mit.**—Pasta Resorcini Mitis, Lassar; Lassar's Mild Resorcinol Paste]

	Metric	Alternative
Resorcinol	**10 Gm.**	175 gr.
Zinc Oxide	**25 Gm.**	1 oz. av.
Starch	**25 Gm.**	1 oz. av.
Light Liquid Petrolatum	**40 Gm.**	1 oz. av. 262 gr.
To make	**100 Gm.**	4 oz. av.

Thoroughly triturate the zinc oxide with sufficient of the liquid petrolatum to make a thin, smooth paste. Reduce the resorcinol to a very fine powder, mix it with the starch, add the mixture to the zinc oxide paste and triturate until a uniformly smooth product is obtained. Then gradually incorporate the remainder of the liquid petrolatum.

PASTA ZINCI. N.F. Zinc Paste

[Past. Zinc.—Pasta Zinci, Lassar; Lassar's Zinc Paste]

	Metric	Alternative
Salicylic Acid, in fine powder	2 Gm.	35 gr.
Zinc Oxide	24 Gm.	420 gr.
Starch	24 Gm.	420 gr.
Petrolatum	50 Gm.	2 oz. av.
To make	100 Gm.	4 oz. av.

Thoroughly triturate the zinc oxide with a portion of the petrolatum; then add the salicylic acid, starch, and the remaining petrolatum, and rub them until a smooth mixture is obtained.

PASTA ZINCI MOLLIS. N.F. Soft Zinc Paste

[Past. Zinc. Moll.—Pasta Zinci Mollis, Unna; Unna's Soft Zinc Paste]

	Metric	Alternative
Zinc Oxide, in very fine powder	25.0 Gm.	1 oz. av.
Precipitated Calcium Carbonate	25.0 Gm.	1 oz. av.
Oleic Acid	2.5 Gm.	44 gr.
Linseed Oil	25.0 Gm.	1 oz. av.
Solution of Calcium Hydroxide	22.5 Gm.	394 gr.
To make about	100 Gm.	4 oz. av.

Thoroughly triturate the zinc oxide and precipitated calcium carbonate with the linseed oil and oleic acid to form a smooth mixture, then gradually incorporate the solution of calcium hydroxide.

PASTA ZINCI SULPHURATA. N.F. Sulphurated Zinc Paste

[Past. Zinc. Sulphur.—Pasta Zinci Sulphurata, Unna; Unna's Sulphurated Zinc Paste]

	Metric	Alternative
Zinc Oxide, in very fine powder	15 Gm.	262 gr.
Precipitated Sulphur	10 Gm.	175 gr.
Purified Siliceous Earth	5 Gm.	87 gr.
Benzoinated Lard	70 Gm.	2 oz. av. 350 gr.
To make	100 Gm.	4 oz. av.

Mix the powders and triturate them with about an equal weight of benzoinated lard until a smooth mixture is obtained. Then incorporate the remainder of the benzoinated lard.

Cataplasmæ—*Poultices*

Only one poultice is official. They are usually used in domestic practice and made in the home. The materials for *spice poultice* are recognized in the N. F. under the title Pulvis Aromaticus Rubefaciens (see page 482).

The terms *fomentum* and *fotus* are applied to a hot aqueous solution applied to an inflamed area by means of a saturated cloth. A saturated solution of magnesium sulphate is frequently used in this manner.

CATAPLASMA KAOLINI. N.F. Cataplasm of Kaolin

[Catapl. Kaolin.]

	Metric	Alternative
Kaolin, recently dried at 110° C. and cooled, and in very fine powder	565.0 Gm.	9 oz. av. 18 gr.
Boric Acid, in very fine powder	45.0 Gm.	315 gr.
Thymol	0.5 Gm.	3½ gr.
Methyl Salicylate	2.0 Gm.	14 gr.
Oil of Peppermint	0.5 Gm.	3½ gr.
Glycerin, recently heated to 100° C.	387.0 Gm.	6 oz. av. 84 gr.
To make about	1000 Gm.	16 oz. av.

Mix the kaolin with the boric acid and thoroughly incorporate the warm glycerin. Add the thymol, dissolved in the methyl salicylate, the oil of peppermint, and make into a homogeneous mass. Preserve it in well-closed containers.

Uses—The large demand for an external application containing glycerin led to the introduction of this cataplasm in the U. S. P. VIII, but it has now been transferred to the N. F.; it is used to allay inflammation in the treatment of pneumonia, boils, carbuncles, etc., and in dermatological practice. Care should be taken to thoroughly dry both the kaolin and the glycerin for this preparation, as its value largely depends upon its ability to absorb moisture, and this is greatly increased when all ingredients are anhydrous. The heating also sterilizes the kaolin and decomposes any carbonate which may be present. In fact, it is desirable to heat the cataplasm, agitating it with mechanical stirrers, for some time before the oils are added, to eliminate the tendency to effervesce. The boxes in which it is sold should be of the so-called seamless type, as other styles are likely to leak.

Some Unofficial Poultices

Title	*Directions*
Cataplasma Amyli (B. P. C)	Make 10 Gm. of starch into paste with cold water, then add with constant stirring the remainder of 100 cc. of water, heated to boiling, and again boil
Amyli et Acidi Borici (B. P. C.)	Mix 10 Gm. of starch and 6 Gm. of boric acid, and proceed as above
Lini (B. P. C.)	Add 28 Gm. of ground linseed gradually to 72 cc. of boiling water
Sinapis (B. P. C.)	Add 28 Gm. of ground linseed gradually to about 70 cc. of boiling water, then add 2 Gm. of powdered mustard, previously rubbed to a paste with a little cold water
Ulmi Fulvæ (B. P. C.)	Mix 24 Gm. of powdered slippery elm with 4 Gm. each of boric acid and wood charcoal, and gradually add 68 cc. of boiling water

Emplastra—*Plasters*

Modern plasters are practically all machine made. The official formulas are chiefly intended to serve as standards for manufacturers to insure uniformity of products. The spreading of plasters at the prescription counter as a pharmaceutical art and a general discussion of manufactured plasters will be found in Part XI. The following formulas and standards are official:

EMPLASTRUM ADHÆSIVUM. U. S. Adhesive Plaster

[Emp. Adhæs.—Emplastrum Elasticum, U. S. P. IX, Rubber Adhesive Plaster]

A mixture of rubber, resins, and waxes, with a filler of an absorbent powder, such as zinc oxide, orris root, or starch, mechanically mixed and spread upon cotton cloth.

The plaster mass should contain about 30 per cent of pure rubber. When zinc oxide is used, it should represent at least 20 per cent of the plaster mass.

The mass must be free from nodules and spread evenly on a cotton fabric backing having not less than 62 threads to each square cm., each piece of 100 square cm. weighing not less than 1.18 Gm.

One hundred square cm. of the Plaster should contain not less than 1.50 Gm. of the plaster mass.

A strip of the Plaster 5 cm. by 6.5 cm., applied to a hard wood surface for thirty minutes at a constant temperature of 37° C., should resist a tension of not less than 40 pounds when applied by a tensile strength machine or other suitable device, the pull being exerted parallel with the warp and with the longer dimension of the Plaster. An instrument used in the application of this test is shown in Fig. 743.

EMPLASTRUM BELLADONNÆ. U. S. Belladonna Plaster

[Emp. Bellad.]

Belladonna Plaster contains extract of belladonna corresponding to not less than 0.25 per cent and not more than 0.30 per cent of the alkaloids of belladonna leaves.

Assay—Introduce 10 Gm. of Belladonna Plaster into a 100 cc. flask. (If the plaster is spread on fabric, cut the portion to be assayed into strips, weigh accurately, and introduce it into the flask.) Now add 50 cc. of chloroform, and shake the mixture until the plaster is dissolved. Pour the chloroform solution into a 250 cc. beaker, and wash the cloth upon which the plaster was

spread with two successive portions of 25 cc. each of chloroform, adding the washings to the chloroform solution in the beaker. Then wash this cloth with 80 cc. of alcohol containing 1 cc. of ammonia T.S., and pour the washings into the chloroform solution in the beaker. Stir the mixture gently and allow it to stand until the rubber has separated into a compact mass. Dry the cloth upon which the plaster was spread, weigh it, and subtract its weight from the first weight of the plaster. Pour the chloroform-alcohol solution into a 250 cc. separator, rinse the beaker and rubber with 10 cc. of alcohol, and add the rinsing to the separator. Completely extract the alkaloids from the chloroform-alcohol solution by shaking out repeatedly with weak sulphuric acid. Collect the acid washings in a separator, and add ammonia T.S. until the solution is decidedly alkaline to litmus paper, and completely extract the alkaloids by shaking out repeatedly with chloroform. Filter the chloroform solution through a pledget of purified cotton, evaporate it to dryness and dissolve the alkaloids from the residue in exactly 5 cc. of tenth-normal sulphuric acid, and titrate the excess of acid with fiftieth-normal potassium hydroxide.

Each cc. of tenth-normal sulphuric acid corresponds to 0.02893 Gm. of the alkaloids of belladonna leaves (Proximate Assays, page 1497).

EMPLASTRUM CANTHARIDIS. U. S. Cantharides Plaster

[Emp. Canthar.—Fly Blister]

Cantharides Cerate,
Adhesive Plaster, spread on fabric, each, a sufficient quantity.

Spread cantharides cerate upon the plaster, leaving a margin around the edges. It may also be spread on muslin, paper, or other suitable material.

Each square cm. of spread plaster should contain 0.1 Gm. of cantharides cerate.

EMPLASTRUM CAPSICI. U. S. Capsicum Plaster

[Emp. Capsic.]

Capsicum Plaster contains not less than 0.25 Gm. of oleoresin of capsicum in each 15 square cm.

EMPLASTRUM PLUMBI OLEATIS. U. S. Lead Oleate Plaster

[Emp. Plumb. Oleat.—Emplastrum Plumbi U. S. P. IX, Lead Plaster, Diachylon Plaster]

	Metric	Alternative
Lead Monoxide	1000 Gm.	1 lb. av.
Olive Oil	1000 Gm.	1 lb. av.
Lard	1000 Gm.	1 lb. av.

Boiling Water, a sufficient quantity.

Heat the olive oil and lard by a gentle heat until liquefied, in a bright copper or other suitable vessel of a capacity of not less than four times the bulk of the ingredients, sift the lead monoxide through a fine sieve, upon the surface of the hot liquid, and mix thoroughly. Then gradually add 350 cc. (about 6 fluid ounces) of boiling water, and boil the mixture, constantly stirring with a wooden spatula, and adding sufficient boiling water from time to time to replace that lost by evaporation, until the mass is homogeneous and a small portion removed and dipped into cold water is found to be pliable and tenacious. Then remove it from the fire, and wash several times with warm water to remove the glycerin. Finally knead the mass until it is free from water, roll it into cylinders of suitable size, and wrap them in paper.

U. S. P. Preparations—Emplastrum Resinæ; Unguentum Diachylon.
N. F. Preparation—Emplastrum Saponis.

History—Diachylon Plaster was the name first applied to a plaster made from oil, litharge and certain plant juices by Menecrates, a physician to the Caesars. The name *diachylon* means prepared from juices. The preparation has not contained any plant juices for many centuries but the name still persists. Some of the older formulas were complicated examples of polypharmacy. It was known for a time under the name of *Emplastrum Commune* or *common plaster.*

EMPLASTRUM SINAPIS. U. S. Mustard Plaster

[Emp. Sinap.—Mustard Paper]

A uniform mixture of powdered black mustard (deprived of its fixed oil) and a solution of rubber, spread on paper, cotton cloth, or other fabric.

Each 100 square centimeters of spread plaster contains not less than 2.5 Gm. of black mustard deprived of its fixed oil.

When moistened thoroughly with tepid water and applied to the skin, the Plaster produces a decided warmth and reddening of the skin within five minutes.

Preserve in tightly-closed containers.

Before Mustard Plaster is applied, moisten it thoroughly with tepid water.

Uses—(See page 993).

EMPLASTRUM FUSCUM CAMPHORATUM. N. F. Camphorated Brown Plaster

[Emp. Fusc. Camph.—Camphorated Mother Plaster]

	Metric	Alternative
Red Lead Oxide	**30 Gm.**	1 oz. av. 25 gr.
Olive Oil	**60 Gm.**	2 oz. av. 51 gr.
Yellow Wax	**15 Gm.**	231 gr.
Camphor	**1 Gm.**	15 gr.

Triturate the red oxide of lead with 55 Gm. [1 oz. av. 411 gr.] of the oil in a suitable kettle until a smooth paste results, and boil the mixture over a fire, with constant stirring, until gas bubbles rise, or until the red color of the mixture begins to turn brown. Then moderate the heat, but continue the stirring until the mixture has acquired a dark-brown color. From time to time allow a few drops of it to fall into cold water to test its condition, and when it congeals to a firm consistence remove the vessel from the fire, add the wax cut into small pieces, and finally the camphor, previously rubbed to a smooth paste with the rest of the olive oil. Mix thoroughly, allow the mixture to partly cool, and while still warm pour it into paper molds, previously coated with mucilage of acacia containing about five per cent of glycerin and allowed to dry.

EMPLASTRUM SAPONIS. N. F. Soap Plaster

[Emp. Sapon.]

	Metric	Alternative
Soap, dried, and in coarse powder	**10 Gm.**	175 gr.
Lead Oleate Plaster	**90 Gm.**	3 oz. av. 262 gr.
Water, a sufficient quantity,		
To make about	**100 Gm.**	4 oz. av.

Rub the soap with enough water to reduce it to a semi-liquid, mix it with the lead oleate plaster, previously melted, incorporate thoroughly by stirring, and evaporate the mixture to the consistence of a plaster.

Some Unofficial Plasters

Title	*Directions*
Emplastrum Adhæsivum Elasticum (B. P. C.)	India rubber, kneaded into fine strips, 20.31 Gm., wool fat 53.12 Gm., copaiba 6.25 Gm., orris root, powder, 20.31 Gm., thymol 0.40 Gm., methyl salicylate 0.60 Gm., solvent mineral naphtha, a sufficient quantity
Belladonnæ (Br. 1914)	Liquid extract of belladonna 50 cc. and resin plaster 137.5 Gm.
Belladonnæ Viride (B. P. C.)	Dry extract of belladonna 25 Gm., chlorophyll sufficient to color, rubber adhesive plaster to make 100 Gm.
Calefaciens (warming plaster) (Br. 1914)	Dissolve 0.2 Gm. of Cantharidin in 20 cc. of chloroform, add 40 cc. of olive oil, and 940 Gm. melted resin plaster
Cantharidini (Br. 1914)	Melt together 450 Gm. yellow wax and 1000 Gm. wool fat, and add 2 Gm. cantharidin, dissolved in 100 cc. of chloroform
Cantharidini Mite (B. P. C.)	Melt together 50 Gm. yellow wax and 50 Gm. wool fat and add 0.10 Gm. cantharidin, dissolved in chloroform
Capsici (B. P. C.)	Liquid extract of capsicum 10 Gm., and resin plaster to make 100 Gm.
Capsici Elasticum (B. P. C.)	Liquid extract of capsicum 10 Gm., and rubber adhesive plaster 95 Gm.

Some Unofficial Plasters—*Continued*

Title	*Directions*
Emplastrum Hydrargyri (Br. 1914)	Heat 2 Gm. sublimed sulphur with 18 Gm. olive oil until a reddish-brown liquid is obtained; triturate 328 Gm. mercury until it is extinguished, and then add 652 Gm. of melted lead plaster
Menthol (Br. 1914)	Melt 100 Gm. yellow wax and 750 Gm. resin together, at about 70° C., and dissolve 150 Gm. menthol in the melted mixture
Plumbi (Br. 1914)	Lead oxide 400 Gm., olive oil 800 Gm., distilled water 400 cc., or a sufficient quantity (See U. S. P. X for process)
Resinæ (U. S. P. IX)	Resin 140 Gm., lead plaster 800 Gm., yellow wax 60 Gm., melt together
Resinæ (Br. 1914)	Resin 100 Gm., lead plaster 850 Gm., hard soap 50 Gm., melt together
Salicylicum Compositum (B. P. C.)	Salicylic acid 20 Gm., extract of Indian hemp 10 Gm., rubber adhesive plaster 70 Gm.
Salicylicum Compositum Fortius (B. P. C.)	Salicylic acid 40 Gm., extract of Indian hemp 5 Gm., India rubber, kneaded into fine strips, 15 Gm., wool fat 40 Gm., copaiba 5 Gm., thymol 0.3 Gm., methyl salicylate 0.45 Gm., solvent mineral naphtha, a sufficient quantity
Salicylicum Elasticum (B. P. C.)	Salicylic acid 10 Gm., rubber adhesive plaster, 90 Gm.
Saponis (Br. 1914)	Hard soap 140 Gm., lead plaster 835 Gm., resin 25 Gm.
Zinci oxidi (B. P. C.)	Zinc oxide 20 Gm., rubber adhesive plaster 80 Gm.

Manufacturers' Standards for India Rubber Base Plasters

This consists of a mass containing approximately thirty-three per cent of plastic India rubber, Burgundy pitch, olibanum and waxes and thirty-three per cent of orris root and other fillers with which the drugs are incorporated.

Arnica Plaster—5 per cent solid extract of arnica.

Belladonna Plaster—0.25 to 0.30 per cent of the alkaloids of belladonna.

Belladonna and Capsicum Plaster—0.125 of the alkaloids of belladonna and 3.5 per cent of powdered capsicum.

Breast Plaster—0.25 per cent of the alkaloids of belladonna.

Cantharides Plaster (Blister Plaster)—30 per cent of powdered cantharides.

Capsicum Plaster—5 per cent of powdered capsicum.

Mercurial Plaster—30 per cent of metallic mercury.

Salicylic Acid Plaster—Made in two strengths, 10 per cent and 20 per cent of salicylic acid.

Salicylic Acid and Cannabis Indica Plaster—10 per cent of extract of cannabis indica and 40 per cent of salicylic acid.

Strengthening Plaster—2 per cent of ferric oxide.

Thapsia Plaster—6 per cent of resin of thapsia garganica.

Mullæ—*Mulls*

[Salve Mulls—Steatins]

Mulls are ointments of high fusing points, containing the desired medicinal agent, and spread on soft muslin or "mull", in a manner similar to the ordinary spread plasters. Although these mulls are more conveniently produced with the aid of special mechanical appliances, it is quite practicable to prepare them on a limited scale as follows:

Spread a sheet of moistened parchment paper on a smooth surface, wipe off the excess of moisture with a cloth, stretch evenly a corresponding piece of unsized mull upon the parchment paper and hold it in place with thumb-tacks. Then spread the previously melted and partly cooled ointment evenly on the mull by means of a broad, flat bristle brush, and, when a sufficient layer has been applied in this way, smooth the surface by the aid of two elastic spatulas, heated by immersion in hot water, wiped dry, and used alternately to expedite the operation. A smooth surface having been produced, remove the thumb-tacks and withdraw the mull from the parchment paper, the operation being facilitated by fastening the uncoated end of the mull upon a flat stick of wood. Then suspend the mull on a string in a cool room, and when thoroughly chilled, cover it with paraffin paper and roll it into a cylinder.

The most suitable base for preparing Mulls is a mixture of suet and lard, in suitable proportions, with the occasional addition of wax or lead oleate plaster—this depending upon the nature of the medicinal component, or the intended use. The following formulas serve as examples:

MULLA ACIDI SALICYLICI. N. F. Salicylic Acid Mull

[Mull. Ac. Salicyl.—Unguentum Salicylatum Extensum]

	Metric	Alternative
Salicylic Acid	10 Gm.	175 gr.
Benzoinated Suet	80 Gm.	3 oz. av. 87 gr.
Benzoinated Lard	10 Gm.	175 gr.
To make	100 Gm.	4 oz. av.

Mix the salicylic acid intimately with the benzoinated lard and then incorporate the benzoinated suet. Spread the mull as needed.

MULLA CREOSOTI SALICYLATA. N. F. Salicylated Creosote Mull

[Mull. Creosot. Salicyl.—Unguentum Creosoti Salicylatum Extensum]

	Metric	Alternative
Salicylic Acid	10 Gm.	175 gr.
Creosote	20 Gm.	350 gr.
Yellow Wax	5 Gm.	87 gr.
Benzoinated Suet	65 Gm.	2 oz. av. 262 gr.
To make	100 Gm.	4 oz. av

Melt the yellow wax, add the benzoinated suet, incorporate the creosote and salicylic acid, and stir until the product congeals. Spread the mull as needed.

MULLA HYDRARGYRI CHLORIDI CORROSIVI. N. F. Corrosive Mercuric Chloride Mull

[Mull. Hydrarg. Chlor. Corros.—Unguentum Hydrargyri Chloridi Corrosivi Extensum]

	Metric	Alternative
Corrosive Mercuric Chloride	2 Gm.	3½ gr.
Alcohol	60 cc.	105 min.
Benzoinated Suet	900 Gm.	3 oz. av. 262 gr.
Benzoinated Lard	50 Gm.	88 gr.
To make about	1000 Gm.	4 oz. av.

Dissolve the corrosive mercuric chloride in the alcohol, mix this with the benzoinated lard, and then incorporate the benzoinated suet. Avoid contact with metallic implements or containers. Spread the mull as needed.

MULLA ZINCI. N. F. Zinc Mull

[Mull. Zinc.—Unguentum Zinci Extensum]

	Metric	Alternative
Zinc Oxide	10 Gm.	175 gr.
Benzoinated Suet	70 Gm.	2 oz. av. 350 gr.
Benzoinated Lard	20 Gm.	350 gr.
To make	100 Gm.	4 oz. av.

Mix the zinc oxide intimately with the benzoinated lard and incorporate the benzoinated suet. Spread the mull as needed.

Chartæ—*Papers*

Papers are preparations intended principally for external application, made either by saturating paper with medicinal substances or by applying the latter to the surface of the paper by the addition of some adhesive liquid. One paper is official in the N. F. (see Charta Potassii Nitratis, page 523).

CHARTA POTASSII NITRATIS. N. F. Potassium Nitrate Paper

[Chart. Pot. Nit.]

	Metric	Alternative
Potassium Nitrate	**200 Gm.**	7 oz. av. 24 gr.
Water	**800 cc.**	27 fl. oz. 24 min.

Dissolve the potassium nitrate in the water. Immerse strips of white, unsized paper in the solution, and dry them. Keep the paper in well-closed containers.

Suppositoria—*Suppositories*

Suppositories are largely prepared extemporaneously, at the prescription counter, only a few formulas being official. An extended presentation of the entire subject will be found in Part XI. The formula for Glycerinated Gelatin has also been included here as it is the basis for one type of suppositories.

SUPPOSITORIA GLYCERINI. U. S. Suppositories of Glycerin

[Supp. Glycerin.]

	Metric	Alternative
Glycerin	**80 Gm.**	2 oz. av. 360 gr.
Monohydrated Sodium Carbonate	**2 Gm.**	31 gr.
Stearic Acid	**8 Gm.**	123 gr.
Water	**10 cc.**	154 gr.
To make about	**30 Suppositories**	30 Suppositories

Dissolve the monohydrated sodium carbonate in the water and add it to the glycerin contained in a suitable vessel, placed in a water bath in such a way that the vessel is well immersed in the boiling water and its contents protected as much as possible from the steam of the bath. Add the stearic acid and heat the mixture for fifteen minutes or until the carbon dioxide ceases to be evolved, and the liquid is clear. Then pour the melted mass into suitable molds, remove the suppositories when they are completely cold, and preserve them in tightly-stoppered glass vessels in a cool place.

SUPPOSITORIA BOROGLYCERINI. N. F. Suppositories of Boroglycerin

[Supp. Boroglycerin.]

	Metric	Alternative
Glycerinated Gelatin	**20 Gm.**	309 gr.
Glycerite of Boroglycerin	**15 Gm.**	231 gr.
Glycerin	**15 Gm.**	231 gr.

To make 12 (twelve) rectal suppositories.

Melt the glycerinated gelatin on a water bath, add the glycerite of boroglycerin and glycerin and mix well. Pour the uniform mixture into well-oiled molds of the required size, which should be slightly warmed, and allow it to stand until the suppositories are firm. Dispense the suppositories in glass containers.

Some Unofficial Suppositories

Title	*Directions*
Suppositoria Acidi Carbolici (Br. 1914)	Dissolve 0.8 Gm. of phenol in 0.5 Gm. of white wax and enough oil of theobroma, previously melted, to make 12 suppositories, and pour into molds
Acidi Tannici (Br. 1914)	Mix, with trituration, 2.4 Gm. of tannic acid with sufficient melted oil of theobroma to make 12 suppositories, and pour into molds
Belladonnæ (Br. 1914)	Prepare as directed for tannic acid, using 1.7 cc. of liquid extract of belladonna
Iodoformi (Br. 1914)	Prepare as directed for tannic acid, using 2.4 Gm. of iodoform
Morphinæ (Br. 1914)	Prepare as directed for tannic acid, using 0.2 Gm. of morphine hydrochloride
Plumbi Composita (1914)	Prepare as directed for tannic acid, using 2.4. Gm. of lead acetate and 0.8 Gm. of opium

Since Glycerinated Gelatin is largely used in suppositories the formula is placed below:

GELATINUM GLYCERINATUM. U.S. Glycerinated Gelatin

[Gelat. Glycerin.]

	Metric	Alternative
Gelatin	100 Gm.	4 oz. av.
Glycerin	100 Gm.	4 oz. av.
Water, a sufficient quantity,		
To make	200 Gm.	8 oz. av.

Pour upon the gelatin sufficient water, which has been previously boiled and cooled, to cover it, allow it to stand one hour, pour off the water, and allow the gelatin to drain for a few minutes. Then transfer it to a dish, add the glycerin, and heat on a water bath until the gelatin is dissolved. Strain the solution while hot, transfer to a tared dish, and continue the heat on the water bath until the product weighs 200 Gm. [8 oz. av.]. When cold, cut the mass into pieces, and preserve in well-closed containers.

STILI MEDICAMENTORUM—Medicated Pencils

[**Stil. Medic.**—UNNA PENCILS, PASTE PENCILS, STILUS DISSOLUBILIS, STILUS UNGUENTIS, STILI DILUBILES, N. F. IV]

Pencils for the direct application of medicinal agents to the skin, used in dermatologic practice. The medicinal agent is incorporated with a paste consisting of starch, dextrin, tragacanth and sucrose, with sufficient water to form a plastic mass. This is rolled into cylinders, of about 5 mm. diameter, which are cut into sections about 5 cm. long, dried on parchment paper at room temperature, and wrapped in tin-foil. Medicated pencils, intended as a caustic application, as sticks of silver nitrate, are sometimes referred to as *escharotica*. The following formula serves as an example:

STILI ACIDI SALICYLICI. N.F. Salicylic Acid Pencils

[**Stil. Acid. Salicyl.**—STILUS ACIDI SALICYLICI DILUBILIS]

	Metric	Alternative
Salicylic Acid, in fine powder	10 Gm.	154 gr.
Tragacanth, in fine powder	5 Gm.	77 gr.
Starch, in fine powder	30 Gm.	1 oz. av. 25 gr.
White Dextrin, in fine powder	35 Gm.	1 oz. av. 103 gr.
Sucrose, in fine powder	20 Gm.	309 gr.
Distilled Water, a sufficient quantity to make a firm plastic mass		

One hundred Gm. of this material is sufficient to make from 40 to 45 pencils.

Miscellaneous Unofficial Preparations

Applicatio—An old term used to imply preparations for external use.

Auristilla—This term is applied to preparations intended for the treatment of the internal ear. The National Formulary Compound Oil of Hyoscyamus is an illustration of the type.

Insufflatio—Insufflations are powders used for blowing into the nose, preferably by means of one of the various kinds of insufflators made for the purpose. They may also be applied in the way in which snuff is usually taken.

The formula for compound menthol snuff of the Br. Phar. Codex, as follows, is typical:

Menthol, in powder	5.00
Ammonium chloride, in powder	10.00
Boric acid, in powder	20.00
Lycopodium	65.00

Mix the powders.

Moxa—This term is used to indicate a soft wooly mass prepared from the young leaves of a Chinese wormwood, and used as a cautery by burning it on the skin; hence, any substance used in a like manner as a counterirritant.

Miscellaneous Unofficial Preparations—*Continued*

Pigmentum—Paints, also referred to as *Litus*, are liquid preparations usually medicated with substances possessing antiseptic, caustic, soothing, or stimulating properties. They are prepared with vehicles which render their consistence suitable for application to the skin or mucous surfaces by means of a brush. The character of the bases differs considerably, their selection depending upon the nature of the medicament to be applied, the duration of contact desired, and the degree of absorption required. Paints intended to remain in contact with a specified surface are usually prepared with collodion, glycerin, glycerin and water, solution of egg albumen in alcohol, or a solution of gutta percha. Paints intended to be absorbed are prepared with oleic acid or fatty oils. Caustic substances when employed as paints are usually applied dissolved in distilled water, and occasionally in alcohol or ethereal vehicles. Resinous substances, such as benzoin, storax, balsam of tolu, or sandarac, dissolved in ether, are employed as bases for medicated varnishes, and used for application to the skin and raw mucous surfaces. Bottles fitted with glass stoppers are usually most suitable as containers for paints. Paints containing chromic acid are applied by means of glass brushes.

Sinapismus—This is an old term applied to a vesicant or blistering agent. A number of substances are used to produce this effect, such as a mustard poultice or mustard plaster (see page 520), or some form of cantharides (see page 519), or thapsia (see page 521).

Vaporis—This term is used as the class name for a number of preparations in the Br. Phar. Codex. These preparations are intended to be vaporized, usually through the aid of heat, although in some instances, an atomizer or nebulizer is employed. They perform their function through inhalation.

A typical preparation is *benzoin inhalation* in which a teaspoonful of compound tincture of benzoin is added to about 1 quart of hot water and the vapor inhaled to relieve a bronchial congestion.

Another type of preparation is illustrated by the formula for *compound eucalyptus inhalation* or vapor in which 16.5 parts of oil of eucalyptus, 8.25 parts of pinus pumilionus, and the same quantity of a strong tincture of iodine, also 16.5 parts of camphor, are dissolved in 34 parts of 10 per cent spirit of ammonia. Pine sawdust is saturated with the mixture which is then used by inhalation. Other formulas will be found in the Codex.

When the material to be inhaled is not liquid, it is known as *vapor siccus*, an illustration being well-known dry smelling salts.

PART IV

INORGANIC CHEMICAL COMPOUNDS

CHAPTER XXXIX

THEORY OF INORGANIC CHEMISTRY

UP TO the present chapter of this book numerous fundamental facts have been considered covering definitions of importance in the study of pharmacy, and the description and discussion of various operations and processes which are necessary in the preparation and compounding of medicines.

At this point will begin the detailed consideration of the substances actually used in pharmacy and medicine.

The group of substances known commonly as chemical compounds or "chemicals" will be taken up at first, beginning with those classified as *inorganic* and later taking up those belonging to the *organic* groups.

It is not to be understood that the following introductory pages are intended to take the place of a complete textbook on chemistry. The discussion of the subject will serve, however, to render the chemical portions of the text intelligible to an apprentice or student who does not happen to possess a textbook on elementary chemistry and also as a review to the student or graduate pharmacist, and for the sake of such persons this section is included.

Chemistry is the science that concerns itself with matter and the changes that takes place in its composition. *Matter* is anything that occupies space and possesses weight. *Matter* as we ordinarily know it is *indestructible*. We may change its form but we cannot annihilate it by any means known to science. The *changes* which matter undergoes may be either *physical* or *chemical*. *Matter* is existent in three physical states—*solid*, *liquid*, and *gaseous*. If a substance changes from one of these states to the other, or undergoes solution, or any other kind of change which does not affect its identity, it is said to be subject to *physical change*. The change of water to ice, on one hand, or to steam, on the other, is in each case a physical change. When however, a change is produced in a substance that affects its identity, it is known as a *chemical change*. The rusting of iron and the striking of a match to kindle a flame are examples of chemical changes. Examples of physical and chemical changes applied to the same substance are afforded by the case of sulphur. If sulphur is heated in a closed vessel, without application of flame, it undergoes vaporization, and sublimes, depositing sulphur in microcrystalline form with no change of identity. If, however, sulphur is heated in the open air to the ignition point, it burns with a characteristic blue flame and loses its identity as elemental sulphur, being converted into a compound of sulphur with oxygen, known as sulphur dioxide.

Chemical change may include (1) *direct combination*, as when sulphur attaches itself to oxygen, as described in the preceding experiment; (2) *rearrangement of fundamental factors*, in which new substances may be formed by *chemical reaction*, as it is called; (3) *by decomposition*, in which complex bodies may be resolved into these that are simpler, as would be illustrated by resolving sulphur dioxide back again into sulphur and oxygen.

The decomposition or subdivision of matter cannot be carried on indefinitely. A point is reached in which substances of great stability known as *elements* are encountered. The fundamental factors of elements in connection with the study of chemical properties and chemical changes are *molecules* and *atoms*. The atom is the normal unit of chemical activity.

The smallest particle into which matter can be subdivided and retain its identity, is the *atom*.[1] The atom possesses an invariable weight and a definite power of attraction. The *atoms* combine with each other to form *molecules*.[2] Molecules when composed of like atoms are simple molecules, and matter composed of such molecules is called an elemental substance or an *element*. Molecules may also be composed of unlike atoms. Such products are known as *chemical compounds*. When the elements are arranged in the order of their atomic weights, they show certain groupings in which elements of similar chemical character are brought together. Several such arrangements were proposed nearly a century ago, but the one that has proved to be of the greatest value is known as the *periodic system* of *Mendelejeff*. (See table of Elements, page 531.)

When the composition of a compound body is ascertained by separating it into simpler factors, the process is called *analysis*. *Proximate analysis* is where a complex product is resolved into simpler factors which are not elemental, any one of these factors being quantitatively determined, as in the estimation of morphine in opium, or of potassium iodide in Lugol's solution. *Ultimate analysis* is when the elemental factors themselves are sought, as in the analysis of quicklime to determine the amounts of calcium and oxygen, or of sugar to determine the amounts of carbon, hydrogen, and oxygen.

The opposite of analysis is *synthesis*. This is the process of combining simpler substances to form those that are more complex. The word *synthetic* is applied to certain compounds that have been produced in this manner to distinguish them from similar compounds of natural origin. The word *artificial* is

---

[1] *The Atom.*

Modern researches on the structure of the atom indicate that all elements have a common relationship, in that there are only two factors present in the atom, i.e., the *nucleus*, and the *electron*. The mass or weight of the atom is concentrated almost entirely in the nucleus, which is near the center of the atom. The electrons are spaced about the nucleus in a systematic manner, but whether the electrons revolve about the nuclei or are merely in a state of constant oscillation has not been decided. The electron is not matter at all but is a manifestation of force. It is the same factor or unit that produces certain phenomena of electricity and radio activity. The simplest and lightest atom is that of hydrogen which contains a single nucleus and a single electron. The nucleus in the case of the hydrogen atom is called the *proton*. The most complex atom of elemental matter and the heaviest is uranium. According to the interpretation of the periodic system, in the light of modern atomic theories, there are 92 possible elements, of which all but three have been discovered. Those most recently discovered were Hafnium, Masurium and Rhenium.

All nuclei are charged with, or may consist of positive electricity. All electrons consist of negative electricity. The balance between these forces is the cause of the stability of the atom. The spontaneous disintegration of *radium* to yield *helium* and *lead* as products of its dissociation has renewed a belief in the theoretical transmutation of the elements, or conversion of one element into another one closely related in the atomic scale. The open structure of the atom is another of the astonishing discoveries of modern physical research. It has not been possible to draw a diagram of the hydrogen atom to scale, for if the nucleus were magnified to a size visible to the naked eye, the electron would have to be placed several hundreds of miles distant to be in proportion.

Atomic structure therefore may be compared to our solar system as regards density.

[2] *The Molecule.*

The size and numbers of molecules as well as their weight have been determined during recent years by physical chemists, with astonishing accuracy.

If a single drop of water were to be magnified to the size of the earth, the molecules would be only about the size of oranges, and would be separated from each other by great open spaces in which they would be free to vibrate or oscillate by the mysterious force known as molecular motion. These molecules themselves are composed of atoms whose open structure is also described in the note under the atom. The speed of this vibration or oscillation (which is independent of the motion of the atomic nuclei and electrons, elsewhere described), is greater than that of a rifle bullet, and it is estimated that each molecule collides with another one about five billion times in every second.

A single glass of water (about 250 cc.). contains about 10,000,000,000,000,000,000 molecules. The significance of this figure cannot be grasped even when written out, but physicists have suggested another means of comparison. If a single glass of water were to be dipped out of the ocean, and then poured back; and, if it is possible to conceive of this original glassful of water being uniformly diffused throughout all the oceans of the world, and another glassful of the same size were then dipped from the ocean, about 2000 molecules which were originally in the first glass of water would be found in the second, if there were means of recognizing them.

sometimes confused with the word *synthetic* in its usage. Artificial means prepared by art and does not signify identity of constitution, but similarity of character or use. Synthetic means identical chemical character but prepared by chemical process and not of natural origin.

Chemists have never been able to isolate or render visible either atoms or molecules, but they have established some fundamental rules that have served admirably to develop chemistry into an exact or mathematical science. Among the general principles of importance are the following:

1. *The atom of each element has a constant and definite weight in its relation to the other elements.* This factor is called the *atomic weight* and is of great importance in chemical calculations.
2. *The atom of hydrogen is the lightest of all atoms,* and is taken as unity in the determination of atomic weights.
3. *Combination takes place between atoms in consequence of an attractive force called chemical affinity.*
4. *Every chemical compound is definite in its nature, and the proportion of its constituents is always constant.*

This is known as the law of constant proportions.

Pure water always consists of 11.2 per cent of hydrogen and 88.8 per cent of oxygen, by weight, corresponding to two atoms of hydrogen and one atom of oxygen.

5. *Elements may combine in more than one set of proportions.* With each change in proportions, however, a different chemical compound results.

This has given rise to a second rule as follows: *When elements combine in more than one proportion, the higher proportions are simple multiples of the lower.* This is known as the law of multiple proportions. Thus two compounds of carbon and oxygen are known in which the first consists of one atom of carbon and one atom of oxygen, written CO, the second consists of one atom of carbon and two atoms of oxygen, written CO_2.

Chemistry, in order to be easily understandable and at the same time mathematically exact, has for many years employed a *system of notation,* which might be called chemical shorthand. A *chemical symbol* is an abbreviation of the name of an element. In many cases an initial letter is used, as H for hydrogen, O for oxygen, C for carbon, S for sulphur, etc. Where more than one element has the same initial letter, the proper distinction is attained by assigning the single initial letter to the most frequently occurring or important element and attaching appropriate small letters to the initial letters in other conflicting cases. Thus Os stands for Osmium to distinguish it from oxygen, and Cl for Chlorine, Ca for Calcium, Co for Cobalt, are several instances of avoiding confusion with the C for carbon.

In some cases the symbol is derived from the Latin name of the element. Thus iron is represented by Fe for *ferrum;* lead by Pb for *plumbum;* silver by Ag for *argentum;* potassium by K for *kalium,* and sodium by Na for *natrium,* to exemplify a few of the more common instances. The student of chemistry should memorize the names and symbols of all of the important elements as a fundamental step in his studies in order that he may be able to read and understand chemical formulas and equations.

To express the combination of elements, so as to indicate with absolute mathematical certainty the composition of a compound body, the symbols are written together like the letters of a word. A properly arranged collection of symbols representing a definite chemical compound is called a *formula.* In a chemical formula the symbol represents a single atom of the element. Where

more than one atom of an element is present the fact is indicated by placing a small number on the lower right hand side of the symbol to which it applies. Thus CaO is the chemical formula for one molecule of calcium oxide or quicklime, in which one atom each of calcium and oxygen are present, while CaO_2 is the formula for one molecule of calcium peroxide which contains one atom of calcium and two atoms of oxygen. In case several atoms are multiplied by the same number, a large figure is placed in front or the group is placed in a parenthesis and a small figure attached to the lower right hand, as in the case of single elements. Thus 4 H_2O might also be written $(H_2O)_4$ as they are mathematically identical The large figures used to precede a formula are usually employed to indicate the number of complete molecules, while the parenthetical grouping is used to indicate the number of certain groups, sometimes called radicles. The following complex formula of an official chemical compound will serve to illustrate all of the possibilities of these uses of modifying numbers:

$$(MgCO_3)_4.Mg(OH)_2.5H_2O.$$

If the foregoing formula were written in the most condensed form possible, it would be given as follows: $Mg_5C_4O_{19}H_{12}$. Such a formula is called an *empiric* or *empirical formula*. It is frequently meaningless in comparison with a formula written as previously given, which is known as a *rational formula*, because it shows, by the use of the reasoning power of the observer, the compound to consist of four molecules of normal magnesium carbonate, one molecule of magnesium hydroxide and five molecules of water, this entire combination constituting *official magnesium carbonate*.

Several other types of formulas are in use besides those described. In a *structural formula*, sometimes called a *graphic formula*, the symbols of the elements are so arranged as to show by bonds of attachment the structural relationship of the elements in a compound. Thus CO_2 is the common empiric formula of carbon dioxide (in such simple compounds the empiric and the rational formulas are usually identical), while, when the same compound is written: O=C=O, it shows the structural relationships of the carbon to the oxygen. Structural formulas have their most important use in organic chemistry and are very complex at times.

Still another type of formula is called the *stereochemical formula* in which attempts are made to show the three or dimensional relationship of the atoms in space. This type will be discussed in the introductory chapter to organic chemistry.

Valence—The combining power of an atom or a group of atoms to indicate the number of hydrogen atoms with which it might combine or might displace, is known as valence. It is sometimes called *replacing value* or *saturating power*. In some elements the valence is indirect or comparative, because there is no known compound of the element with hydrogen. In such cases valence is determined by indirect comparison. Degrees of valence are indicated by Greek or Latin names or prefixes and Roman numerals, the latter being placed to the upper right hand of the symbol.

I indicates a monad, the element being referred to as monovalent, or univalent.
II indicates a dyad (bivalent).
III indicates a triad (trivalent).
IV indicates a tetrad (tetravalent, or quadrivalent).
V indicates a pentad (pentavalent, or quinquevalent).
VI indicates a hexad (hexavalent).
VII indicates a heptad (heptavalent).

Valence has nothing to do with energy or chemical activity. It is a measure of combining capacity only. Degrees of valency are a matter of established record, the same as are atomic weights. They must be correctly learned, for a knowledge of the valence of the elements is the key to the composition of all chemical compounds and enables chemical formulas and equations to be comprehended and written with ease.

When elements are combined in such proportion that their valences are equalized, compounds are said to be *saturated*. *Unsaturated* compounds are represented by groups known as *radicles*.

The following list of the more important elements gives the valences:

Table of the Elements with their Symbols, Valences, and Atomic Weights
Adopted by the International Committee on Chemical Elements[1]

The basis for this table is **Oxygen = 16**

Name	Symbol	Valence		Atomic[2] Weight 1921	Atomic Weight 1925
		Positive	Negative		
Aluminum	Al	III	—	27.0	26.97
Antimony	Sb	III and V	III	120.2	121.77
Argon	A	O	—	39.9	39.91
Arsenic	As	III and V	III	74.96	74.96
Barium	Ba	II	—	137.37	137.37
Bismuth	Bi	III	—	209.0	209.0
Boron	B	III	III	10.9	10.82
Bromine	Br	I, III, V and VII	I	79.92	79.916
Cadmium	Cd	II	—	112.40	112.41
Calcium	Ca	II	—	40.07	40.07
Carbon	C	IV	IV	12.005	12.000
Cerium	Ce	III and IV	—	140.25	140.25
Cesium	Cs	I	—	132.81	132.87
Chlorine	Cl	I, III, V and VII	I	35.46	35.457
Chromium	Cr	II, III and VI	—	52.0	52.01
Cobalt	Co	II and III	—	58.97	58.97
Columbium	Cb	III and V	—	93.1	93.1
Copper	Cu	I and II	—	63.57	63.57
Dysprosium	Dy	III	—	162.5	162.52
Erbium	Er	III	—	167.7	167.7
Europium	Eu	III	—	152.0	152.0
Fluorine	F	—	I	19.0	19.0
Gadolinium	Gd	III	—	157.3	157.26
Gallium	Ga	III	—	70.1	69.72
Germanium	Ge	IV	—	72.5	72.60
Glucinum	Gl	II	—	9.1	9.02
Gold	Au	I and III	—	197.2	197.2
Helium	He	O	—	4.0	4.00
Holmium	Ho	III	—	163.5	163.4
Hydrogen	H	I	—	1.008	1.008
Indium	In	III	—	114.8	114.8
Iodine	I	I, III, V and VII	I	126.92	126.932
Iridium	Ir	II, III and IV	—	193.1	193.1
Iron	Fe	II and III	—	55.84	55.84
Krypton	Kr	O	—	82.92	82.92
Lanthanum	La	III	—	139.0	139.0
Lead	Pb	II and IV	—	207.2	207.2
Lithium	Li	I	—	6.94	6.94
Lutecium	Lu	III	—	175.0	175.0
Magnesium	Mg	II	—	24.32	24.32

[1] A new element has recently been discovered in monazite residues by Prof. B. S. Hopkins, of the University of Illinois. Its isolation and identification have been made possible by means of X-ray photographs and the spectroscope. This element belongs to the group of rare earth elements and has been given the name, *Illinium*, and the symbol, Il.

[2] The 1921 atomic weights are used in the U. S. P. X. and in the N. F. V., as the 1925 table was not available in time.

Table of the Elements with their Symbols, Valences and Atomic Weights—*Continued*

Name	Symbol	Valence		Atomic Weight 1921	Atomic Weight 1925
		Positive	Negative		
Manganese	Mn	II, III, IV and VII	—	54.93	54.93
Mercury	Hg	I and II	—	200.6	200.61
Molybdenum	Mo	III, IV and VI	—	96.0	96.0
Neodymium	Nd	III	—	144.3	144.27
Neon	Ne	O	—	20.2	20.2
Nickel	Ni	II and III	—	58.68	58.69
Niton (Radon)	Nt	O	—	222.4	222.4
Nitrogen	N	III and V	III	14.008	14.008
Osmium	Os	II, III, IV and VI	—	190.9	190.8
Oxygen	O	—	II	16.0	16.00
Palladium	Pd	II and IV	—	106.7	106.7
Phosphorus	P	III and V	III	31.04	31.027
Platinum	Pt	II and IV	—	195.2	195.23
Potassium	K	I	—	39.1	39.096
Praseodymium	Pr	III	—	140.9	140.92
Radium	Ra	II	—	226.0	225.95
Rhodium	Rh	II and IV	—	102.9	102.91
Rubidium	Rb	I	—	85.45	85.44
Ruthenium	Ru	II and IV	—	101.7	101.7
Samarium	Sa	III	—	150.4	150.43
Scandinum	Sc	III	—	45.1	45.1
Selenium	Se	II, IV and VI	—	79.2	79.2
Silicon	Si	IV	IV	28.1	28.06
Silver	Ag	I	—	107.88	107.88
Sodium	Na	I	—	23.0	22.997
Strontium	Sr	II	—	87.63	87.63
Sulphur	S	II, IV and VI	II	32.06	32.064
Tantalum	Ta	III and V	—	181.5	181.5
Tellurium	Te	IV and VI	II	127.5	127.5
Terbium	Tb	III	—	159.2	159.2
Thallium	Tl	I and III	—	204.0	204.39
Thorium	Th	IV	—	232.15	232.15
Thulium	Tm	III	—	169.8	169.4
Tin	Sn	II and IV	—	118.7	118.7
Titanium	Ti	IV	—	48.1	48.1
Tungsten	W	II, IV and VI	—	184.0	184.0
Uranium	U	IV and VI	—	238.2	238.17
Vanadium	V	III and V	—	51.0	50.96
Xenon	Xe	O	—	130.2	130.2
Ytterbium	Yb	III	—	173.5	173.5
Yttrium	Yt	III	—	89.33	89.33
Zinc	Zn	II	—	65.37	65.37
Zirconium	Zr	IV	—	90.6	91.0

Several Facts of Interest about the Elements.

Although ancient civilizations and early peoples were familiar with the metallic elements, gold, silver, iron, copper, mercury, lead, etc., and with a few of the non-metallic elements, such as sulphur and carbon which occur free in nature, they seem to have had no conception of their fundamental character and ascribed elemental properties to earth, air, fire, and water.

It was not until about 1803 that the work of Dalton resulted in the formulation of an atomic theory, which, while presupposing the indestructibility of the atom concerning which there is now grave doubt, served the important purpose of developing chemistry into an exact mathematical science of inestimable practical and economic value.

Most of the elements are uncommon and even their names are not familiar except to the scientific workers. Some are of greater industrial importance than others, such as iron and copper. A few are valued for their rarity and stability, such as gold and platinum.

Chemists and geologists have made a survey of the estimated composition of the earth's crust and the frequency of the occurrence of the elements together, with their approximately relative amounts, and the results are somewhat surprising. Ten elements make up over 99 per cent of the earth's crust. They are oxygen, silica, aluminum, iron, calcium, magnesium, sodium, potassium, carbon, and phosphorus. Sulphur, hydrogen, chlorine, and nitrogen come next, and the 78 remaining elements, some of which are among the commonest in pharmacy and in every day life, make up the very small proportion remaining.

A few of the elements are associated intimately with life processes and are found in what are known as organic compounds which are primarily compounds of carbon. These compounds will be further discussed under the heading—Introduction to Organic Chemistry.

Monad elements combine in equal atomic proportions. Examples, NaCl, HI, KBr, etc.

Dyad elements combine in equal atomic proportions also, as FeS, CaO, etc.

When a dyad element combines with a monad element, it requires two of the latter to each one of the former. Examples H_2O, $HgCl_2$, etc.

Triad elements follow analogous combining rules. It requires three monads for each triad as in $SbCl_3$ or three dyads for each two triads as in As_2O_3.

Valence is sometimes expressed for purposes of instruction and in structural formulas by means of hypothetical bonds attached to the symbol.

Examples:

H—(monad) —O—or O = (dyad)

—A—or As≡(triad) —C—or =C= or C≣ tetrad

and so on similarly to the end of the list.

The degrees of valence are not invariable. A number of elements (such as chlorine for example) exhibit more than one valence. When an element changes its valence, either increasing or diminishing, the change is by two degrees at a time. Thus chlorine may be univalent, trivalent, pentavalent, or septivalent:

Cl— Cl≡ Cl≣ Cl≣

Instances where an apparent change of one degree occurs are accounted for by the assumption that the atoms have the power of combining with their own kind. For example, mercury is ordinarily a bivalent element, combining with chlorine to form mercuric chloride, $HgCl_2$ exhibiting normal valence, Cl—Hg—Cl. To account for mercurous chloride (Hg_2Cl_2) the following structural relationship must be assumed: Cl—Hg—Hg—Cl.

Exceptions of this kind are not very numerous and may be easily remembered.

Valence variations are distinguished by the use of appropriate terminations, *ous* indicating a lower and *ic* indicating a higher valence. There is thus ferrous (dyad) and ferric (triad); cuprous (monad) and cupric (dyad); and numerous similar instances which the student needs to learn and remember in order to understand the theory of chemistry.

After having learned the names and symbols of the elements and the mathematical rules governing their use in formulas, the student must next learn the system of nomenclature, or naming of compounds, which when once mastered enables a person to name the compound accurately even though he may have never seen the particular formula before.

Chemical compounds which contain only two elements are known as *binary* compounds. They are named by joining the names of the elements in proper sequence and changing the name of the latter element to terminate in *ide* (written *id* in much of the chemical literature). Numerical modifications are indicated by proper Greek or Latin prefixes. To express the formula of such a compound, the symbols are simply placed together in the proper order, the more strongly electro-positive element being named first and with the proper modifying numerals, if necessary. For example, sulphur and oxygen combine to form several compounds. The simplest of these is called sulphur dioxide (*dioxide* meaning two atoms of oxygen) and is written SO_2, and the second is called sulphur trioxide (*trioxide* meaning three atoms of oxygen), and is written SO_3. The compound of sodium and chlorine (common salt) thus becomes sodium chloride (NaCl) and so on indefinitely.

In some of the older works on pharmacy and chemistry these same compounds are named in a slightly different manner as ZnO—monoxide of zinc; NaCl, chloride of sodium, etc. Other appropriate prefixes are used in special cases. Thus Cu_2O is called copper suboxide. The following list gives a range of examples of the previously discussed types:

Hg_2O—mercury suboxide—usually called mercurous oxide.
HgO—mercury oxide—usually called mercuric oxide.
NO_2—nitrogen dioxide—sometimes called nitrogen peroxide.
SO_3—sulphur trioxide—sometimes called sulphur oxide.
CCl_4—carbon tetrachloride.
PCl_5—phosphorus pentachloride.
SF_6—sulphur hexafluoride.

An intermediate form where the elements are present in the proportion of two of the first to three of the second takes the prefix *sesqui* (meaning one and one-half) as Fe_2O_3, iron sesquioxide.

The foregoing terminations apply to the second element. In the case of a series of compounds other terminations, applicable to the first element, are known.

Cl_2O—chlorine monoxide is known as hypochlorous oxide.
Cl_2O_3—chlorine sesquioxide is known as chlorous oxide.
Cl_2O_5—chlorine pentoxide is known as chloric oxide.
Cl_2O_7—chlorine heptoxide is known as perchloric oxide.

All of the foregoing rules apply to binary compounds, or those containing two elements, only.

There are some few compounds containing more than two elements in which the foregoing rules are applicable. Thus KOH is potassium hydroxide, looking upon the group represented by OH as though it were elemental; KCN is potassium cyanide, because the group CN, called the cyanogen radicle enters into compounds much like a single element. Another such group commonly seen, which combines as a single element, is the ammonium group, NH_4.

Compounds containing three or more elements are called *ternary compounds*. For these and still more complex compounds, special rules of nomenclature are necessary. Among the more frequently occurring classes of compounds in chemistry are what are known as *acids*, *bases*, and *salts*.

An *acid* is a compound of an electro-negative element, or group of elements, with hydrogen. Oxygen may or may not be present. Acids are sometimes called salts of hydrogen. Some acids are simple binary compounds, as HCl (hydrochloric acid) which is also known as hydrogen chloride. Others are ternary compounds and usually contain oxygen. As examples of a series of acids derived from the oxides of chlorine just discussed we have the following:

HClO—hypochlorous acid.
$HClO_2$—chlorous acid.
$HClO_3$—chloric acid.
$HClO_4$—perchloric acid.

An acid is often produced by the union of an oxide of an electro-negative element with water.

The relationship between the two foregoing tables can be illustrated by the following groupings of chemical symbols in what are known as chemical equations, which serve to show the value of the symbols and figures in express-

ing chemical combinations or reactions and changes definitely and mathematically.

$$\underset{\text{hypochlorous oxide}}{Cl_2O} + \underset{\text{water}}{H_2O} = \underset{\text{hypochlorous acid}}{2HClO}$$

$$\underset{\text{chlorous oxide}}{Cl_2O_3} + \underset{\text{water}}{H_2O} = \underset{\text{chlorous acid}}{2HClO_2}$$

$$\underset{\text{chloric oxide}}{Cl_2O_5} + \underset{\text{water}}{H_2O} = \underset{\text{chloric acid}}{2HClO_3}$$

$$\underset{\text{perchloric oxide}}{Cl_2O_7} + \underset{\text{water}}{H_2O} = \underset{\text{perchloric acid}}{2HClO_4}$$

The number of acids is very great and many of them are of importance in pharmacy and chemistry. They possess many properties in common, among which are the power to neutralize bases or alkalies, to alter the colors of certain solutions known as indicators (as litmus which is turned red by acids) the power of reacting with metals, usually with the liberation of the hydrogen of the acid. They usually possess a sour taste, and in the concentrated condition are frequently destructive of animal and vegetable tissues.

Bases are usually compounds of electro-positive elements with the combination of oxygen and hydrogen written (OH) and known as *hydroxyl*. They are frequently called alkalies, or hydroxides. Examples of commonly occurring bases are:

KOH — potassium hydroxide.
$NaOH$ — sodium hydroxide.
$(NH_4)OH$ — ammonium hydroxide.
$Ca(OH)_2$ — calcium hydroxide.

Some of the hydroxides are produced from the oxides by the combining action of water as in the following cases:

$$K_2O + H_2O = 2\,KOH.$$
$$CaO + H_2O = Ca(OH)_2.$$

The characteristic properties of bases are the power to react with acids and neutralize them to form salts, to act upon indicators such as litmus in a distinctly different manner from acids (as litmus which is turned blue by bases), and the possession of a characteristic alkaline and disagreeable taste.

Salts are compounds formed by the union of bases and acids or by the action of alkalies upon metals or sometimes by the direct union of the elements themselves. They are compounds in which the hydrogen of an acid has been replaced in whole or in part by a positive element. The generic name *salt* must not be confused with the specific name of sodium chloride. In the following equations examples of salts are illustrated as produced in several different ways.

1. By neutralization of an acid by a base.

$$\underset{\text{hydrochloric acid}}{HCl} + \underset{\text{sodium hydroxide}}{NaOH} = \underset{\text{sodium chloride}}{NaCl} + \underset{\text{water}}{H_2O}$$

2. By direct combination of the elements.

$$\underset{\text{iron}}{Fe} + \underset{\text{iodine}}{I_2} = \underset{\text{ferrous iodide}}{FeI_2}$$

3. By action upon a metal by an acid with the formation of a salt and the liberation of hydrogen.

$$\underset{\text{iron}}{Fe} + 2\,\underset{\text{hydrochloric acid}}{HCl} = \underset{\text{ferrous chloride}}{FeCl_2} + \underset{\text{hydrogen}}{H_2}$$

Binary salts are named according to the rules previously discussed. Ternary salts are named by changing the terminal syllable of the acid in a definite manner and adding to the name any prefix which may have been used to distinguish the acid. Acids whose names end in *ic* form salts with names ending in *ate*. Acids whose names end in *ous* form salts with names ending in *ite*.

Taking the series of chlorine acids previously discussed:

Hypochlorous acid, $HClO$, forms hypochlorites,
Example: $NaClO$, sodium hypochlorite.

Chlorous acid, $HClO_2$, forms chlorites,
Example: $NaClO_2$, sodium chlorite.

Chloric acid, $HClO_3$, forms chlorates,
Example: $NaClO_3$, sodium chlorate.

Perchloric acid, $HClO_4$, forms perchlorates,
Example: $NaClO_4$, sodium perchlorate.

There are several types of salts which are distinguished by appropriate designations.

Normal salts, in which the replaceable hydrogen of an acid is entirely replaced by a metal or a positive group.

Examples:

$NaCl$ —sodium chloride.
$(NH_4)_2SO_4$ —ammonium sulphate.
Na_3PO_4 —sodium phosphate.
Na_2CO_3 —sodium carbonate.

Acid salts, in which the available hydrogen of an acid is only partly replaced by a metal.

Examples:

$NaHSO_4$ —acid sodium sulphate (sodium bisulphate).
NaH_2PO_4 —acid sodium phosphate (sodium biphosphate).
$NaHCO_3$ —acid sodium carbonate (sodium bicarbonate).

Mixed or double salts, in which the replaceable hydrogen of an acid is replaced by two different metals.

Examples:

$KNaC_4H_4O_6$ — potassium and sodium tartrate.

The term double salts is sometimes applied to combinations of two complete salts which crystallize together to form a definite chemical compound, as $K_2SO_4.Al_2(SO_4)_3$. Potassium aluminum sulphate (anhydrous alum).

Basic salts, also called sub- or oxy-salts are those in which not all of the hydroxyl or the oxygen of the underlying base has been replaced by an acid radicle.

Examples:

$BiONO_3$ — bismuth oxynitrate (bismuth subnitrate or basic bismuth nitrate).

$Ca(OH)Cl$ — basic calcium chloride or calcium subchloride.

Nomenclature—In the older nomenclature the basic or electro-positive elements had names ending in *um*, and it was customary to give the termination *a* to the oxide or hydroxide. Thus Mg was magnesi*um*, while MgO was magnesi*a*; K was potassi*um* while KOH was potass*a*; Na was sodi*um* while NaOH was sod*a*; Al was alumin*um*, while Al_2O_3 was alumin*a*, etc.

Prefixes from the Greek were formerly used in place of *ous* and *ic* terminations. Thus *proto*chloride of mercury was used for mercur*ous* chloride or calomel, and *deuto*chloride of mercury for mercur*ic* chloride or corrosive sublimate. *Proto* means first and *deuto* means second.

Chemical Reactions—Chemical Equations

A chemical equation is a collection of symbols or formulas and arithmetical signs so arranged as to give to one who understands the notation an exact picture of a chemical change which has been or can be produced. Such a change is called a chemical reaction.

It requires a number of words to express the fact that when sodium bicarbonate and hydrochloric acid are brought together, several new compounds are produced, *i. e.*, sodium chloride, carbon dioxide, and water. The same may be graphically and briefly expressed as follows:

$$NaHCO_3 + HCl = NaCl + H_2O + CO_2.$$

Furthermore, the symbolic equation gives more information than appears at first glance for it is also an accurate mathematical statement, and can be used as a basis for chemical calculations in either laboratory experiments or in manufacturing operations for ascertaining costs and yield.

This is made possible by the use of *molecular weights* in connection with a reaction like the foregoing. A molecular weight is the sum of the weights of the atoms composing a compound. Turning to the atomic weight table and using the figures therein given the following molecular weights for the substances mentioned are found by calculation:

$NaHCO_3$—

Na	$- 1 \times 23$	$=$	23.000
H	$- 1 \times 1.008$	$=$	1.008
C	$- 1 \times 12.005$	$=$	12.005
O_3	$- 3 \times 16$	$=$	48.000
			84.013 = The molecular weight of sodium bicarbonate.

HCl

H	$- 1 \times 1.008$	$=$	1.008
Cl	$- 1 \times 35.46$	$=$	35.460
			36.468 = The molecular weight of hydrochloric acid.

NaCl

Na	$- 1 \times 23$	$=$	23.00
Cl	$- 1 \times 35.46$	$=$	35.46
			58.46 = The molecular weight of sodium chloride.

H_2O

$H_2 - 2 \times 1.008 = 2.016$
$O - 1 \times 16 = 16.000$

18.016 = The molecular weight of water.

CO_2

$C - 1 \times 12.005 = 12.005$
$O_2 - 2 \times 16 = 32.000$

44.005 = The molecular weight of carbon dioxide.

Now rewriting the equation and giving each substance its appropriate molecular weight the following is found:

$$\underset{84.013}{NaHCO_3} + \underset{36.468}{HCl} = \underset{58.46}{NaCl} + \underset{18.016}{H_2O} + \underset{44.005}{CO_2}$$

If the figures on each side of the equation are now added it is found that $84.01 + 36.468 = 120.481$ and also that $58.46 + 18.016 + 44.005 = 120.481$. Therefore the equation balances mathematically as well as atomically and opens to the intelligent student a vista of what chemistry really means.

Following this logical train of thought, it is realized that as chemical compounds are invariable in their composition, for every 84.013 parts by weight of $NaHCO_3$ we will always require 36.486 parts of HCl for its neutralization, and that the resultant amount of NaCl will be 58.46 parts by weight. By arithmetical proportion these quantities may be translated into any units desired.

Suppose it is necessary to know how many ounces av. of NaCl will be yielded by the decomposition of 16 oz. av. of $NaHCO_3$—the proportion would be as follows:

$84.013 : 58.46 :: 16 : x$, or, by rounding off the decimals, and working out the proportion we obtain the answer 11.14 oz. av.

If there is occasion to know how many grams of $NaHCO_3$ will be required to produce 100 grams of NaCl, the proportion, rounding off the decimals, would be as follows:

$58.5 : 84 :: 100 : x$ and the working out of this proportion gives the answer 143.6 grams.

The student who fully and clearly understands the principles involved in the foregoing calculations and the mathematical deductions which have resulted from a close study of it need have no fear that chemistry will prove a difficult subject, for the entire science is based upon the same principles and similar deductions. Chemical calculations are sometimes included in a separate branch of study known by the formidable name of *stoichiometry*. The subject of stoichiometry need have no terrors for those who know simple arithmetic and the rules of proportion.

Other methods are used in chemical literature to express chemical reactions besides equations. The equality sign (=) is not always correct in showing the trend or direction of a reaction and has been replaced according to some authorities with an arrow indicating that the materials on the left hand side pass, in chemical transformation, into those on the right hand side.

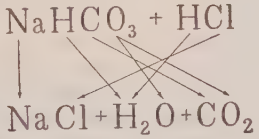
By this system the previous reaction would be expressed in the following manner:

$$NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

Sometimes a reversal of reaction may be expected or a state of equilibrium occurs, in which case two arrows, pointing in opposite directions, are used as in the following equation:

$$MnCl_4 \rightleftharpoons Mn\ Cl_2 + Cl_2$$

Another manner of expressing reactions, which is excellent for the student to practice frequently enough to familiarize himself with the principle of balancing equations, is by placing the formulas opposite each other and drawing connecting lines between the similar atoms on each side of the equation until all are accounted for. This is illustrated by the following diagram applied to the equation previously studied.



It must be remembered that an equation or reaction must always balance; that is, the number of atoms of each kind must be the same on each side of the equation.

Volume Combination.

If equal volumes of elements in the gaseous state are weighed under similar conditions, the relative weights will be in proportion to the atomic weight of each element.

This has resulted in the establishment of a general principle which is known as Avogadro's law, to the effect that: *Equal volumes of elementary gases contain equal numbers of molecules.*

Atomic and molecular weights are determined by the practical application of this law.

Other laws relating to combinations of gases were formulated by Gay-Lussac and are as follows: (1) *Gases combine by volume in simple numerical ratios.* (2) *The resulting volume of the compound, if a gas, bears a simple ratio to the volumes of the original constituents.*

Thus: 1 volume of H combines with 1 volume of Cl to produce 2 volumes of HCl; 2 volumes of H combine with 1 volume of O to produce 2 volumes of H_2O (vapor); 3 volumes of H combine with 1 volume of N to produce 2 volumes of NH_3.

Electrical Properties of the Elements—and Ionic Dissociation.

Energy or *force* is manifested in a number of different ways, such as *motion, heat, light, chemical action,* or *electricity.* Just as matter is indestructible so is energy persistent. The great fundamental law of physics is that known as the *conservation of energy,* in which it is assumed that *the total energy of the universe is constant,* no energy being created or destroyed in any of the processes of nature.

Electricity is more closely related to chemistry than is any other manifestation of energy. Electricity is frequently referred to as static or dynamic. Static electricity is that which requires activation, as by friction; dynamic electricity is the electricity of action, producing power, light, and heat.

Electrical excitement, as it is called, is exhibited in two conditions known respectively as *positive* and *negative.* In any apparatus developing electricity

the points at which these conditions are manifested are known as poles or electrodes. The positive pole is usually designated by the + sign and is known as the *anode*. The negative pole is designated by the − sign and is called the *cathode*.

Similarly charged electrical bodies or particles repel each other and bodies possessing dissimilar charges show an attractive effect.

From a study of the principles governing these facts has developed much valuable knowledge of the relations existing between the elements.

In the older works in chemistry the elements were always arranged in an electrical series. Those which were at the negative end of the series were observed to yield acids when their oxides united with water, while those at the opposite or positive end of the series yielded bases under similar conditions.

The more recent investigations have been directed toward the study of what has come to be called *electrical properties*.

Thus if a current of electricity is passed through a solution of HCl in water, Cl is given off at the anode or positive pole, and hydrogen at the cathode or negative pole. Distilled water, when freshly prepared and free from all traces of impurities, does not conduct electricity to any appreciable extent. Solutions of acids, bases, and salts, however, are ready conductors of electricity.

The substances whose aqueous solutions are capable of conducting electricity are known as *electrolytes*. There are many chemical compounds known, usually organic bodies like sugar, albumen, etc., which do not conduct electricity. These are known as *non-electrolytes*. It has been found that electrolytes during the simple act of solution in water undergo a certain degree of *dissociation* with the separation of elements or groups such as would be attracted to the respective poles if a current of electricity were traversing the solution. These elements or groups have been called *ions*, and the condition of electrolytic dissociation without the use of an actual current of electricity has come to be known as *ionization*.

These *ions* are believed to move about in a solution just the same as independent molecules (the word *ion* is from the Greek root word meaning to roam or wander). Positive ions are denoted by a + sign placed above or to the right of the symbol or group, and negative ions by a − sign similarly placed.

The molecule and the ion differ in this respect—the former are electrically balanced while the latter carry charges of free electricity, either positive or negative. An important law of ionic dissociation is to the effect that the *sum of the positive charges is always equal to the sum of the negative charges* in dissociation phenomena.

Elements or groups of elements, in the form of ions, carry electrical charges according to their valences. An electrolyte in solution is only partially ionized and the molecules and ions are more or less in equilibrium. The degree of ionization is dependent upon temperature and concentration and the nature of the dissolved substance.

Thus in a solution of sodium chloride there are undissociated molecules of NaCl, positively charged ions of Na and negatively charged ions of Cl. The dissociation that occurs is expressed by the following equation:

$$NaCl = Na^{+} Cl^{-}$$

As the positive Na *ion* equalizes the negative Cl *ion*, the solution is electrically neutral.

The following examples are added with equations, to illustrate the dissociation shown by other electrolytes in solution:

In a solution of ferrous chloride.

$$FeCl_2 = Fe^{+2}2Cl^-$$

and in a solution of ferric chloride.

$$FeCl_3 = Fe^{+++}3Cl^-$$

Groups of atoms, or radicles, also show this electrical behavior in the form of ions. For example, in a solution of sodium nitrate the dissociation is expressed:

$$NaNO_3 = Na^+ NO_3^-$$

and in a solution of sodium sulphate as:

$$Na_2SO_4 = 2Na^+ SO_4^{--}$$

In considering the foregoing facts regarding ionization it must be clearly understood that *atoms* and *ions are not identical.* Atoms are never free but are combined to form molecules. Ions are atoms or groups plus an electrical charge. These charges are assumed only in the liquid phase so that ions are only possible in solution or when the electrolyte is fused.

The degree of ionic dissociation varies with the concentration of the solution and with the nature of the dissolved substance. In the dry condition the substance is assumed to exist entirely in the molecular state, in concentrated solutions there is slight dissociation, while it is in dilute solutions that the greatest degree of dissociation is found.

Dissociation is a reversible phenomenon, as illustrated by the following equations:

$$HCl \rightleftarrows H^+ Cl^-$$

$$NaOH \rightleftarrows Na^+ (OH)^-$$

The degree of ionic dissociation has a marked influence upon the intensity and speed of chemical reactions. The student who has comprehended the foregoing summary of the subject will understand why it is that strong sulphuric acid has a very feeble action upon metallic iron, while the addition of water intensifies the reaction markedly until a certain degree of dilution occurs when the action again diminishes.

The degree of ionization, measured in terms of acidity or alkalinity, is known as the pH value and is more thoroughly discussed in the following pages.

The Determination of Ionic Dissociation

Ionic dissociation may be measured in terms of acidity or alkalinity.

Acids in the presence of water yield positively charged *hydrogen* (H+) *ions,* sometimes called *hydrions,* and negatively charged simple or grouped *anions.* Each acid possesses its characteristic anion.

EXAMPLE: $HCl = H^+ + Cl^-$ $\quad H_2SO_4 = H_2^{++} + SO_4^{--}$

Bases in the presence of water yield negatively charged *hydroxyl* (OH^-) *ions,* called *hydroxidions,* and positively charged simple or compound *cations.* Each base possesses its characteristic cation.

EXAMPLE: $KOH = K^+ + OH^-$ $\quad NH_4OH = NH_4^+ + OH^-$

$Ca(OH)_2 = Ca^{++} + (OH)_2^{--}$

Acid or alkaline properties are mainly dependent upon the degree of dissociation, or the proportion of H^+ or OH^- ions respectively that are liberated in the presence of water. The degree to which a substance is ionized is expressed as its "pH *factor*" which is a measure of intensity rather than of concentration.

The sour taste and intensity of action of acids is entirely dependent upon this factor. Thus, in dilute solutions sulphuric, hydrochloric, and nitric acids are all highly ionized, while acetic acid is ionized to a much lesser degree, and boric acid undergoes scarcely any ionization at all. These facts account for what is commonly called the strength of acids, which has little to do with either composition or concentration.

The same is true of alkalies. Alkalinity of soluble carbonates is due first to hydrolytic dissociation, followed by ionization. Sodium carbonate in solution first dissociates into NaOH and H_2CO_3. These respective compounds then ionize, and, as the former ionizes more strongly than the latter, the resulting solution is always alkaline.

The ionic theory explains neutralization reactions on the ground that the H^+ ions of the acid solution and the OH^- ions of the alkaline solution recombine to form nonionized H_2O.

The symbol used to denote the ionization factor of acids and alkalies is pH, meaning "hydrogen potential". Two methods of determination are possible, *i. e.*, electrical and colorimetric. The electrical method requires the skilful use of an instrument known as the *potentiometer* in connection with a specialized terminal known as the hydrogen electrode. The colorimetric method is more frequently used because of its greater convenience and lower cost, but the accuracy is not so great as with the electrical method.

The expression of the pH value is given mathematical exactness within a fairly wide range of acidity and alkalinity as may be seen by a study of the following table, taken from an article upon the subject by Prof. F. X. Moerk. The first column contains the unit pH values. In the second column will be found the equivalents given in terms of H ions (acidity) and OH ions (alkalinity). In the third column the results are translated into normality of the acid or alkali respectively.

pH value[1]	1 Gm. H ions in	Equivalent to
0.0	1 liter	A normal acid V.S.
1.0	10 liters	0.1 normal acid V.S.
2.0	100 liters	0.01 normal acid V.S.
3.0	1000 liters	0.001 normal acid V.S.
4.0	10000 liters	0.0001 normal acid V.S.
5.0	100000 liters	0.00001 normal acid V.S.
6.0	1000000 liters	0.000001 normal acid V.S.
7.0	10000000 liters	Perfect neutrality
pH value	**17 Gm. (OH) ions in**	**Equivalent to**
8.0	1000000 liters	0.000001 normal alkali V.S.
9.0	100000 liters	0.00001 normal alkali V.S.
10.0	10000 liters	0.0001 normal alkali V.S.
11.0	1000 liters	0.001 normal alkali V.S.
12.0	100 liters	0.01 normal alkali V.S.
13.0	10 liters	0.1 normal alkali V.S.
14.0	1 liter	A normal alkali V.S.

[1] The figures in this column are the logarithms of the reciprocals of the H ion concentration, expressed on the basis of a definite volume concentration. The pH of neutral water is 7, since water contains 00.0000001 Gm. of hydrogen per liter or 10^{-7}.

In the application of the colorimetric method, certain uncommon indicators must be used and certain specified conditions of applying the tests must be rigidly adhered to. These are described in detail in a comprehensive book upon the subject by M. W. Clark, entitled " The Determination of Hydrogen Ions". The indicators given in Clark's list, together with their respective ranges, are as follows:

Indicator	pH range
Thymol blue	1.2 — 2.8
Brom phenol blue	3.0 — 4.6
Methyl red	4.4 — 6.0
Brom cresol purple	5.4 — 7.0
Bromthymol blue	6.0 — 7.6
Phenol red	6.6 — 8.2
Cresol red	7.2 — 8.8
Thymol blue	8.2 — 9.8

The intelligent application of research in this line has developed many new fields in which the determination of pH values has been found to be of great practical use. Among these are the study of enzymes, soils, culture media, body fluids, germicides, and disinfectants.

The *potentiometer* and its use. If a piece of one of the noble metals is coated with platinum black, it will adsorb and hold large amounts of hydrogen and thus serve as a hydrogen electrode. When such a hydrogen laden electrode is immersed in a solution containing hydrogen ions, a difference of electric potential is exhibited, which is proportionate to the hydrogen ion concentration or the pH value.

The measurement of this difference is accomplished by the use of the instrument known as the potentiometer which makes use of the principles of the Wheatstone bridge in connection with a certain type of cell which acts as a standard of electromotive force.

An apparatus of this kind enables determinations of differences in potential to be made by the application of Ohm's law:

$$\text{Current (in amperes)} = \frac{\text{Difference in potential (in volts)}}{\text{Resistance (in Ohm's)}}$$

Catalogues describing various types of potentiometers and their uses and applications, may be had upon application to Leeds and Northrup, Philadelphia, Pa.

CHAPTER XL

HYDROGEN, OXYGEN, WATER, AND NITROGEN

H; 1.008. O; 16.00. H_2O; 18.016. N; 14.008.

Hydrogen is from Greek words meaning "to produce," or "to generate," water. Water is the product of its combustion. It is a colorless, inodorous, combustible gas; it is the lightest of all substances. Chemically, it is one of the most important and interesting of the elements, and it was used as unity for many years in fixing the atomic weights of other elements. However, oxygen at 16.00 has now been generally adopted as the basis for atomic weights, thus making hydrogen 1.008, the change being made chiefly because, with oxygen as the basis, a larger number of the elements became whole numbers. Pharmaceutically, in its uncombined state, it is of very little importance, and the reader is referred, for further information, to chemical textbooks.

Nitrogen is from the Greek "nitron" (saltpetre) and "gen", meaning "I produce", indicating that the gas is a constituent of saltpetre. It is a colorless, tasteless and odorless gas of a density slightly less than air. In the free state it constitutes about four-fifths of the weight of the atmosphere. It shows little activity towards other elements. Many of its compounds, however, are intensely active, such as nitric acid, the alkaloids, cyanides, etc. Nitrogen itself is of little pharmaceutical importance, but many of its compounds are official.

Oxygen is from the Greek meaning, "I produce sour", to denote that in many cases the combustion of substances in this gas produces acids. It is a colorless, inodorous gas which aids combustion; it is the most abundant of the elements, forming about one-fifth of the total weight of the atmosphere, where it exists in the free or uncombined state. Combined oxygen constitutes nearly ninety per cent by weight of water, and is present in varying quantities in most vegetable and animal substances. The compounds which it forms with other bodies are termed oxides; those which are of pharmaceutical interest will be considered hereafter under their appropriate heads. Oxygen in a state of purity is frequently used medicinally and is now official. It is chiefly supplied in compressed form in cylinders.

OXYGENIUM. U.S. Oxygen

[Oxygen.]

It contains not less than 98 per cent by volume of O (16). For convenience it is usually furnished in compressed form in metallic cylinders.

Preparation—Among the processes used for preparing oxygen is one that involves the liquefying of air with extreme cold and great pressure. When the liquid air is allowed to vaporize, the nitrogen escapes first because of its greater volatility, and the gas that comes off last is nearly pure oxygen.

Another commercial method is based upon the electrolysis of water whereby the water is decomposed into its constituent elements, namely, oxygen and hydrogen, which separate at opposite electrodes.

An older method, now largely replaced, involved heating barium monoxide (BaO) in a current of air to form barium dioxide (BaO_2). Upon increasing the temperature, the barium dioxide is decomposed, giving off free oxygen and again forming barium monoxide.

Description and Physical Properties—A colorless, odorless, and tasteless gas. It supports combustion more readily than air.

One volume of Oxygen dissolves in about 34 volumes of water and in about 3.6 volumes of alcohol, at 25° C.

Test for Identity—A glowing splinter of wood held in Oxygen bursts into flame.

Tests for Purity—Pass 2000 cc. of the gas, measured under normal atmospheric pressure at about 25° C., through 100 cc. of barium hydroxide T.S. at a rate not exceeding 4000 cc. per hour: the turbidity produced, if any, is not greater than that produced by 1 cc. of a solution prepared by dissolving 0.2 Gm. of sodium bicarbonate in 100 cc. of freshly boiled and cooled distilled water (*carbon dioxide*).

Pass 2000 cc. of Oxygen, under the conditions described above, through a mixture of 100 cc. of distilled water and 1 cc. of silver nitrate T.S.: no opalescence is produced (*halogens*).

Pass 2000 cc. of Oxygen through 100 cc. of distilled water, colored with a few drops of litmus T.S., under the conditions described above: the color of the liquid is not changed (*acids or alkalies*).

Pass 2000 cc. of Oxygen through 100 cc. of a freshly prepared starch-potassium iodide T.S.: the color of the liquid is not changed (*oxidizing substances*).

Assay—Mix about 50 cc. of Oxygen, accurately measured in a calibrated tube, with 10 cc. of alkaline pyrogallol T.S.: not less than 98 per cent by volume is absorbed, corresponding to not less than 98 per cent by volume of O.

This assay is explained on page 1482.

History—Oxygen was discovered independently by Priestly in 1774 and Scheele about the time of the American Declaration of Independence.

Uses—Medicinally, Oxygen is used in grave cases of sickness to supply sufficient oxygen to the blood or to prevent cyanosis during the administration of anesthetics. It is sold in cast-steel cylinders, under about 120 to 130 atmospheres pressure, and when used the pressure is regulated by a special attachment. It is also largely used industrially in the oxy-hydrogen or oxy-acetylene blow-pipe for welding platinum, cutting structural iron work, etc., in oxidizing oils in varnish manufacture, and in many other industrial operations.

AQUA. U.S. Water

$H_2O = 18.016$

Water is the most important and useful compound known to the pharmacist. It corresponds to about 88.8 parts of oxygen and 11.2 parts of hydrogen, by weight.

The purity of water is specified in the official description, which is as follows:

Description and Physical Properties—A colorless, limpid liquid, practically tasteless and odorless.

Tests for Purity—Water is neutral to litmus paper.

When heated nearly to the boiling point and agitated, no disagreeable odor is evolved.

The residue obtained upon evaporating 100 cc. of Water in a platinum dish does not exceed 0.03 Gm. (*solids*), and this residue, when carefully heated to redness, evolves no visible fumes and shows no appreciable charring (*organic impurities*).

Add 1 cc. of hydrochloric acid to 100 cc. of Water and then add 50 cc. of hydrogen sulphide T.S.: no darkening occurs after standing for fifteen minutes (*lead or copper*).

Add 1 cc. of hydrochloric acid to 100 cc. of Water and then add 1 cc. of potassium ferrocyanide T.S.: no blue coloration is produced immediately (*iron*).

Add 0.5 cc. of tenth-normal silver nitrate to 200 cc. of Water, heat to boiling, filter, and add to the filtrate 3 drops of potassium chromate T.S.: a red precipitate is produced (*limit of chloride*).

Add successively 1 drop of acetic acid, 1 cc. of sulphanilic acid T.S., and 1 cc. of naphthylamine acetate T.S. to 100 cc. of Water in a Nessler tube, stirring with a glass rod after each addition. Closely cover the tube with a glass plate, place it upon a white surface, and view it from above: no pink coloration appears within five minutes (*nitrite*).

Add 1 cc. of sodium carbonate T.S. to 100 cc. of Water, and evaporate the liquid in a small porcelain dish just to dryness. Moisten the residue thoroughly with 2 cc. of phenoldisulphonic acid T.S., gently warm the dish, add 20 cc. of ammonia T.S. and sufficient distilled water to measure 100 cc. Any yellow color produced is not greater than that obtained by evaporating 0.0021 Gm. of potassium nitrate, dissolved in 3 cc. of distilled water and 1 cc. of sodium carbonate T.S., to dryness and treating the residue in the same manner as the residue from the Water. The comparison of colors must be made in Nessler tubes of the same diameter and size (*nitrate*).

Add 2 cc. of alkaline mercuric potassium iodide T.S. to 100 cc. of Water in a Nessler tube, and mix thoroughly. Place the tube on a white surface, and view the contents from above:

the water does not at once assume a deep yellow or orange color (*ammonium salts and nitrogenous impurities*).

Mix 100 cc. of Water with 10 cc. of diluted sulphuric acid in a clean porcelain dish, and heat it rapidly to boiling; then add 0.4 cc. of tenth-normal potassium permanganate, and boil the liquid for ten minutes: the color of the liquid is not completely destroyed (*oxidizable substances*).

Potable Water or Drinking Water—Potable water is water which is fit to drink. Since water dissolves a part of nearly everything with which it comes in contact it is impossible to find, in nature, water which is absolutely pure.

The water for drinking and domestic purposes is generally supplied by rivers, lakes, wells, and springs. Such waters commonly contain salts of magnesium, calcium, iron, potassium, and sodium, with organic matter from falling leaves and twigs, traces of ammonia, and other gases from the atmosphere. There is also a variety of suspended matter in natural water such as fine particles of clay, sand, microscopic organisms including bacteria and fragments of vegetation. Drinking waters that contain small amounts of dissolved salts and only traces of inert suspended matter are not directly injurious to health.

Drinking water is rendered more agreeable, or palatable, because of the dissolved gas which it contains. To most people the taste of boiled water is insipid or flat. This is because the air has been removed in the boiling. The taste of water is also influenced by the presence of dissolved salts, and waters having appreciable amounts of these salts in solution are always more acceptable for drinking than those free from solids, but good drinking water should not contain an excessive amount of dissolved salts and must be free from disease-producing organisms and from sewage contamination. Most cities and towns have established plants for purifying water. This is usually accomplished by slowly filtering the water through large beds of sand and gravel. The suspended matter is removed from the water mechanically and many impurities are decomposed by the micro-organisms which form on the surface of the filter. The filter bed must be frequently cleaned.

Turbid water is sometimes clarified by treatment with alum. In solution the alum undergoes dissociation, especially in the presence of a little lime water, forming flocculent, microscopic particles of aluminum hydroxide which settle and carry with them the suspended impurities. A simpler method used in some localities is to allow the water to remain in large settling basins or reservoirs where the suspended matter slowly settles by gravity.

The purification of potable water is one of the most important chemical problems of the present time. In some cases treatment of the filtered water with traces of such chemicals as ozone, chlorine, sodium hypochlorite, or copper sulphate is employed. Such chemical treatment is the most effective means of destroying organic matter, especially bacteria and algæ. Sometimes the water is freed from objectionable odors, ferrous salts, etc., by the simple process of oxidation that involves spraying the water into the air. An electrolytic method of purification consists in removing the temporary hardness of the water with lime, after which it is passed between electrodes and subjected to the action of ozone (nascent hydrogen and oxygen), whereby the unstable organic matter is oxidized and the bacteria destroyed. Following this treatment the water is sedimentized and filtered according to standard practice.

One of the latest processes for water purification consists of the action of ultra violet light. By this method filtered water is exposed in thin layers and at short range, to the light of an electric mercury vapor lamp with walls of quartz.

During recent years filtered water is required, in many states, to be treated with a very small amount of chlorine which is an effective germicide. Ozone is a very desirable purifying agent because of its harmless nature, its insolubility,

which prevents an excessive amount from going into solution, and the fact that it effectively removes odor and taste due to organic pollution. These purification methods have greatly diminished the death rate due to water-borne diseases such as typhoid fever.

Everyone should know how to purify water on a small scale for household consumption. At times pure water may not be obtainable and in an emergency, or during an epidemic purification will be imperative. This can be done by boiling the water for fifteen or twenty minutes and storing it in bottles or jars which have also been sterilized by boiling. Containers must be closed with a pledget of absorbent cotton to prevent contamination. An effective chemical method of purification is the addition of a drop of tincture of iodine to a quart of water, mixing and allowing it to stand for fifteen or twenty minutes before using.

A product developed by Dakin during the World War for the extemporaneous purification of drinking water is sold under the name *Halazone*. It is one of the dichloramine group and is said to be a powerful disinfectant. A tablet containing 0.004 Gm. is added to a quart of water and allowed to stand a short while. For other efficient methods for purifying water for camp use, see the Hospital Corps Handbook, U. S. Navy.

Some knowledge of the origin of a water supply is important, especially because of possible contamination with sewage. Usually the presence of sodium chloride indicates sewage unless its presence can otherwise be explained. The presence of ammonia, nitrites, and nitrates are of themselves harmless in drinking water, but they are usually assumed to be evidence of sewage contamination, having been the product of gradual oxidation of nitrogenous matter. (See Water Supply, by Mason, John Wiley & Sons.)

Uses—The powers and uses of water as a solvent have been already noted in the previous chapters. The United States Pharmacopœia directs water, distilled water or sterilized distilled water, to be used according to the necessities of the occasion. The solid matter and traces of various salts in solution or suspension in ordinary water would often seriously interfere with the purity of many chemical substances if such water were used in their preparation. The official processes direct distilled water in all cases where the use of ordinary water might be injurious or of doubtful propriety. In some sections of the country, the drinking water might be pure enough for the processes, or at least not contain serious impurities; in other sections the water would be totally unfit for use. The purity of official distilled water is beyond question, and its use therefore removes all doubts.

AQUA DESTILLATA. U. S. Distilled Water
[Aq. Dest.]

Water [$H_2O = 18.016$] purified by distillation.

For manufacture, see page 254. The official tests for the purity of distilled water are, of course, much more exacting than those for water (see below).

Description and Physical Properties—A colorless, limpid liquid, without odor or taste, and neutral to phenolphthalein T.S. and to methyl orange T.S.

Tests for Purity—Evaporate 100 cc. of Distilled Water to dryness on a water bath, and subsequently dry the residue in an oven to constant weight at 100° C.: not more than 0.001 Gm. of residue remains.

Separate portions of 100 cc. each of Distilled Water are not affected by the addition of barium chloride T.S. (*sulphate*); silver nitrate T.S. (*chloride*); ammonium oxalate T.S. (*calcium*); hydrogen sulphide T.S. (*metals*).

Distilled Water shows no deep yellow, orange or brown coloration when 1 cc. of alkaline mercuric potassium iodide T.S. is added to a 100 cc. portion (*ammonia*).

Add 50 cc. of calcium hydroxide T.S. to 25 cc. of Distilled Water: the mixture remains clear and transparent (*carbon dioxide*).

Heat 100 cc. of Distilled Water to boiling, acidulate with 10 cc. of diluted sulphuric acid, and subsequently add 0.1 cc. of tenth-normal potassium permanganate: the color of the liquid is not completely destroyed by boiling for ten minutes (*oxidizable substances*).

Uses—Distilled water is used in pharmacy principally as a solvent for chemical salts, in filling prescriptions, and for purposes for which ordinary water is unfitted (see page 546).

LIQUOR HYDROGENII DIOXIDI. U.S. Solution of Hydrogen Dioxide

[Liq. Hydrog. Diox.—Aqua Hydrogenii Dioxidi, Solution of Hydrogen Peroxide]

Solution of Hydrogen Dioxide is an aqueous solution containing not less than 3 per cent by weight of H_2O_2(34.02), representing approximately 10 volumes of available oxygen. Preserve it in a cool place protected from light. Upon removing the stopper from the bottle, not more than a slight pressure should be observed.

Preparation—Solution of Hydrogen Dioxide is made commercially on a large scale. The H_2O_2 for medicinal use is prepared by the action of an acid on hydrated barium dioxide. The acids used are phosphoric, sulphuric, or hydrofluoric. When the correct molecular proportion of the acid is used, practically all of the undesirable barium is precipitated as phosphate, sulphate, or fluoride, respectively, leaving hydrogen dioxide in solution.

A largely used commercial process employs both phosphoric and sulphuric acids. Finely divided barium dioxide, after having been washed, is hydrated by thorough agitation with water. The hydrated barium dioxide is made to react with phosphoric acid at a low temperature, since excessive heat causes decomposition and loss of the hydrogen dioxide. The cost of production is considerably reduced by also using sulphuric acid which regenerates the phosphoric acid from the barium phosphate and this phosphoric acid again reacts with more barium dioxide.

After allowing the mixture to settle, the clear solution is decanted or siphoned off from the insoluble barium compounds and brought to the required strength by dilution.

The final insoluble residue of barium sulphate, after washing it free from hydrogen dioxide, is disposed of as a mineral pigment.

The main reactions of the process are illustrated by the following equations:

$$\underset{\text{barium dioxide}}{BaO_2} + \underset{\text{phosphoric acid}}{H_3PO_4} = \underset{\text{secondary barium phosphate}}{BaHPO_4} + \underset{\text{hydrogen dioxide}}{H_2O_2}$$

$$\underset{\text{barium dioxide}}{BaO_2} + \underset{\text{secondary barium phosphate}}{BaHPO_4} + \underset{\text{sulphuric acid}}{2H_2SO_4} = \underset{\text{barium sulphate}}{2BaSO_4} + \underset{\text{hydrogen dioxide}}{H_2O_2} + \underset{\text{phosphoric acid}}{H_3PO_4}$$

Any trace of barium salt remaining in the solution of hydrogen dioxide after the decomposition, is removed by the cautious addition of sulphuric acid, which precipitates insoluble barium sulphate, a minute excess of sulphuric acid being permitted.

Oxalic acid in small amount was formerly added to the solution by manufacturers, thus fraudulently raising its indicated strength when assayed, but this is now detected by a special test.

Owing to the readiness with which this solution ordinarily undergoes decomposition, many attempts have been made to render it more stable. Acetanilid is generally used as a preservative and the Pharmacopœia permits the use of this or other harmless preservatives in amounts not exceeding 0.04 Gm. in each 100 cc. In solutions where acetanilid has been introduced, a bitter almond-like odor sometimes develops. This indicates decomposition of the preservative. It has been found that one of the most efficient preservatives for hydrogen dioxide solution is quinine sulphate. Benzoic, salicylic, and boric acids have also been used for this purpose.

The stability of hydrogen dioxide solution depends, to some extent, upon the character of the bottle in which it is stored. Alkali, due to the solubility of the glass bottle used, accelerates decomposition. Blue glass should be avoided because it favors deterioration.

A commercial method for the preparation of solution of hydrogen dioxide is as follows:

Barium Dioxide	3 lbs. av.
Phosphoric Acid (85 per cent)	2½ oz. av.
Sulphuric Acid (32 per cent)	
Barium Hydroxide (saturated solution)	
Ice,	
Distilled Water, of each, a sufficient quantity,	
To make	1 gal.

The barium dioxide, which must be of the purest quality and very finely ground, is hydrated by stirring with 6 pints of water, for ten minutes. The mixture is allowed to settle and the supernatant liquid siphoned off. This washing with stirring is repeated twice and distilled water is then added to restore the original volume. The mixture is then subjected to prolonged agitation or stirring by a mechanical stirrer, to effect complete hydration of the barium dioxide. This will probably require a full day.

The phosphoric acid added to 3 pints of water is then mixed with ice and treated with about three-eighths of the hydrated barium dioxide mixture, after first reserving about ½ ounce of the mixture for the final neutralization. The mixing is done with constant mechanical stirring. After an interval of about ten minutes an equal amount of the hydrated barium dioxide mixture is again added with constant stirring. At this point the reaction should be acid but not too strongly so, otherwise more of the barium mixture should be added. The temperature throughout should be kept between 90° and 110° F.

Sufficient of the sulphuric acid is then added to regenerate about 85 per cent of the phosphoric acid, keeping the temperature down and adding more of the hydrated barium dioxide mixture until again almost neutral. The remainder of the hydrated barium dioxide mixture is then added to the reaction mixture, still reserving the half ounce for final neutralization. The reaction should now be slightly acid and should not be allowed to become alkaline, otherwise sulphuric acid should be added.

The reserved portion is then slowly added to convert the acid phosphates of barium into normal phosphate, and sulphuric acid may be added to render the mixture just faintly acid. An alkaline reaction favors decomposition.

The mixture is now filtered and should yield about 6 pints of filtrate, and the precipitate is washed with distilled water until the filtrate and washings measure 1 gallon.

The saturated barium hydroxide solution is then heated and carefully added until a faintly alkaline reaction is produced and the mixture is quickly filtered. This precipitates and removes any iron or free phosphoric acid.

Sulphuric acid is then added to precipitate the slight excess of barium and to render the liquid faintly acid. After allowing the mixture to stand overnight, the clear solution is siphoned off. This is then assayed and the strength, in terms of H_2O_2, is adjusted to 3 per cent by proper dilution with distilled water.

Three grains of acetanilid to each pint of solution may be added as a preservative, or in its place 0.3 grain of quinine sulphate to each pint of solution.

Description and Physical Properties—A colorless liquid, odorless, or having an odor suggesting ozone. It is slightly acid to the taste and produces a peculiar sensation and froth in the mouth. It is prone to deteriorate upon keeping or upon protracted agitation, and rapidly decomposes by contact with many oxidizing as well as reducing substances.

When exposed to the air at the ordinary temperature or when heated on a water bath at a temperature not exceeding 60° C., the Solution loses chiefly water. When rapidly heated, it frequently decomposes suddenly.

Solution of Hydrogen Dioxide is acid to litmus paper.

Test for Identity—Shake 1 cc. of Solution of Hydrogen Dioxide with 10 cc. of distilled water containing 1 drop of diluted sulphuric acid, and add 2 cc. of ether: the subsequent addition of a drop of potassium dichromate T.S. produces a blue color in the aqueous layer. Upon agitation and standing, this blue color passes into the ether layer.

Tests for Purity—Not more than 0.03 Gm. of residue remains on evaporating 20 cc. of the Solution to dryness on a water bath (*non-volatile matter*).

It requires not more than 2 cc. of tenth-normal sodium hydroxide, phenolphthalein T.S. being used as indicator, to neutralize 25 cc. of Solution of Hydrogen Dioxide (*free acid*).

Add 1 cc. of ammonia T.S. to 1 cc. of the Solution and evaporate the liquid to dryness on a water bath: the residue meets the requirements of the test for *arsenic*, page 1512.

Evaporate 1 cc. of the Solution to dryness on a water bath, and dissolve the residue in 10 cc. of distilled water containing 1 cc. of diluted hydrochloric acid: the liquid meets the requirements of the test for *heavy metals*, page 1519.

To 50 cc. of the Solution add sodium hydroxide T.S. until it is alkaline, then evaporate it on a water bath, and transfer the dry residue to a platinum crucible. Moisten the residue with sulphuric acid, and cover the crucible with a watch glass, the convex side of which is coated with a thin layer of beeswax which is scratched so as to expose the glass. Cool the watch glass by placing water in the concave side and standing in this a small beaker which must be kept filled with cold water. Now heat the crucible and contents on a water bath for one hour: the surface of the watch glass after the removal of the wax shows no sign of corrosion (*hydrofluoric acid*).

The addition of 2 drops of diluted sulphuric acid to 10 cc. of the Solution produces no turbidity or precipitate within ten minutes (*barium*).

Add 4 drops of sodium acetate T.S. to 10 cc. of the Solution, and follow with 4 drops of calcium chloride T.S.: no turbidity or precipitate is produced within ten minutes (*oxalic acid*).

Shake out 100 cc. of Solution of Hydrogen Dioxide in a separator with a mixture of 3 volumes of chloroform and 2 volumes of ether, using 50 cc., 25 cc., and 25 cc., respectively, and evaporate the combined solutions to dryness at room temperature in a tared glass dish: the residue, if any, weighs not more than 0.04 Gm. (*limit of preservative*).

Assay—Dilute about 2 cc. of Solution of Hydrogen Dioxide, accurately weighed, with 20 cc. of distilled water, add 20 cc. of diluted sulphuric acid, and titrate with tenth-normal potassium permanganate. Each cc. of tenth-normal potassium permanganate corresponds to 0.001701 Gm. of H_2O_2.

This assay is explained on page 1474.

History—The substance H_2O_2 which constitutes the activity of this preparation was discovered by Thenard, a French pharmacist in the early part of the 19th century.

Uses—Solution of hydrogen dioxide (or "peroxide", as it is usually termed) is an energetic antiseptic and disinfectant. As found in commerce it is designated as a 100 vol., 30 vol., 15 vol., 10 vol., 8 vol. solution, etc., by which is meant a solution of the hydrogen dioxide which will yield 100 volumes, 30 volumes, 15 volumes, 10 volumes, or 8 volumes of active oxygen when used. The official 3 per cent solution yields approximately 10 volumes of available oxygen under normal conditions of temperature and pressure. The 100 volume, or 30 per cent by weight solution, is being used medicinally under the name *perhydrol*, and is said to be less irritating than weaker solutions because of the absence of free acid. In this form it is relatively permanent, but when diluted with water it rapidly deteriorates. Diluted solutions are employed as local applications and in inflammations of mucous membranes. Solution of Hydrogen Dioxide is believed to be free from poisonous properties.

Preservation—*Great care must be exercised to prevent decomposition; the bottles containing the solution must be kept in a cool place protected from light*

and dust, and the stoppers may be coated with paraffin or replaced by a pledget of cotton, as this relieves pressure and retards decomposition.

Average dose—1 fluidrachm (4 cc.).

Unofficial Peroxides

Calcium Peroxide CaO_2 (N. N. R.)	It contains not less than 60 per cent of CaO_2, equivalent to 13.3 per cent of available oxygen, a cream-colored, odorless and tasteless powder; practically insoluble in water. It is decomposed by dilute acids, liberating H_2O_2 used for its oxidizing effect. Dose, 1 to 5 grains (0.06 to 0.3 Gm.), in water or with sodium bicarbonate
Magnesium Peroxide, Magnesium Superoxide MgO_2 (N. N. R.)	It contains not less than 15 per cent of MgO_2, equivalent to 4.3 per cent of available oxygen A white powder; practically insoluble in water. Decomposed by dilute acids, liberating H_2O_2 Used in dentifrices and for oxidizing effects. Dose, 4 to 8 grains (0.25 to 0.5 Gm.)
Sodium Peroxide, Bioxidum Natrii Na_2O_2 (N. N. R.)	It contains not less than 90 per cent of Na_2O_2, equivalent to 18.4 per cent of available oxygen. A white or yellowish powder; soluble in water, with decomposition and heat, liberating oxygen and forming NaOH. It does not react with alcohol but ignites ether. It is a powerful oxidizing agent and is never used internally. Mixed with liquid petrolatum or soap to form a paste it is used for acne
Strontium Peroxide SrO_2 (N. N. R.)	It contains not less than 80 per cent of SrO_2 similar to calcium peroxide. Used in ointments and as a dusting powder, also in dentifrices
Zinc Peroxide ZnO_2 (N. N. R.)	It contains not less than 45 per cent of ZnO_2, equivalent to 7.4 per cent of available oxygen. Similar to calcium peroxide. Used as a dusting powder, either alone or mixed with tannin, or in the form of gauze or in a 10 per cent ointment

Nitrogen, N; 14.008

Tests for Nitrates and Nitrites

Nitrates—When a solution of a nitrate is mixed with an equal volume of sulphuric acid, the mixture cooled, and a solution of ferrous sulphate superimposed, a brown color is produced at the junction of the two liquids. When a nitrate is heated with sulphuric acid and metallic copper, brownish-red fumes are evolved.

Nitrites—When treated with diluted mineral acids or with acetic acid, nitrites yield brownish-red fumes. On adding a few drops of potassium iodide T.S. and a few drops of dilute sulphuric acid to a solution of a nitrite, iodine is liberated which colors starch T.S. blue.

NITROGENII MONOXIDUM. U. S. Nitrogen Monoxide

[**Nitrogen. Monox.**—Nitrous Oxide]

Nitrogen Monoxide gas [$N_2O = 44.02$].

Preparation—It is usually prepared by heating ammonium nitrate to about 170° C., when the following reaction occurs:

$$\underset{\text{ammonium nitrate}}{NH_4NO_3} = \underset{\text{nitrogen monoxide}}{N_2O} + \underset{\text{water}}{2H_2O}$$

The gas has also been produced by heating a mixture of ammonium sulphate and sodium nitrate, according to the following equation:

$$\underset{\text{ammonium sulphate}}{(NH_4)_2SO_4} + \underset{\text{sodium nitrate}}{2NaNO_3} = \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{nitrogen monoxide}}{2N_2O} + \underset{\text{water}}{4H_2O}.$$

Description and Physical Properties—A colorless gas, having a slight characteristic odor and a somewhat sweet taste. It supports the combustion of many substances. For convenience in handling and use, Nitrogen Monoxide is compressed in metallic cylinders.

It is quite soluble in water at low temperatures; 1 volume of water dissolves about 1.3 volumes of nitrous oxide at 25° C.

Tests for Purity—(See the U.S.P. X.)

Uses—For convenience in handling and use, it is furnished in compressed form in metallic cylinders. It is used as a surgical anesthetic by inhalation. During its administration some patients become hysterical and because of this characteristic it is often called *laughing gas.*

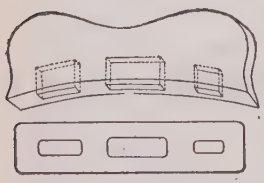
CHAPTER XLI

THE INORGANIC ACIDS

The official inorganic acids form one of the most important classes of compounds used in pharmacy. They will be considered in the following order: 1. Those which do not contain oxygen or *hydracids*, and which are derived from non-metallic elements—*viz.*: hydrochloric, hydriodic, and hydrobromic acids. 2. The non-metallic oxygen acids—nitric, nitrohydrochloric, sulphuric, hypophosphorous, and phosphoric acids. Arsenic trioxide and chromium trioxide (formerly known as arsenous and chromic acids) and boric acid will not be discussed in this chapter, but will be described under the headings of the elements from which they are derived.

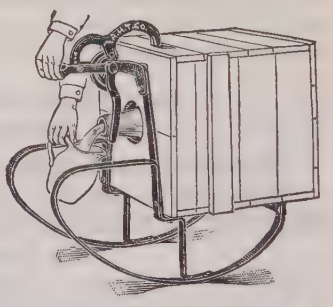
Practical Points in Handling Strong Acids—The strong inorganic acids are never made by the pharmacist for commercial purposes, as they can be manufactured much more economically upon the large scale. They are corrosive in their action, and must be handled very cautiously to avoid personal injury. They are usually sent out by manufacturers in one pound, or in five pint, glass-stoppered bottles, or in carboys holding about ten gallons. One of the common annoyances is the liability of the glass stopper to become so tightly fastened in the neck of the bottle that it is extracted with difficulty. Should this occur, place the container in a vessel, such as an enameled kettle, before attempting to force the stopper. This will prevent a serious accident, should the bottle be broken. Frequently the stopper may be removed by grasping the bottle firmly, and, after cleaning off the lute, carefully tapping the stopper *gently* with a stick of wood. If very moderate measures do not succeed, the stopper wrench (Fig. 424) should be used. This is made of hard wood, of the shape shown in the cut, the lower cut giving the end view and showing the relative sizes of three holes in the wrench. These should be made somewhat larger than the stoppers of the bottles for which the wrench is likely to be used. The refractory stopper is placed in the hole, and the operator grasps the wrench with the right hand and endeavors to twist the stopper out. If it does not yield to moderate treatment, the neck of the bottle may be cautiously heated by wrapping it in a cloth wet with hot water, or by means of a spirit-lamp or Bunsen burner with a low flame, passing the flame quickly around it several times so that it shall be uniformly heated. This will cause expansion of the neck, and if the right moment be seized, which is just before the outer surface of the stopper becomes correspondingly heated, the stopper may be easily extracted. If these means do not succeed, the bottle should be inverted in a vessel of warm water to a depth sufficient to cover the neck and allowed to remain several hours; if the

Fig. 424



Stopper wrench

Fig. 425



Carboy inclinator

wrench is then used, success is generally assured. Corks should not be used as stoppers for the strong acids, because of the corrosive action of the latter—the cork almost invariably contaminating and discoloring the acid.

The handling of carboys containing strong acids is sometimes attended with difficulty and danger. The simplest method is by the use of the "Universal Carboy Inclinator" (Fig. 425). This consists of a steel frame of the shape shown in the cut. It is clamped to the carboy while the latter is standing on the floor and the carboy can then be tilted easily and without spilling the contents. The last drop can be poured out readily.

Quality of Commercial Acids—Several grades of acids are found in commerce. The designation "U. S. P." is attached to those which are of the quality indicated by the U. S. Pharmacopœia for use in making preparations and for tests, etc. The designation "Chemically Pure" is usually meaningless, and acids are now sold as of "U. S. P." or "Reagent" quality or as "Analysed", which means that the impurities which are present are expressed in terms of actual amounts upon the label of each package of acid.

Too much importance cannot be attached to the duty of procuring pure and strong acids. Loss and annoyance in making many preparations will surely follow the use of acids deficient in strength and purity.

Strength of the Official Acids—The official inorganic acids are aqueous solutions of the respective acids and there is no uniformity in strength. For instance, hydrochloric acid contains from 31 to 33 per cent of HCl, nitric acid contains from 67 to 69 per cent of HNO_3, and sulphuric acid contains from 93 to 95 per cent of H_2SO_4. These respective strengths are the most practicable from the commercial standpoint. On the other hand, the *diluted acids* are purposely made uniform—diluted hydriodic, hydrochloric, phosphoric, and sulphuric acids each containing from 9.5 to 10.5 per cent of what is sometimes referred to as the *absolute* acid. Diluted acetic acid (6 per cent) and diluted hydrocyanic acid U. S. P. IX (2 per cent) are exceptions.

FIG. 426

Acid dropper

Medical Properties—The inorganic acids are generally tonic and refrigerant when administered in a diluted condition; externally, if applied undiluted, they are caustic and corrosive, and should be used with the greatest care. Brushes made of spun glass are sometimes employed to apply strong acids externally to ulcers. Test bottles with elongated stoppers, or the form of bottle shown in Fig. 426, are also advantageously used. One of the principal difficulties attendant upon the internal administration of acids is their injurious action upon the teeth. To avoid the destructive contact with the enamel, the acid should be highly diluted and should be taken through a narrow glass tube.

Antidotes—See Part XV, Toxicology and Antidotes.

ACIDUM HYDROCHLORICUM. U. S. Hydrochloric Acid
[Acid. Hydrochl.]

Hydrochloric Acid is an aqueous solution containing not less than 31 per cent and not more than 33 per cent of HCl (36.47).

Preparation—Hydrochloric acid, the only known compound of chlorine and hydrogen, is made on a very large scale both abroad and in this country. It is obtained as a by-product resulting from the manufacture of soda-ash, by decomposing common salt heated to a high temperature with sulphuric acid. Sodium sulphate is formed, and gaseous hydrochloric acid is liberated.

The latter is conducted into a tall tower filled with coke, called a coke scrubber, the ascending gas being met by a descending flow of water, which readily dissolves the gas.

The sodium sulphate from the above process is itself afterward used in the manufacture of sodium carbonate by the Leblanc process. When sulphuric acid is employed, two steps are recognized. In this first reaction a relatively low temperature is used to heat the pan containing the mixture, the heat being obtained from the furnace gases. During this period but one-half of the sodium chloride reacts, as follows:

$$\underset{\text{sodium chloride}}{2NaCl} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{hydrochloric acid}}{HCl} + \underset{\text{sodium chloride}}{NaCl} + \underset{\text{acid sodium sulphate}}{NaHSO_4}$$

In the second step the mass is heated to redness by the direct action of the flame and yields the rest of the hydrochloric acid:

$$\underset{\text{sodium chloride}}{NaCl} + \underset{\text{acid sodium sulphate}}{NaHSO_4} = \underset{\text{hydrochloric acid}}{HCl} + \underset{\text{sodium sulphate}}{Na_2SO_4}$$

The hydrochloric acid gas from the first reaction is purer than that obtained from the second, as the latter is mixed with the furnace gases. The product from each process is therefore separately led into batteries of earthenware jars, similar to Woulff's bottles, containing water, and is there absorbed. Hydrochloric acid is also a by-product in the electrolytic production of sodium hydroxide from sodium chloride. The liberated chlorine is heated with steam to 1000° C. (1832° F.), in the presence of an excess of carbon:

$$\underset{\text{chlorine}}{Cl_2} + \underset{\text{water}}{H_2O} + \underset{\text{carbon}}{C} = \underset{\text{hydrochloric acid}}{2HCl} + \underset{\text{carbon monoxide}}{CO}$$

The yellow color of the common acid (*muriatic acid*) is generally due to organic substances or a trace of iron. This variety is sometimes called for by plumbers and tinsmiths under the very old name of *spirit of salt.*

The white fumes produced when the acid is exposed to the air are caused by the gaseous acid combining with the moisture in the air, and also with a trace of ammonia usually present, forming ammonium chloride.

Description and Physical Properties—A colorless, fuming liquid having a pungent odor. The fumes and odor disappear on diluting the Acid with 2 volumes of water.

On distilling Hydrochloric Acid at normal barometric pressure, a stronger acid passes over first, until at 110° C. an acid of about 20 per cent remains, and this distils unchanged.

Specific gravity: about 1.155 at 25° C.

Tests for Identity—It is strongly acid to litmus paper, even when highly diluted.

When Hydrochloric Acid is heated with manganese dioxide, chlorine is evolved.

Hydrochloric Acid responds to the reactions for chlorides, page 567.

Tests for Purity—Hydrochloric Acid when diluted with 2 volumes of water conforms to the following tests:

Evaporate 25 cc. of the dilution and dry at 110° C.: not more than 0.003 Gm. of residue remains.

Add 1 cc. of chloroform to 10 cc. of the dilution, and cautiously add, a drop at a time with constant agitation, chlorine T.S. which has been diluted with an equal volume of distilled water: the chloroform remains free from even a transient yellow, orange, or violet color (*bromide or iodide*).

Add 1 cc. of potassium iodide T.S. and 1 cc. of chloroform to 10 cc. of the dilution and agitate the mixture: the chloroform remains free for at least one minute from any violet coloration (*free chlorine or bromine*).

A 2 cc. portion of the dilution further diluted with 14 cc. of distilled water meets the requirements of the test for *heavy metals*, page 1519.

A 5 cc. portion of the dilution further diluted with 12 cc. of distilled water (without the treatment with sulphuric and sulphurous acids) meets the requirements of the test for *arsenic*, page 1512.

Add 5 drops of barium chloride T.S. to a mixture of 3 cc. of the dilution and 5 cc. of distilled water: neither turbidity nor precipitation appears within one hour (*sulphuric acid or sulphate*).

At the end of this period, the further addition to the liquid of 2 drops of tenth-normal iodine produces neither turbidity nor decoloration of the iodine (*sulphurous acid*).

Assay—Proceed as directed under the assay for acids, page 1514, using about 3 cc. of the Acid, accurately weighed, and methyl orange T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.03647 Gm. of HCl.

This assay is explained on page 1453.

Preserve in glass stoppered bottles.

U. S. P. Preparations—Acidum Hydrochloricum Dilutum; Resina Podophylli; Sulphur Præcipitatum.

N. F. Preparations—Acidum Nitrohydrochloricum; Acidum Nitrohydrochloricum Dilutum; Liquor Chlori Compositus; Tinctura Sanguinariæ.

History—This acid was first prepared commercially by Glauber in the seventeenth century by distilling sea salt with sulphuric acid, hence the common name *Spirit of Salt* which attached to it for many years.

Uses—Hydrochloric acid is largely used in making chlorides and other preparations. Medicinally it is usually prescribed in the diluted form in stomach disorders. The dose is five to ten minims (0.3 to 0.6 cc.). (For antidotes, see Part XV.)

ACIDUM HYDROCHLORICUM DILUTUM. U.S. Diluted Hydrochloric Acid
[Acid. Hydrochl. Dil.]

Diluted Hydrochloric Acid is an aqueous solution containing not less than 9.5 per cent and not more than 10.5 per cent of HCl (36.47).

	Metric	Alternative
Hydrochloric Acid	**313 Gm.**	4½ fl. oz.
Distilled Water	**687 Gm.**	11½ fl. oz.
To make	**1000 Gm.**	16 fl. oz.

Mix them.

Description and Physical Properties—A colorless, odorless liquid.

Specific gravity: about 1.049 at 25° C.

Tests for Identity and Purity—Diluted Hydrochloric Acid is strongly acid to litmus paper.

Diluted Hydrochloric Acid conforms to the tests for identity and purity under *Acidum Hydrochloricum*.

Assay—Proceed as directed under the assay for acids, page 1514, using 10 cc. of Diluted Hydrochloric Acid, accurately weighed, and methyl orange T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.03647 Gm. of HCl.

This assay is explained on page 1453.

Preserve in glass-stoppered bottles.

U. S. P. Preparation—Liquor Acidi Arsenosi.

N. F. Preparations—Elixir Chloridorum; Elixir Pepsini; Extractum Conii; Glyceritum Pepsini; Liquor Pepsini; Liquor Pepsini Antisepticus; Liquor Pepsini Aromaticus.

Uses—Diluted hydrochloric acid is used as in the treatment of certain types of dyspepsia in doses of fifteen minims (1 cc.), largely diluted with water. It should be drawn through a glass tube or straw, to avoid injury to the teeth.

ACIDUM HYDRIODICUM DILUTUM. U.S. Diluted Hydriodic Acid
[Acid. Hydriod. Dil.]

Diluted Hydriodic Acid is an aqueous solution containing not less than 9.5 per cent and not more than 10.5 per cent of HI (127.93).

	Metric	Alternative
Potassium Iodide	**135 Gm.**	4 oz. av. 420 gr.
Hypophosphorous Acid	**20 cc.**	338 min.
Tartaric Acid	**122 Gm.**	4 oz. av. 210 gr.
Distilled Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	**1000 Gm.**	2 pints

Dissolve the potassium iodide in 250 cc. [8 fl. oz.] of distilled water and the tartaric acid in 400 cc. [12 fl. oz.] of diluted alcohol. Pour the solu-

tion of tartaric acid into a bottle of about 1000 cc. [2 pints] capacity, add the solution of the potassium iodide and the hypophosphorous acid, and shake the mixture briskly. Cool to about 5° C. for several hours, and, having fitted a pledget of purified cotton tightly into a funnel, transfer the contents of the bottle to the funnel. When all of the liquid has passed through, wash the bottle and crystalline precipitate with several small portions of diluted alcohol until the filtrate weighs 1000 Gm. [or measures 2 pints]. Warm the liquid at a moderate temperature on a water bath until all of the alcohol has evaporated, and add sufficient distilled water to make the product weigh 1000 Gm. [or measure 2 pints].

Diluted hydriodic acid was introduced into the U. S. Pharmacopœia for the purpose of quickly preparing syrup of hydriodic acid (see page 265).

This is a modification of the Wade or Fothergill process. The potassium iodide is decomposed by tartaric acid, acid potassium tartrate crystallizing out; the use of diluted alcohol and the cooling of the liquid are depended upon to assist in separating the crystals.

$$\underset{\text{potassium iodide}}{KI} + \underset{\text{tartaric acid}}{H_2C_4H_4O_6} = \underset{\text{hydriodic acid}}{HI} + \underset{\text{acid potassium tartrate}}{KHC_4H_4O_6}$$

Hypophosphorous acid is added to protect the diluted acid from discoloration through the possible liberation of iodine. If any free iodine is liberated, the hypophosphorous acid is oxidized to phosphoric acid and hydriodic acid is produced by the action on the iodine, both products being colorless.

$$\underset{\text{hypophosphorous acid}}{H_3PO_2} + \underset{\text{iodine}}{2I_2} + \underset{\text{water}}{2H_2O} = \underset{\text{hydriodic acid}}{4HI} + \underset{\text{phosphoric acid}}{H_3PO_4}$$

The formula for diluted hydriodic acid, page 555, may also be used for preparing *Diluted Hydrobromic Acid*, in which case the potassium iodide is replaced by 108.2 Gm. of potassium bromide.

Traces of potassium iodide, acid potassium tartrate, or hypophosphorous acid will not affect the medicinal action of the finished product.

Description and Physical Properties—A colorless or not more than pale yellow, odorless liquid.

Specific gravity: about 1.100 at 25° C.

Tests for Identity—It is strongly acid to litmus paper.

Diluted Hydriodic Acid responds to the reactions for iodides, page 575.

Tests for Purity—A 5 cc. portion of Diluted Hydriodic Acid, when evaporated to dryness on a water bath and ignited at dull red heat (about 750° C.), leaves not more than 0.165 Gm. of residue.

No blue color is produced on adding a few drops of starch T.S. to 5 cc. of the Acid (*free iodine*).

The addition of 1 cc. of potassium sulphate T.S. to 10 cc. of the Acid causes no turbidity (*barium*).

Mix 0.5 cc. of Diluted Hydriodic Acid with 10 cc. of distilled water, add 8 cc. of silver nitrate T.S. and 6 cc. of ammonium carbonate T.S., digest the mixture for ten minutes on a water bath, cool, and filter: the filtrate upon supersaturation with nitric acid shows no more *chloride* than corresponds to 0.5 cc. of fiftieth-normal hydrochloric acid, page 1520.

A 10 cc. portion of Diluted Hydriodic Acid shows no more *sulphate* than corresponds to 1.0 cc. of fiftieth-normal sulphuric acid, page 1520.

A 10 cc. portion of Diluted Hydriodic Acid without further acidulation meets the requirements of the test for *heavy metals*, page 1519.

Mix 5 cc. of Diluted Hydriodic Acid with 1 cc. of nitric acid, and evaporate the liquid to dryness on a water bath: the residue meets the requirements of the test for *arsenic*, page 1512.

Assay—Pour about 5 cc. of Diluted Hydriodic Acid into a tared flask, weigh accurately, dilute with 20 cc. of distilled water, add 50 cc. of tenth-normal silver nitrate, and shake the mixture well. Then add 5 cc. of nitric acid, heat the mixture on a water bath until the precipitate has a bright yellow color, cool, add 2 cc. of ferric ammonium sulphate T.S., and determine the

residual silver nitrate by titration with tenth-normal potassium thiocyanate. Each cc. of tenth-normal silver nitrate corresponds to 0.01279 Gm. of HI.

This assay is explained on page 1462.

Preserve in amber-colored, glass-stoppered bottles, protected from light. Do not dispense if it contains free iodine.

U. S. P. Preparation—Syrupus Acidi Hydriodici.

Uses—Although this liquid is used mainly for dilution with syrup (see Syrupus Acidi Hydriodici, page 266), it is sometimes given internally in doses of eight minims (0.5 cc.).

ACIDUM NITRICUM. U. S. Nitric Acid
[Acid. Nitric.]

Nitric Acid contains not less than 67 per cent and not more than 69 per cent of HNO_3 (63.02).

Preparation—Nitric acid is prepared from N_2O_5, one of the five compounds of nitrogen and oxygen; these are nitrogen monoxide, or hyponitrous oxide (laughing gas), N_2O; nitrogen dioxide, N_2O_2 or $(NO)_2$; nitrous oxide, N_2O_3; nitrogen tetroxide or peroxide, N_2O_4; and nitric oxide, N_2O_5. From this latter, by the addition of water, nitric acid is formed, $N_2O_5 + H_2O = (HNO_3)_2$. Nitric acid is prepared commercially by reacting on sodium nitrate or *Chili saltpetre* with sulphuric acid. Sodium nitrate is preferred as the source, because it is cheaper than potassium nitrate, and, in addition, it affords a larger proportion of nitric acid. If two molecules of the sodium salt and one of the sulphuric acid are taken, the reactions will be as follows:

$$\underset{\text{sodium nitrate}}{NaNO_3} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{acid sodium sulphate}}{NaHSO_4} + \underset{\text{nitric acid}}{HNO_3}$$

It is possible, by raising the heat, to bring about a second reaction in which the acid sodium sulphate acts upon the second molecule of sodium nitrate as follows:

$$\underset{\text{sodium nitrate}}{NaNO_3} + \underset{\text{acid sodium sulphate}}{NaHSO_4} = \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{nitric acid}}{HNO_3}$$

Commercially, however, it has not been found desirable to force this second reaction and the process is concluded with the production of the acid sodium sulphate.

Nitric acid is also being made from atmospheric nitrogen in enormous quantities by means of the electric furnace, especially in Norway where the electric current is produced cheaply by water power. The nitric acid so obtained, being weak, is transformed directly into calcium nitrate and this, in turn, treated with sulphuric acid, the operation being started by the addition of a little nitric acid. Even in the cold, concentrated nitric acid is formed and the insoluble calcium sulphate is separated by filtration. Many other processes for preparing nitric acid from atmospheric nitrogen have been proposed and a number of them are in successful operation.

The specific gravity of the official acid, or, as it is technically termed "43 degree" acid, is 1.40 at 25° C. That which is usually furnished in commerce is not so strong as this, but has the specific gravity of 1.355, and is known as "38 degree" acid. Care should always be observed to specify "U. S. P. strength" in ordering from the manufacturing chemist or dealer, for if official preparations are to be made, like the solutions of iron, success cannot be expected if acids of official strength are not used. The reddish acid, called *nitrous acid*,

is nitric acid containing more or less nitrogen tetroxide (N_2O_4). The same acid may be formed by passing nitrogen dioxide (N_2O_2) into nitric acid. When exposed to sunlight the pure acid soon undergoes decomposition, developing N_2O_4 and a red color. It should therefore be kept in a dark place.

Description and Physical Properties—A fuming liquid, very caustic and corrosive and having a characteristic, highly irritating odor.

It boils at about 120° C., but volatilizes completely when heated on a steam bath.

Specific gravity: about 1.40 at 25° C.

Tests for Identity—Nitric Acid is strongly acid to litmus paper, even when highly diluted.

Nitric Acid responds to the reactions for nitrates, page 551.

Nitric Acid acts upon copper, mercury, silver, and many other metals, with the evolution of brownish-red fumes, and stains woolen fabrics and animal tissues a bright yellow.

Tests for Purity—Evaporate 20 cc. of Nitric Acid from a platinum or porcelain dish, and dry at 110° C.: not more than 0.003 Gm. of residue remains (*non-volatile substances*).

Shake 2.5 cc. of Nitric Acid, diluted with 7.5 cc. of distilled water, with 2 cc. of chloroform: the latter remains colorless (*iodine or bromine*) even after the introduction of a small piece of metallic tin (*iodic or bromic acid*).

Nitric Acid diluted with 25 volumes of distilled water and neutralized with ammonia T.S. meets the requirements of the test for *heavy metals*, page 1519.

The residue remaining from the evaporation of 0.5 cc. of Nitric Acid to dryness on a water bath meets the requirements of the test for *arsenic*, page 1512.

Separate portions of Nitric Acid diluted with 10 volumes of distilled water do not yield a precipitate upon the addition of barium chloride T.S. (*sulphate*), or of silver nitrate T.S. (*chloride*).

Assay—Proceed as directed under the assay for acids, page 1514, using 2 cc. of the Acid, accurately weighed, and methyl orange T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.06302 Gm. of HNO_3.

This assay is explained on page 1453.

Preserve in dark amber-colored, glass-stoppered bottles, protected from light.

U. S. P. Preparation—Liquor Ferri Tersulphatis.

N. F. Preparations—Acidum Nitrohydrochloricum; Acidum Nitrohydrochloricum Dilutum; Glyceritum Bismuthi; Liquor Ferri Sulphatis; Magma Bismuthi; Unguentum Hydrargyri Nitratis.

History—Both nitric acid and nitro-hydrochloric acid were described by Geber in the seventh century, A.D.

Uses—Nitric acid, sometimes called *aqua fortis*, is used in pharmaceutical operations to form nitrates and as an oxidizing agent. Free nitric acid, however, will evolve oxygen when heated to a high temperature, according to the following reaction:

$$\underset{\text{nitric acid}}{4HNO_3} = \underset{\substack{\text{nitrogen}\\\text{tetroxide}}}{2N_2O_4} + \underset{\text{oxygen}}{O_2} + \underset{\text{water}}{2H_2O}$$

It oxidizes sulphur and phosphorus (giving rise to sulphuric and phosphoric acids) and all of the metals, with a few exceptions. It combines with salifiable bases and forms nitrates. Medicinally, nitric acid is used chiefly as a caustic. It is occasionally given internally in stomach and intestinal disorders in doses of five to ten minims (0.3 to 0.6 cc.). When applied to the skin it produces a yellow stain, due to the formation of *xanthoproteic acid*. When used as a caustic, the surrounding area should be well greased to prevent its action from spreading. (For Antidotes, see Part XV.)

Diluted nitric acid is no longer official but will be found among the reagents (see Chapter XCII).

ACIDUM SULPHURICUM. U. S. Sulphuric Acid
[Acid. Sulphuric.]

Sulphuric Acid contains not less than 93 per cent and not more than 95 per cent of H_2SO_4 (98.08).

Preparation—The reaction by which sulphuric acid is obtained in the "lead chamber process" has been the subject of careful investigation. The term "lead chamber process" is derived from the fact that the reaction takes

place in lead lined rooms. According to one theory, which has been recognized for many years, the sulphur dioxide, SO_2, obtained by burning sulphur or iron pyrites, FeS_2, is allowed to mix with nitrous fumes obtained from the decomposition of sodium nitrate, which changes SO_2 into sulphur trioxide, SO_3, and this uniting with steam yields sulphuric acid H_2SO_4. If the sulphur were burned by itself, the product would be sulphur dioxide, which contains only two-thirds as much oxygen as sulphur trioxide. The object of the sodium nitrate is to furnish, by its decomposition, the requisite additional quantity of oxygen. To understand the process, it is necessary to remember that several of the oxides of nitrogen have oxidizing power. The reactions are thus expressed:

$$\underset{\text{sulphur dioxide}}{2SO_2} + \underset{\text{nitrogen tetroxide}}{N_2O_4} = \underset{\text{sulphur trioxide}}{2SO_3} + \underset{\text{nitrogen dioxide}}{N_2O_2};$$

then

$$\underset{\text{nitrogen dioxide}}{N_2O_2} + \underset{\text{oxygen}}{O_2} = \underset{\text{nitrogen tetroxide}}{N_2O_4};$$

then

$$\underset{\text{sulphur trioxide}}{SO_3} + \underset{\text{water}}{H_2O} = \underset{\text{sulphuric acid}}{H_2SO_4};$$

in which the sulphur dioxide, from the burning pyrites or sulphur, is oxidized to sulphur trioxide by the nitrogen tetroxide, which readily parts with two atoms of oxygen to such bodies as sulphur dioxide, and then takes two atoms of oxygen again from the atmosphere, regenerating the original tetroxide. The nitrogen tetroxide thus acts simply as a carrier of atmospheric oxygen, whereby the SO_2 is changed into SO_3. This latter compound then unites with steam to form H_2SO_4, the final product.

According to a later theory, advanced by Lunge and Naef, the sulphur dioxide combines with nitrogen trioxide, N_2O_3, oxygen from the air, and water, in the form of steam, to produce an intermediate crystalline product termed *nitrosylsulphuric acid*. This, in turn, in the presence of steam, is immediately decomposed into sulphuric acid, the nitrogen trioxide being again regenerated. The reactions are as follows:

$$\underset{\text{sulphur dioxide}}{2SO_2} + \underset{\text{nitrogen trioxide}}{N_2O_3} + \underset{\text{oxygen}}{O_2} + \underset{\text{water}}{H_2O} = \underset{\text{nitrosylsulphuric acid}}{2SO_2\begin{matrix}\diagup OH \\ \diagdown ONO\end{matrix}}$$

then

$$\underset{\text{nitrosylsulphuric acid}}{2SO_2\begin{matrix}\diagup OH \\ \diagdown ONO\end{matrix}} + \underset{\text{water}}{H_2O} = \underset{\text{sulphuric acid}}{2H_2SO_4} + \underset{\text{nitrogen trioxide}}{N_2O_3}$$

This acid is made on an immense scale and a great deal of sulphur dioxide formed in the smelting of sulphide ores, and formerly wasted, is now converted into sulphuric acid by this method. Sulphur is used most largely in the United States as the source of production, while pyrites is used almost exclusively abroad. As the latter nearly always contains arsenical compounds, the foreign commercial product is contaminated with them. The "lead chamber acid" is only suitable for technical purposes when highly purified.

Sulphuric acid is now made on a large scale by what is termed the "con-

tact method", in which a purified mixture of air and sulphur dioxide, from burning sulphur, is cooled to a temperature between 380° and 450° C. (716° and 842° F.) and then caused to pass over what is termed a catalytic agent, resulting in the extraction of oxygen from the air and the production of SO_3, which in turn is dissolved in water or, for complete absorption, in concentrated sulphuric acid. As much as 99 per cent of the theoretical yield of sulphuric acid is thus obtained. Various substances have been used as the catalytic agents, which are themselves not altered during the reaction. Platinized asbestos, finely subdivided platinum distributed over a magnesium salt, vanadium pentoxide, and the sulphates of thorium, cerium, and praseodymium have all been employed. This process is more easily operated than the "lead chamber process" and the pure acid can be produced at less cost.

The reactions involved in making the acid by the "contact method" are expressed as follows:

$$\underset{\text{sulphur}}{S_2} + \underset{\text{oxygen}}{2O_2} = \underset{\text{sulphur dioxide}}{2SO_2}$$

$$\underset{\text{sulphur dioxide}}{2SO_2} + \underset{\text{oxygen}}{O_2} = \underset{\text{sulphur trioxide}}{2SO_3} \quad \text{then} \quad \underset{\text{sulphur trioxide}}{2SO_3} + \underset{\text{water}}{2H_2O} = \underset{\text{sulphuric acid}}{2H_2SO_4}$$

Description and Physical Properties—A colorless, odorless liquid of oily consistence, very caustic and corrosive.

Sulphuric Acid is miscible with water and with alcohol with the evolution of much heat. The Acid must be added with great caution to the diluent.

When strongly heated, the Acid is vaporized with the evolution of dense, white fumes.

Specific gravity: about 1.83 at 25° C.

Tests for Identity—It is strongly acid to litmus paper even when highly diluted.

Sulphuric Acid responds to the reactions for sulphates, page 581.

Sulphuric Acid with or without the aid of heat chars cane sugar, wood, and many other organic substances.

Tests for Purity—No precipitate is formed within an hour on mixing 1 volume of Sulphuric Acid with 5 volumes of alcohol (*lead*).

Sulphuric Acid diluted with 15 volumes of distilled water conforms to the following tests:

Evaporate 25 cc. of the dilution from a platinum or porcelain dish, and ignite: not more than 0.0015 Gm. of residue remains after ignition (*non-volatile substances*).

A 10 cc. portion of the dilution does not at once discharge the color of 0.1 cc. of tenth-normal potassium permanganate (*sulphurous or nitrous acid*).

Mix 5 cc. of the dilution with an equal volume of ferrous sulphate T.S. and superimpose it upon reagent sulphuric acid: the zone of contact does not assume a brown or brownish-red color (*nitrate*).

The dilution is not immediately affected by silver nitrate T.S. (*chloride*).

A 10 cc. portion of the dilution meets the requirements of the test for *heavy metals*, page 1519.

A 2 cc. portion of the dilution meets the requirements of the test for *arsenic*, page 1512.

Assay—Proceed as directed under the assay for acids, page 1514, using about 1 cc. of the Acid, accurately weighed, and methyl orange T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.04904 Gm. of H_2SO_4.

This assay is explained on page 1453.

Preserve in glass-stoppered bottles.

U. S. P. Preparations—Acidum Sulphuricum Aromaticum; Acidum Sulphuricum Dilutum; Liquor Ferri Tersulphatis.

N. F. Preparations—Liquor Ferri Subsulphatis; Oleum Æthereum.

Sulphuric acid is generally known by the old name of *oil of vitriol*. A commercial variety of sulphuric acid which contains an extra molecule of SO_3 and which is sometimes given the formula $H_2S_2O_7$, is known sometimes by the name of *Nordhausen Sulphuric Acid*, and in some of the industries is referred to by the dangerously misleading name of *oleum*. An acid of 66° B. (about 93 per cent H_2SO_4) is known to the trade as "*O. V.*"

History—The sulphates were all originally termed *vitriols*. *Green vitriol* or *vitriol of Mars* contained iron; *blue vitriol* or *vitriol of Venus* contained copper, and *white vitriol* was known to be in some way connected with calamine. *Albertus Magnus* in the thirteenth century first used these terms

and found that when a vitriol was subjected to a high temperature in a retort an oily liquid distilled over which was called *oil of vitriol.*

Uses—Sulphuric acid is the most powerful of the official inorganic acids. It is employed in making many preparations, mostly on account of its energetic action in decomposing salts, and the large use made of its compounds with metals, alkaloids, and other bodies. It is rarely used in the pure state as an escharotic, owing to its tendency to spread. When accidentally dropped upon the skin, a quick and profuse application of magnesia will prove effective. Unless the quantity of acid is very small, care should be used in applying water, except when a very large quantity can be applied at once, as the amount of heat produced when water is mixed with sulphuric acid increases the pain. Internally, sulphuric acid is administered either in its diluted form or as aromatic sulphuric acid. (See also Antidotes, Part XV.)

ACIDUM SULPHURICUM AROMATICUM. U. S. Aromatic Sulphuric Acid [Acid. Sulph. Arom.]

Aromatic Sulphuric Acid contains free sulphuric acid and ethyl-sulphuric acid together equivalent to not less than 19 per cent and not more than 21 per cent of H_2SO_4 (98.08).

	Metric	Alternative
Sulphuric Acid	109 cc.	3 fl. oz. 234 min.
Tincture of Ginger	50 cc.	1 fl. oz. 288 min.
Oil of Cinnamon	1 cc.	15 min.
Alcohol, a sufficient quantity,		
To make	1000 cc.	2 pints

Add the sulphuric acid gradually and with great caution to 700 cc. [22½ fl. oz.] of alcohol, and allow the mixture to cool. Then add to it the tincture of ginger and the oil of cinnamon, and afterwards enough alcohol to make the product measure 1000 cc. [2 pints].

If the acid-alcohol mixture is not cooled, as directed, before adding the oil and tincture, the finished product will be much darker in color than normally, due to greater caramelization than occurs in the cold.

Description and Physical Properties—A clear, reddish-brown liquid having a pleasant aromatic odor.

Specific gravity: about 0.94 at 25° C.

Tests for Identity—Aromatic Sulphuric Acid is strongly acid to litmus paper.

Aromatic Sulphuric Acid responds to the reactions for sulphates, page 581.

Assay—Transfer about 5 cc. of Aromatic Sulphuric Acid, accurately weighed, to a tall beaker. Add exactly 30 cc. of normal sodium hydroxide, and evaporate the mixture to complete dryness on a sand bath. Dissolve the residue in 30 cc. of distilled water, and titrate the excess of alkali with normal sulphuric acid, using methyl orange T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.04904 Gm. of H_2SO_4.

This assay is explained on page 1454.

Preserve in glass-stoppered bottles.

Alcohol content, by volume, 82 to 85 per cent.

History—This preparation was devised by Dr. Adrian Mynsicht of Germany in the early part of the seventeenth century and was used by him under the name *Elixir Vitrioli Mynsichti.* The original formula which was adopted in the P. L. 1721 was quite complex and contained eleven vegetable drugs. The formula was simplified in 1746 and the name changed to *Elixir Vitrioli Acidum* which was changed during the last century to the present title.

Uses—This preparation, known as *elixir of vitriol,* is employed principally as a remedy for diarrhea. It is used sometimes as an excipient for quinine pills, to reduce their size and render them more soluble. The introduction of the acid sulphate of quinine has diminished this use. The dose is eight minims (0.5 cc.).

ACIDUM SULPHURICUM DILUTUM. U. S. Diluted Sulphuric Acid

[Acid. Sulph. Dil.]

Diluted Sulphuric Acid is an aqueous solution containing not less than 9.5 per cent and not more than 10.5 per cent of H_2SO_4 (98.08).

	Metric	Alternative
Sulphuric Acid	107 Gm.	1 fl. oz.
Distilled Water	893 Gm.	15 fl. oz.
To make	1000 Gm.	16 fl. oz.

Pour the Acid gradually, with constant stirring, into the distilled water, and allow the solution to cool.

The strong acid is added gradually to the water, to guard against the too sudden production of heat, which might cause the fracture of a glass vessel. If "lead chamber" sulphuric acid which has not been purified by redistillation is diluted with water, the liquid becomes slightly turbid, and in the course of a few days deposits a grayish-white powder, which is lead sulphate. Sulphuric acid prepared by the "contact method" will not show this precipitate.

The formation of this precipitate does not occur when official or "reagent" sulphuric acid is used, as the lead salt is present only when sulphuric acid has not been purified.

Description and Physical Properties—A colorless, odorless liquid having a strongly acid taste. Specific gravity: about 1.067 at 25° C.

Tests for Identity and Purity—Diluted Sulphuric Acid is strongly acid to litmus paper.

Diluted Sulphuric Acid conforms to the tests for identity and purity under *Acidum Sulphuricum*.

Assay—Proceed as directed under the assay for acids, page 1514, using 20 cc. of the Acid, accurately weighed, and methyl orange T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.04904 Gm. of H_2SO_4.

This assay is explained on page 1453.

Preserve in glass-stoppered bottles.

U. S. P. Preparations—Ferri Carbonas Saccharatus; Ferri Sulphas Granulatus.

N. F. Preparations—Infusum Rosæ Compositum; Syrupus Rosæ.

Uses—Diluted sulphuric acid has the same properties as the acid from which it is made, except those which are dependent upon the strength of the latter. It is given internally in gastric and intestinal disorders, properly diluted, in doses of fifteen minims (1 cc.).

ACIDUM PHOSPHORICUM. U. S. Phosphoric Acid

[Acid. Phos.]

Phosphoric Acid contains not less than 85 per cent and not more than 88 per cent of H_3PO_4 (98.06).

Phosphoric Acid is sometimes referred to as *syrupy phosphoric acid* on account of its consistence.

Preparation—A pure grade of phosphoric acid may be made by adding the proper equivalent of water to phosphorus pentoxide according to the following equation:

$$\underset{\text{phosphorus pentoxide}}{P_2O_5} + \underset{\text{water}}{3H_2O} = \underset{\text{phosphoric acid}}{2H_3PO_4}$$

The acid is made commercially by the action of sulphuric acid on bone ash, or crude calcium phosphate. The crude acid so obtained is unfit for medicinal use unless it is highly purified.

A very pure phosphoric acid, suitable for medicinal use, is made by oxidizing ordinary phosphorus with nitric acid. The following equation explains the reaction that takes place:

$$3P_4 + 20HNO_3 + 8H_2O = 12H_3PO_4 + 10N_2O_2$$

phosphorus — nitric acid — water — phosphoric acid — nitrogen dioxide

Description and Physical Properties—A colorless, odorless liquid of a syrupy consistence.

Phosphoric Acid is miscible with water and with alcohol.

When heated, the liquid loses water, and at 200° C. gradually changes to pyrophosphoric acid. At a still higher temperature (about 300° C.) it is converted into metaphosphoric acid, which either volatilizes as dense fumes, or forms, on cooling, a transparent mass of metaphosphoric acid.

Specific gravity: about 1.71 at 25° C.

Tests for Identity—Phosphoric Acid is strongly acid to litmus paper, even when highly diluted.

Phosphoric Acid carefully neutralized with sodium hydroxide T.S. responds to the reactions for phosphates, page 586.

Render 3 cc. of the dilution alkaline with ammonia T.S., and add magnesium sulphate T.S. (or magnesia mixture T.S.): a white, crystalline precipitate of magnesium-ammonium phosphate is produced. Collect this precipitate, wash it, and then dissolve it in diluted acetic acid: the solution yields a yellow precipitate with silver nitrate T.S. (*distinction from metaphosphoric or pyrophosphoric acid*).

Tests for Purity—Phosphoric Acid diluted with 14 volumes of distilled water conforms to the following tests:

Warm 5 cc. of the dilution gently, and add 2 cc. of silver nitrate T.S.: the mixture does not become brown (*phosphorous or hypophosphorous acid*).

A 10 cc. portion of the dilution meets the requirements of the test for *heavy metals*, page 1519.

A 2 cc. portion of the dilution meets the requirements of the test for *arsenic*, page 1512.

The dilution is not immediately affected by silver nitrate T.S. (*hydrochloric acid*), nor is it affected even after one hour by the addition of an equal volume of tincture of ferric chloride (*pyrophosphoric or metaphosphoric acid*).

Mix 1 cc. of the dilution with 6 cc. of distilled water, and add 1 cc. of barium chloride T.S.: no precipitate is produced immediately (*sulphate*).

Mix 5 cc. of the dilution with an equal volume of ferrous sulphate T.S., and superimpose the mixture upon 3 cc. of sulphuric acid contained in a test tube: the zone of contact does not assume a brown or brownish-red color (*nitrate*).

Transfer 1 cc. of Phosphoric Acid to a graduated cylinder, and add 6 cc. of ether and 2 cc. of alcohol: no turbidity appears (*phosphates*).

Assay—Pour about 1 Gm. of Phosphoric Acid into a tared, 100 cc. volumetric flask, weigh accurately, and add enough distilled water to make 100 cc. Transfer 10 cc. of this solution to a 100 cc. volumetric flask, add a drop of phenolphthalein T.S., and neutralize the mixture with special sodium hydroxide T.S. (page 1550). Add 50 cc. of tenth-normal silver nitrate from a burette while gently shaking. Mix a small amount of reagent zinc oxide (page 1543) with distilled water and gradually add the mixture, in small portions, until the liquid is neutral to litmus paper. Now add distilled water to make the liquid measure 100 cc., mix well, and filter through a dry filter, rejecting the first 5 cc. Transfer 50 cc. of the filtrate with a pipette to a flask, add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S., and determine the excess of silver nitrate by titration with tenth-normal potassium thiocyanate to the production of a permanent red color. Each cc. of tenth-normal silver nitrate corresponds to 0.003269 Gm. of H_3PO_4.

This assay is explained on page 1463.

Preserve in glass-stoppered bottles.

U. S. P. Preparation—Acidum Phosphoricum Dilutum.

N. F. Preparations—Elixir Calcii et Sodii Glycerophosphatum; Elixir Calcii Lactophosphatis; Elixir Gentianæ Glycerinatum; Liquor Phosphatum Acidus; Liquor Phosphatum Compositus; Syrupus Calcii Lactophosphatis; Syrupus Ferri, Quininæ et Strychninæ Phosphatum.

Uses—Phosphoric acid is used to make diluted phosphoric acid and in the galenical preparations indicated above. (For Antidotes, see Part XV.)

ACIDUM PHOSPHORICUM DILUTUM. U.S. Diluted Phosphoric Acid [Acid. Phos. Dil.]

Diluted Phosphoric Acid is an aqueous solution containing not less than 9.5 per cent and not more than 10.5 per cent of H_3PO_4 (98.06).

	Metric	Alternative
Phosphoric Acid	**116 Gm.**	**2¼ fl. oz.**
Distilled Water	**884 Gm.**	**29¾ fl. oz.**
To make	**1000 Gm.**	**2 pints**

Mix them.

The precipitation which sometimes occurs when phosphoric acid is mixed with tincture of ferric chloride is generally due to the presence of pyrophosphoric acid. Ferric pyrophosphate is precipitated in the form of an insoluble gelatinous precipitate.

Description and Physical Properties—A clear, colorless, odorless liquid.

Specific gravity: about 1.057 at 25° C.

Tests for Identity and Purity—Diluted Phosphoric Acid is strongly acid to litmus paper.

Evaporate 20 cc. of Diluted Phosphoric Acid on a water bath to a volume of 4 cc. Cool, transfer 2 cc. to a graduated cylinder, and add 6 cc. of ether and 2 cc. of alcohol: no turbidity appears (*phosphate*).

Diluted Phosphoric Acid conforms to the other tests for identity and purity under *Acidum Phosphoricum*.

Assay—Pour about 1 Gm. of Diluted Phosphoric Acid into a tared, 100 cc. volumetric flask, weigh accurately, add a drop of phenolphthalein T.S., and neutralize the mixture with special sodium hydroxide T.S. (page 1550). Add 50 cc. of tenth-normal silver nitrate, and proceed as directed in the assay under *Acidum Phosphoricum*. Each cc. of tenth-normal silver nitrate corresponds to 0.003269 Gm. of H_3PO_4.

This assay is explained on page 1463.

Preserve in well-stoppered bottles.

Uses—Diluted phosphoric acid is used as a tonic in doses of fifteen minims (1 cc.).

ACIDUM HYPOPHOSPHOROSUM. U. S. Hypophosphorous Acid

[Acid. Hypophos.]

Hypophosphorous Acid is an aqueous solution containing not less than 30 per cent and not more than 32 per cent of HPH_2O_2 (66.06).

Preparation—Hypophosphorous Acid may be made in several ways. Two satisfactory methods are based upon carefully decomposing barium hypophosphite with diluted sulphuric acid or through the decomposition of 17 parts of calcium hypophosphite with 13 parts of oxalic acid.

Another method is the one in which Fothergill's process is involved (page 556). Potassium hypophosphite is made to react with tartaric acid in the presence of diluted alcohol. After the precipitate of potassium bitartrate is removed and the alcohol has been evaporated, the liquid is brought up to the required volume by the addition of distilled water. The equation is expressed as follows:

$$\underset{\text{potassium hypophosphite}}{KPH_2O_2} + \underset{\text{tartaric acid}}{H_2C_4H_4O_6} = \underset{\text{hypophosphorous acid}}{HPH_2O_2} + \underset{\text{acid potassium tartrate}}{KHC_4H_4O_6}$$

Description and Physical Properties—A colorless or slightly yellow, odorless liquid.

When the Acid is heated in a suitable dish, water evaporates, leaving a more concentrated acid. On further heating between 130° and 140° C., it decomposes, forming spontaneously combustible hydrogen phosphide and phosphorous acid. The latter, between 160° and 170° C., decomposes into hydrogen phosphide and phosphoric acid. The pasty residue finally reddens, ignites, and the last portions of unoxidized phosphorus burn out at a higher temperature.

Specific gravity: about 1.130 at 25° C.

Tests for Identity and Purity—It is acid to litmus paper even when highly diluted.

Hypophosphorous Acid responds to the reactions for hypophosphites, see below.

Hypophosphorous Acid diluted with 3 volumes of water conforms to the following tests for identity and purity:

Neutralize 30 cc. of the dilution with ammonia T.S.: not more than a slight precipitate results. Filter, acidulate 10 cc. of the filtrate with hydrochloric acid, and add 2 cc. of potassium sulphate T.S.: no turbidity is produced (*barium*). Another 10 cc. portion of the filtrate shows no turbidity upon the addition of 1 cc. of calcium chloride T.S. (*oxalate*).

One cc. of the dilution mixed with 9 cc. of distilled water meets the requirements of the test for *heavy metals*, page 1519.

Mix 5 cc. of the dilution with 3 cc. of nitric acid and 10 cc. of distilled water, and evaporate the liquid to dryness on a water bath: the residue meets the requirements of the test for *arsenic*, page 1512.

Tests for Hypophosphites

Hypophosphites—When strongly heated, hypophosphites evolve spontaneously inflammable hydrogen phosphide. Hypophosphites in solution yield a white precipitate with mercuric chloride T.S. This precipitate becomes

gray when an excess of hypophosphite is present. Solutions of hypophosphites, acidulated with sulphuric acid and warmed with copper sulphate T.S., yield a red precipitate.

Assay—Proceed as directed under the assay for acids, page 1514, using about 7 cc. of the Acid, accurately weighed, and methyl orange T.S., as indicator. Each cc. of normal sodium hydroxide corresponds to 0.06606 Gm. of HPH_2O_2.

This assay is explained on page 1453.

Preserve in glass-stoppered bottles.

U. S. P. Preparation—Syrupus Ferri Iodidi.

N. F. Preparations—Syrupus Ammonii Hypophosphitis; Liquor Hypophosphitum Compositus; Syrupus Calcii et Sodii Hypophosphitum; Syrupus Calcii Hypophosphitis; Syrupus Hypophosphitum; Syrupus Hypophosphitum Compositus.

Uses—This acid is used as a reducing agent in syrup of ferrous iodide and in hydriodic acid to prevent discoloration through the decomposition of the iodides by light and air. It is used to assist in the solution of the hypophosphites, especially calcium hypophosphite, in various N. F. syrups, elixirs, and solutions. In addition to the official acid, a 10 per cent and a 50 per cent acid are also commercial articles. It has been credited, probably wrongly, with peculiar tonic and alterative powers.

ACIDUM NITROHYDROCHLORICUM. N. F. Nitrohydrochloric Acid

[**Acid. Nitrohydrochl.**—Nitromuriatic Acid]

A strong aqueous solution containing hydrochloric acid, nitric acid, nitrosyl chloride, and chlorine.

	Metric	Alternative
Nitric Acid	18 cc.	1 fl. oz.
Hydrochloric Acid	82 cc.	4½ fl. oz.
To make about	100 cc.	5½ fl. oz.

Mix the acids in a capacious glass vessel, and, when effervescence has ceased, pour the product into dark amber-colored, glass-stoppered bottles, which must not be more than half filled, and must be kept in a cool place.

Note—Do not dispense Nitrohydrochloric Acid which does not immediately liberate iodine when one drop of the Acid is added to 1 cc. of an aqueous solution of potassium iodide (1 in 5).

When Nitric acid is mixed with hydrochloric acid, mutual decomposition takes place, according to the reaction

$$\underset{\text{nitric acid}}{HNO_3} + \underset{\text{hydrochloric acid}}{3HCl} = \underset{\text{nitrosyl chloride}}{NOCl} + \underset{\text{chlorine}}{Cl_2} + \underset{\text{water}}{2H_2O}$$

and a liquid called *aqua regia* is formed, capable of dissolving gold.

The value of this acid depends upon the completion of the above reaction and the production of nitrosyl chloride and free chlorine. It should be kept in a cool dark place, on account of its liability to lose chlorine by heat, and to have its chlorine converted into hydrochloric acid by the action of light and the decomposition of water. Because of its tendency to decompose, it should not be made in large quantities, nor be kept on hand very long, and should always be tested as directed in the above "Note" before being dispensed. Care should be taken not to transfer it to the bottle in which it is to be dispensed until effervescence has ceased, lest the pressure within drive out the stopper or cause the bottle to explode violently.

Official Description—A golden-yellow, fuming, and very corrosive liquid.

Odor and Reaction—It has a strong odor of chlorine; intensely acid to litmus paper, afterwards bleaching it.

Test for Identity—It readily dissolves gold leaf.

Impurities and Tests for Impurities—Not more than 0.0035 Gm. of residue remains on evaporating 10 cc. of the Acid in a glass or porcelain dish and drying at 110° C.

Uses—Nitrohydrochloric acid, or, as it is still called, nitromuriatic acid, is given internally in hepatic and gastric affections, in doses of three minims (0.2 cc.) and upward, well diluted with water. Great care should be taken in dispensing this acid, particularly if directed in combination with infusions, tinctures, etc.; the reaction occurring upon mixing should be permitted to cease entirely before dispensing, to avoid the possibility of an explosion taking place when the preparation is in the patient's hands.

ACIDUM NITROHYDROCHLORICUM DILUTUM. N. F. Diluted Nitrohydrochloric Acid

[**Acid. Nitrohydrochl. Dil.**—Diluted Nitromuriatic Acid]

A diluted aqueous solution containing hydrochloric acid, nitric acid, nitrosyl chloride, and chlorine.

	Metric	Alternative
Nitric Acid	**10.0 cc.**	1 fl. oz.
Hydrochloric Acid	**45.5 cc.**	4½ fl. oz.
Distilled Water	**194.5 cc.**	19½ fl. oz.
To make about	**250 cc.**	25 fl. oz.

Mix the acids in a capacious glass vessel, and, when effervescence has ceased, add the distilled water; pour it into dark amber-colored glass-stoppered bottles and keep it in a cool place.

It should be made strictly according to the official directions. The acids must be mixed while concentrated, otherwise the nitrosyl chloride and chlorine are not produced. Also the "rapid method", so frequently used, of mixing the acids and immediately diluting with water, does not produce an official preparation, and is reprehensible in practice.

Note—Do not dispense Diluted Nitrohydrochloric Acid which does not immediately liberate iodine when five drops of the Acid are added to 1 cc. of an aqueous solution of potassium iodide (1 in 5).

Official Description—A colorless or pale yellow liquid.

Odor, Taste and Reaction—It has a faint odor of chlorine, a very acid taste and is strongly acid to litmus paper, afterwards bleaching it.

Test for Identity—Not more than 0.0015 Gm. of residue remains on evaporating 20 cc. of the Acid in a glass or porcelain dish and drying at 110° C.

Uses—Diluted nitrohydrochloric acid is given in various digestive disorders, in doses of fifteen minims (1 cc.), properly diluted.

Unofficial Inorganic Acids

Acidum Hydrobromicum Dilutum (U. S. P. IX) Diluted Hydrobromic Acid	Containing about 10 per cent of HBr (80.93). It may be prepared extemporaneously, see page 556, but most of the acid is made by distillation. It should conform to the descriptions and tests of the U. S. P. IX

Uses—A nerve sedative in doses of 15 minims (1 cc.).

CHAPTER XLII

PREPARATIONS OF THE HALOGENS

Chlorine, Bromine, Iodine, and Fluorine

Cl; 35.46. Br; 79.92. I; 126.92

Four elements, *chlorine*, *bromine*, *iodine*, and *fluorine*, are termed *halogens* (salt-producers). Fluorine is of little interest in pharmacy, but the other three are of great importance both to medicine and to pharmacy.

Chlorine Cl; 35.46

Chlorine is derived from a Greek word meaning greenish-yellow. It is a greenish-yellow, gaseous body, having a very suffocating odor; its specific gravity is 2.45. One of its most useful and characteristic properties is that of bleaching organic coloring principles; the presence of water is necessary to produce this effect. Chlorine is one of the most reliable disinfectants; it is extensively used in combination with lime as bleaching powder, the official name being calx chlorinata or chlorinated lime. It is also official as sodium hypochlorite in Labarraque's solution (page 569), and in a modified Dakin's solution (page 570). Chlorine in its free state is recognized in chlorine water which is now among the test solutions of the U. S. P. X, and also in compound solution of chlorine of the N. F. V. It is also used in water purification.

Chlorine combines with hydrogen and the metals, but has very little attraction for oxygen; its principal hydrogen compound is hydrochloric acid, HCl (see *Acidum Hydrochloricum*). The compounds of chlorine with metals and bases are termed chlorides; they will be considered under the heads of their respective bases.

Chlorine combines indirectly with oxygen, and the compounds produced by the union of the oxyacid, chloric acid, $HClO_3$, with metals or bases are termed chlorates. Perchlorates are also known.

Chlorine is now commercially available in compressed form in metallic cylinders for use in the preparation of Dakin's solution and in the manufacture of chloramine, chlorinated paraffin and similar products. Chlorine is also being offered in solution in ampuls to provide for bronchial treatments by inhalation.

Tests for Chlorides and Chlorates

Chlorides—Solutions of chlorides yield a white, curdy precipitate with silver nitrate T.S. This precipitate is insoluble in nitric acid, but is easily and completely dissolved by a slight excess of ammonia T.S.

Chlorates—Solutions of chlorates yield no precipitate with silver nitrate T.S. The addition of sulphurous acid to this mixture produces a white precipitate which is insoluble in nitric acid but soluble in ammonia T.S. Upon ignition, chlorates yield chlorides, recognizable by appropriate tests. When concentrated sulphuric acid is added to a dry chlorate, decrepitation occurs and a greenish-yellow gas is evolved.

Caution—Only a small amount of chlorate should be used for this test and extreme caution must be exercised in performing it.

Chlorates are recognized by the evolution of oxygen when heated, and by the reaction of the residue corresponding with that of chlorides.

The chlorate may also be reduced to chloride by warming with an acidified solution of ferrous sulphate, then applying the above test for chlorides.

Unofficial Chemical Compounds of Chlorine, Bromine, and Iodine

Acidum Hypochlorosum, HClO Hypochlorous Acid	The pure acid, free from water, is unknown. Its aqueous solution is used as an oxidizing agent. With bases it forms salts called hypochlorites. The acid is so weak that it is displaced from these salts by the carbon dioxide of the air. The odor of this acid is noted when bleaching powder is exposed to moist air
Acidum Chloricum, $HClO_3$ Chloric Acid	Its concentrated solution is a colorless, viscous liquid with a pungent odor. It is readily decomposed on exposure to light and when in contact with organic matter. This acid is a powerful bleaching agent and forms salts with bases, known as chlorates
Acidum Perchloricum, $HClO_4$ Perchloric Acid	A volatile, colorless, fuming liquid. It reacts with violence when in contact with organic matter or with carbon. It is a powerful oxidizing agent
Bromi Chloridum, BrCl Bromine Chloride	A reddish-yellow, mobile, very volatile, fuming liquid, having a powerful odor which causes the flow of tears. It has been used externally as a caustic and internally in the treatment of cancer
Acidum Bromicum, $HBrO_3$ Bromic Acid	Known only in solution. It decomposes, when concentrated, into bromine, oxygen, and water. The acid forms salts with bases that are called bromates. Like ch oric acid t is a powerful oxidizing and bleaching agent
Acidum Iodicum, HIO_3 Iodic Acid	A soluble, white, crystalline solid. A powerful oxidizing agent and a monobasic acid, the salts being known as iodates. The acid is decomposed by heat and by exposure to sunlight
Acidum Periodicum, HIO_4 Periodic Acid	Colorless, transparent, deliquescent crystals. The acid is a powerful oxidizing agent and is melted and decomposed by heat
Amylum Iodatum Iodized Starch	A dark blue to black powder containing about five per cent of iodine The formula $(C_6H_{10}O_5)_5I$ was at one time suggested for iodized starch, but it is doubtful if it is a definite chemical compound Iodized starch is a convenient preparation for administering iodine internally. The dose is two to four drachms (8 to 16 Gm.)

CALX CHLORINATA. U. S. Chlorinated Lime

[Calx Chlorin.—"Chloride of Lime"]

Chlorinated Lime is a product resulting from the action of chlorine upon calcium hydroxide, and yields not less than 30 per cent of available chlorine [Cl = 35.46].

Available chlorine is a term that applies to the amount of chlorine that can be liberated by the chlorinated lime upon treatment with an acid. A study of the equation given on the following page, showing the decomposition of chlorinated lime, shows that not only is the chlorine liberated from the hypochlorite radicle which is linked to the calcium but from the chloride also. This is due to the active character of the hypochlorite radicle which is capable of producing an oxidizing effect equal to twice its chlorine content (see equation, page 569). Available chlorine, therefore, is the "hypochlorite chlorine" multiplied by two, and is a potential rather than an actual factor as usually stated in terms of per cent.

Preparation—Chlorinated lime is made by exposing finely powdered, dry calcium hydroxide, which has been placed on trays in a suitable chamber, to the action of chlorine. The gas is absorbed by the lime, as indicated in the following equation:

$$Ca(OH)_2 + Cl_2 = Ca\begin{matrix}(OCl)\\Cl\end{matrix} + H_2O$$

calcium hydroxide — chlorine — calcium chloro-hypochlorite — water

This calcium chloro-hypochlorite together with some undecomposed calcium hydroxide and some calcium chloride constitutes the so-called "chloride of lime" of commerce. A condensation of the formula into $CaOCl_2$

is frequently used to designate chloride of lime in chemical equations. The calcium chloride is of no value in the product, but is a detriment, owing to its hygroscopic character and the fact that the absorbed water decomposes the chlorinated lime.

Free acids, such as hydrochloric, decompose chlorinated lime as follows:

$$Ca\begin{matrix}OCl\\Cl\end{matrix} + 2HCl = CaCl_2 + Cl_2 + H_2O$$

calcium chloro-hypochlorite — hydrochloric acid — calcium chloride — chlorine — water

Even the carbon dioxide of the air can decompose chlorinated lime with the liberation of its available chlorine, when it is exposed and this accounts, in part, for the deodorant and disinfectant properties for which it is so widely employed. The small packages of chlorinated lime usually sold in grocery stores or drug stores are rarely of full strength, in fact most of the packages only claim 25 per cent of available chlorine. Sealed zinc cans, holding 5 or 10 pounds, or more of full 30 per cent strength are, however, available. The better grade material should be insisted upon for the making of Dakin's solution.

Description and Physical Properties—A white, or grayish-white, granular powder, having the odor of chlorine. It becomes moist and gradually decomposes on exposure to air and when in such condition must not be used.

It is partially soluble in water and in alcohol, the insoluble portion settling readily when mixed with water.

Tests for Identity—Shake 1 Gm. of Chlorinated Lime with 50 cc. of distilled water, and filter: the filtrate at first turns litmus paper blue and then bleaches it.

Dissolve 0.5 Gm. of Chlorinated Lime in 5 cc. of diluted acetic acid: an abundance of chlorine gas is evolved and only a slight residue remains undissolved. Ammonium oxalate T.S. added to this solution yields a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid.

Assay—Transfer to a mortar about 4 Gm. of Chlorinated Lime, accurately weighed in a tared weighing bottle, using 50 cc. of distilled water. Triturate thoroughly, and pour the mixture into a graduated liter flask, rinsing the mortar with distilled water to make 1000 cc. Stopper the flask, and allow it to stand for ten minutes. Shake thoroughly, add to 100 cc. of the mixture 1 Gm. of potassium iodide and 5 cc. of acetic acid, and titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.003546 Gm. of available chlorine (Cl).

This assay is explained on page 1465.

Preserve in air-tight containers, in a cool, dry place.

U. S. P. Preparations—Liquor Sodæ Chlorinatæ; Liquor Sodæ Chlorinatæ Chirurgicalis.

Uses—Chlorinated lime is used in the preparation of solution of chlorinated soda. It is a cheap and powerful disinfectant and deodorant and is used for sterilizing various infected materials; it is largely used for purifying drinking water (see page 546). It is rarely employed for any purpose around the body having been replaced by chlorinated soda. It is also an active bleaching agent. When an acid, even vinegar, is added to it, it evolves large volumes of chlorine. It is not given internally.

LIQUOR SODÆ CHLORINATÆ. U. S. Solution of Chlorinated Soda

[**Liq. Sod. Chlorinat.**—Labarraque's Solution]

An aqueous solution of chlorine compounds of sodium, containing not less than 2.6 per cent of NaOCl (74.46), equivalent to not less than 2.5 per cent of available chlorine.

	Metric	Alternative
Monohydrated Sodium Carbonate	**70 Gm.**	9 oz. av. 148 gr.
Chlorinated Lime	**100 Gm.**	13 oz. av. 149 gr.
Water, a sufficient quantity,		
To make	**1000 Gm.**	8 pints

Triturate the chlorinated lime with 500 cc. [4 pints] of water gradually added until a uniform mixture results. Dissolve the monohydrated sodium carbonate in 500 cc. [4 pints] of warm water, and add this solution to the chlorinated lime mixture contained in a suitable vessel. Stir or shake the mixture thoroughly, and if it becomes gelatinous warm the vessel very gently until its contents again liquefy. Then transfer the mixture to a wetted muslin strainer, and return the first portion until the liquid passes through clear. Add a few drops of sodium carbonate T.S. to 10 cc. [2½ fl. dr.] of this clear filtrate. If it remains clear on the addition of the reagent, continue the operation without further treatment. If the filtrate becomes cloudy, return the mixture to the vessel, add sufficient monohydrated sodium carbonate to precipitate the excess of lime and again filter, returning the first portions until the liquid passes through clear. When no more liquid drains from the filter, wash the precipitate with enough water to make the product weigh 1000 Gm. [or measure 8 pints].

Double decomposition results in the formation of insoluble calcium carbonate or precipitated chalk, while sodium hypochlorite and sodium chloride remain in solution.

$$Ca\begin{matrix}Cl\\OCl\end{matrix} + Na_2CO_3 = CaCO_3 + NaCl + NaOCl$$

calcium chloro-hypochlorite — sodium carbonate — calcium carbonate — sodium chloride — sodium hypochlorite

Description and Physical Properties—A clear, pale greenish liquid, having a faint odor suggesting chlorine, and a disagreeable, alkaline taste.

The Solution at first colors red litmus paper blue and then bleaches it.

Test for Identity—The addition of hydrochloric acid to the Solution causes an evolution of chlorine and carbon dioxide.

Assay—Mix in a flask about 7 cc. of Solution of Chlorinated Soda, accurately weighed, with 50 cc. of distilled water, add 1 Gm. of potassium iodide and 5 cc. of acetic acid, and titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.003546 Gm. of Cl.

This assay is explained on page 1468.

Preserve in well-stoppered bottles, in a cool place, protected from light.

Uses—Solution of chlorinated soda, or "Labarraque's solution", is principally employed as a disinfectant or bleaching solution. A similar preparation, formerly official in the N. F., in which potassium carbonate replaces sodium carbonate, is commonly known as *Javelle water*. The two solutions are identical for all practical purposes and hence the chlorinated potassa solution has been deleted from the N. F.

LIQUOR SODÆ CHLORINATÆ CHIRURGICALIS. U.S.
Surgical Solution of Chlorinated Soda

[**Liq. Sod. Chlorinat. Chir.**—Modified Dakin's Solution, frequently known as Carrel-Dakin Solution]

An aqueous solution of chlorine compounds of sodium, containing not less than 0.45 per cent and not more than 0.50 per cent of NaOCl (74.46), equivalent to from 0.43 to 0.48 per cent of available chlorine.

Chlorinated Lime,
Exsiccated Sodium Phosphate,
Water, each, a sufficient quantity,
To make ..... **1000 cc.**

Assay the chlorinated lime (page 569) and, having determined its percentage of available chlorine, prepare the solution as directed below, using the quantities of chlorinated lime and exsiccated sodium phosphate indicated in the following table:

Per cent of available chlorine in the chlorinated lime used	Gm. of chlorinated lime for each 1000 cc. of solution	Gm. of exsiccated sodium phosphate for each 1000 cc. of solution
20	29	38
21	28	36
22	27	34
23	26	32
24	25	30
25	24	28
26	23	26
27	22	24
28	21	22
29	20.5	21
30	20	20
31	19.5	20
32	19	20
33	18	20
34	17.5	20
35	17	20

Triturate the necessary amount of chlorinated lime, as indicated by the table, with 400 cc. of water, gradually added, until a uniform mixture results. Dissolve the required amount of exsiccated sodium phosphate, which has been recently dried, in 400 cc. of water, heated to 50° C., and add this solution to the chlorinated lime mixture. Shake thoroughly and allow it to stand for fifteen minutes. Transfer the mixture to a filter, returning the first portions of filtrate until it runs through clear, and when no more liquid drains from the filter, wash the precipitate with sufficient water to make the product measure 900 cc. Assay a portion as directed below, and dilute the remainder with sufficient water to make the finished Solution contain 0.48 per cent of NaOCl.

This solution was developed during the World War to provide an inexpensive but efficient germicide for the treatment of wounds. The alkalinity of Labarraque's solution rendered it unfit for such use and in the first attempts to develop a neutral solution, suitable for wound dressing, boric acid was employed. The alkali present in this solution is sodium hydroxide, resulting from the reaction between the sodium carbonate and the calcium hydroxide present in chlorinated lime.

Sodium bicarbonate was later suggested by Daufresne as a more efficient neutralizing agent. The detailed process is given below. Many other formulas have been suggested (see J. A. Ph. A. 1924, page 32), but the special pharmacopœial referee, Dr. E. F. Kelly, through the coöperation of the Johns Hopkins' Hospital, found sodium phosphate to be the most satisfactory substance for this purpose. Its special value depends upon its being a so-called "buffer salt", one which insures neutrality without careful adjustment. The third method suggested is admirably adapted to hospital practice, because of its cheapness and rapidity of preparation, but cannot be used unless special apparatus is provided.

It is of primary importance that the strength of this preparation be accurately adjusted and it should be retested if kept for more than a few days.

The equation for the development of sodium hypochlorite is shown on page 570.

The War Demonstration Hospital's modification of Daufresne's method, neutralizing with sodium bicarbonate, which was largely used throughout the World War, is as follows:

The percentage of available chlorine in the chlorinated lime to be employed is first determined.

To make about 40 liters: Place in a 20 liter container the amount of chlorinated lime indicated in the following table; mix this well with 5 liters of tap water and allow it to stand several hours.

"Available" Chlorine in Chlorinated Lime, per cent	Chlorinated Lime for 5 Liters Water, Gm.	Monohydrated Sodium Carbonate for 5 Liters Water, Gm.	Add Sodium Carbonate as directed below
20–26	800	700	
28–34	600	490	
36–42	500	390	

Dissolve the designated amount of monohydrated sodium carbonate in another 5 liters of water, and pour the solution into the bottle containing the chlorinated lime; mix thoroughly and allow the calcium carbonate to settle. (If all the calcium is not precipitated, add small amounts of sodium carbonate solution until precipitation is complete.) Siphon off the supernatant liquid through a double filter. This concentrated and alkaline solution will keep for several weeks. For use it is treated thus: A measured portion (20 to 50 cc.) is titrated with 10 per cent hydrochloric acid until the red color produced by the addition of solid phenolphthalein disappears (more solid phenolphthalein is added to determine that decolorization was not due to bleaching). The calculated amount of 10 per cent hydrochloric acid is then added to the original specimen, having a volume designated "V". After the acid has been added, a volume the same as "V" of 6.25 per cent sodium bicarbonate solution is added. The chlorine content of this concentrated solution is now determined by the method prescribed for the assay of solution of chlorinated soda (page 570) and it is then diluted to the proper strength.

Method of Preparing Dakin's Solution as suggested by Cullen and Austen and used at the Rockefeller Institute for Medical Research, New York City

This method requires initial expenditure for a tank and meter, but if these are procured, an absolutely reliable solution can be prepared in from fifteen to twenty-five minutes, at a very low cost, without filtration, and with no preliminary analysis. A final analysis for adjustment is all that is required.

To Prepare One Liter—Measure 1000 cc. of water into a tall cylinder. Dissolve in it 18 Gm. of monohydrated sodium carbonate (15 Gm. of anhydrous sodium carbonate, or 40 Gm. of crystallized sodium carbonate could be used instead).

Pass chlorine gas into the solution from a Wallace and Tiernan tank and meter, adapted for Dakin's solution, for three and one-half minutes at a rate of 500 cc. per minute as indicated on the meter. The gas must enter the solution through a gas diffuser attached to the meter by stethoscope tubing. This diffuser is supplied by the same company.

Test the hypochlorite concentration as follows:

Dilute 10 cc. of the solution with 50 cc. of distilled water, add about 1 Gm. of potassium iodide and 4 cc. of glacial acetic acid. Titrate the liberated iodine with tenth-normal sodium thiosulphate. When near the end point, add 0.5 cc. of starch T.S. and titrate until the blue color disappears. The number of cc. of tenth-normal sodium thiosulphate required, multiplied by the factor 0.0372, gives the percentage of NaOCl. It should contain not less than 0.45 per cent and not more than 0.5 per cent of NaOCl.

NOTE—The addition of 1 cc. of 0.5 per cent solution of potassium permanganate to every liter of Dakin's solution tends to stabilize the solution and imparts a pink color that is convenient for distinguishing it from other antiseptics.

Dakin's solution is also prepared from concentrated preparations, such as "*Hychlorite*" which is eight times the strength of the U. S. P. product.

Antiformin is a concentrated hypochlorite solution used as a disinfectant. It contains 5.68 Gm. of available chlorine in each 100 cc.

The solution, however prepared, must conform to the U. S. P. tests as follows:

Description and Physical Properties—A colorless or faintly yellow liquid having a slight odor suggesting chlorine.

Tests for Purity—Add about 0.02 Gm. of powdered phenolphthalein to 20 cc. of Surgical Solution of Chlorinated Soda: no red color is produced on agitation (*maximum alkalinity*).

Add about 0.5 cc. of phenolphthalein T.S. to 5 cc. of the Solution contained in a test tube: a momentary red flash is produced (*minimum alkalinity*).

Assay—Dilute 25 cc. of the Solution, accurately weighed with 50 cc. of distilled water, add 1 Gm. of potassium iodide and 5 cc. of acetic acid, and titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.003723 Gm. of NaOCl.

This assay is explained on page 1468.

Preserve in well-stoppered bottles, preferably for not more than seven days, in a cool place, protected from light.

Uses—The N. N. R. describes its uses as follows: "Surgical solution of chlorinated soda is a rapid germicide and efficient antiseptic for infected

wounds, when it is used after free incision and cleansing, and applied by practically continuous irrigation, as in the Carrel technic.

Its strength and reaction are carefully adjusted so as to be practically non-irritant to wounds. The skin, however, is subject to irritation and must be protected by petrolatum. The solution does not precipitate proteins, but, on the contrary, dissolves necrotic tissues, and thus helps to keep the wound clean. On the other hand, it dissolves silk ligatures and loosens catgut, thus favoring secondary hemorrhage. The solution is practically non-toxic when used externally. It should not be injected into the peritoneum.

Dosage—For external use, full strength. It is claimed that below 0.4 per cent of sodium hypochlorite the clinical effect of hypochlorite solutions is nil, while above 0.5 per cent the irritating effect on the skin becomes serious."

A solution of chloramine in water is not identical with Dakin's solution and should not be dispensed as such.

LIQUOR CHLORI COMPOSITUS. N. F. Compound Solution of Chlorine

[Liq. Chlor. Co.—Chlorine Water]

An aqueous solution containing, when freshly made, a mixture of chlorine and chlorine oxides equivalent to about 0.35 Gm. of available chlorine in each 100 cc.

	Metric	Alternative
Potassium Chlorate, granulated	3.5 Gm.	51 gr.
Hydrochloric Acid	10.0 cc.	154 min.
Distilled Water, a sufficient quantity, To make	500 cc.	1 pint

Graduate a bottle of not less than 1000 cc. [2 pints] capacity to 500 cc. [1 pint] and fit it with a tightly fitting stopper having two perforations. Through one of these perforations pass a funnel tube fitted with a stop-cock and through the other a straight glass tube about 8 mm. [$\frac{5}{16}$ inch] in diameter and 7 cm. [about 3 inches] in length. Place the potassium chlorate in the bottle and add through the funnel tube the hydrochloric acid, previously mixed with 10 cc. [154 min.] of distilled water. Close the stop-cock and place the bottle on a water bath for a few moments or until the potassium chlorate is dissolved and the bottle completely filled with a gas having a greenish-yellow color. Then remove the bottle from the water bath and add cold distilled water in several portions through the funnel, agitating thoroughly after each addition to make the product measure 500 cc. [1 pint].

This Solution should not be dispensed unless it has been recently prepared and then only in well-filled, amber-colored bottles.

Official Description—A yellow liquid.

Odor, Taste, and Reaction—It has a strong odor and taste of chlorine.

Tests for Identity—One drop when added to 5 cc. of potassium iodide T.S., liberates iodine. When evaporated to dryness on a water bath it leaves a white residue consisting mainly of potassium chloride.

Chlorine water was official in the U. S. P. 1890 and the process is now included among the reagents of the U. S. P. (page 1545). In its preparation hydrochloric acid is heated with 10 Gm. of manganese dioxide and the generated chlorine conducted into 400 cc. of distilled water until a saturated solution is produced. The reaction is shown below:

$$\underset{\text{manganese dioxide}}{MnO_2} + \underset{\text{hydrochloric acid}}{4HCl} = \underset{\text{manganese chloride}}{MnCl_2} + \underset{\text{chlorine}}{Cl_2} + \underset{\text{water}}{2H_2O}$$

The chlorine water must be kept protected from light, to prevent its partial conversion into hydrochloric acid through the decomposition of the water by the union of the chlorine with its hydrogen.

The apparatus shown in Fig. 264 or 265 is well adapted for making small quantities of chlorine water rapidly. The N. F. process for compound solution of chlorine produces a "chlorine water" which is equally efficient for medical purposes and far more readily prepared. The slight traces of potassium chloride and the oxides of chlorine which are present when made in this way may be ignored when used medicinally; but it is not so well suited for reagent purposes and hence the introduction of "chlorine water" among the reagents.

Uses—Compound solution of chlorine, or chlorine water, was formerly largely used as an intestinal antiseptic and also as a gargle in diphtheria but has largely diminished in popularity. The dose is from thirty to sixty minims (2 to 4 cc.) diluted with water.

Bromine Br; 79.92

Tests for Bromides and Bromates

Bromides—In solutions of bromides, the addition of chlorine T.S., drop by drop, liberates bromine which is dissolved by shaking with chloroform, coloring the chloroform red to reddish-brown. Silver nitrate T.S., produces in solutions of bromides a yellowish precipitate which is insoluble in nitric acid, and only slightly soluble in dilute ammonia T.S.

Bromates—Sulphurous acid added drop by drop to a solution of a bromate produces a yellow color, which disappears upon the addition of an excess of sulphurous acid. Bromates, when gently ignited with charcoal, yield bromides which may be recognized by the characteristic reactions.

BROMUM. N.F. Bromine

Bromine is from a Greek word meaning "stench", suggesting its unpleasant odor. The official Bromine contains not less than 99 per cent of Br (79.92) and not more than 1 per cent of Cl. Bromine should be preserved in glass-stoppered bottles in a cool place, the bottle being enclosed in a larger vessel with the space between filled with some substance, such as lime, capable of absorbing and combining with any vapors which might escape.

Preparation—This non-metallic element, which is in the form of a dark red, volatile liquid, is produced largely in the United States, in Michigan, Ohio, West Virginia, and Pennsylvania. It is prepared from the brine obtained from salt-wells by the following process. The brine is concentrated to separate chlorides, sulphates, etc., by crystallization. The mother liquor, containing the bromine principally in the form of magnesium bromide, is decomposed by treating it with chlorine gas.

The manner of conducting this process is as follows: The original salt liquor, or brine, is pumped out of the ground and evaporated to about 15° B. in large iron pans, then allowed to settle, and is further evaporated to the point of crystallization in wooden tanks heated by steam pipes. These tanks, five in number, are placed at different elevations, one above the other. Each day the liquor is run off from No. 1, the highest, to No. 2, next day to No. 3, and so on until it reaches No. 5, the crystallized salt being removed from each tank after draining off the liquor. The brine which reaches No. 5 is termed *bittern*, and consists chiefly of calcium, magnesium, sodium, and aluminum chlorides, with varying percentages of sodium and calcium bromides.

The bittern marking 30° to 38° B. is evaporated to about 45° B. The liquor is then run into stone stills, materials for generation of bromine added, and heat applied by means of steam until the bromine, which comes over first, has all been vaporized. It is condensed and collected in cooled receivers.

$$\underset{\text{magnesium bromide}}{MgBr_2} + \underset{\text{chlorine}}{2Cl} = \underset{\text{magnesium chloride}}{MgCl_2} + \underset{\text{bromine}}{2Br}$$

A process has also been perfected for the separation of the bromine from the "bittern" by electrolytic methods and is being successfully conducted on a commercial scale. Bromine may also be prepared by distillation from a mixture of a bromide, manganese dioxide, and sulphuric acid as explained by the following equation:

$$\underset{\text{magnesium bromide}}{MgBr_2} + \underset{\text{sulphuric acid}}{2H_2SO_4} + \underset{\text{manganese dioxide}}{MnO_2} = \underset{\text{manganous sulphate}}{MnSO_4} + \underset{\text{magnesium sulphate}}{MgSO_4} + \underset{\text{water}}{2H_2O} + \underset{\text{bromine}}{Br_2}$$

The salts, termed bromides, are used very largely in medicine. They will be considered under the heads of their respective bases. *Bromates*, formed, like chlorates, by combination with the corresponding oxyacid, bromic acid, ($HBrO_3$), are rarely used.

Official Description—A heavy, dark brownish-red, mobile liquid, evolving, even at ordinary temperatures, reddish fumes, highly irritating to the eyes and lungs.

Odor, Taste, and Reaction—It has a peculiar, suffocating odor, resembling that of chlorine.

Specific gravity: about 3.1 at 25° C.

Boiling Point—About 63° C.

Solubility—One cc. dissolves in about 90 cc. of water; it is freely soluble in alcohol, ether, chloroform, or carbon disulphide.

Impurities and Tests for Impurities—*Organic Bromine Compounds*—Add 1 cc. of Bromine to 50 cc. of sodium hydroxide T.S.; it combines to form a permanently clear liquid, without the separation of oily drops.

Iodine—Shake 10 cc. of a saturated aqueous solution of Bromine with a slight excess of reduced iron until it becomes nearly colorless, filter the liquid and add 1 cc. of ferric chloride T.S. and 1 cc. of starch T.S.; it does not assume a blue color.

Assay—Dissolve 10 Gm. of potassium iodide in 25 cc. of distilled water, introduce the solution into a 100 cc. measuring flask, stopper and determine accurately the weight of the flask

and its contents. Add about 1 Gm. of Bromine to the contents of the flask, determine its exact weight and then fill the flask to the mark with distilled water and titrate 25 cc. of this solution with tenth-normal sodium thiosulphate, using starch T.S. as indicator.

The presence of free bromine in aqueous liquids may be detected by agitating the liquid with chloroform, or ether, and noting the color of the bromine in the immiscible layer that separates. Free bromine will also give a blue color with a trace of an iodide in the presence of starch.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.007992 Gm. of Br or 0.003546 Gm. of Cl. Each Gm. of Bromine (containing not more than 1 per cent of chlorine) corresponds to not more than 126.7 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1467.

N. F. Preparation—Liquor Auri et Arseni Bromidi.

Uses—Bromine is used in the manufacture of bromides for medicine and photography. It is a powerful caustic and germicide but is, at present, rarely employed. The *utmost care* should be exercised in handling bromine; the vapor not only attacks the eyes and nostrils, but renders the air irrespirable. If exposed to the vapors of bromine the part should be washed with a solution of sodium bicarbonate. The vapor acts on metallic surfaces, and may ruin balances if permitted to remain in contact with them.

Unofficial Preparation

Liquor Bromi (N. F. IV) Solution of Bromine (Smith's Solution of Bromine)	Dissolve 12.5 Gm. (228 gr.) of potassium bromide in 80 cc. (3 fl. oz. 96 min.) of water, contained in a bottle, add 8.3 cc. (159 min.) of bromine, and shake the mixture until solution is effected. Finally add sufficient water to make the product measure 100 cc. (4 fl. oz.) Keep the Solution in glass-stoppered bottles in a dark place

Iodine I; 126.92

Tests for Iodides

Iodides—In solutions of iodides, the addition of chlorine T.S., drop by drop, liberates free iodine which colors the solution yellow to red, and on shaking with chloroform the latter is colored violet. The iodine thus liberated gives a blue color with starch. Silver nitrate T.S. produces in solutions of iodides a yellow, curdy precipitate which is insoluble in nitric acid and in ammonia T.S.

IODUM. U.S. Iodine

Iodine is from a Greek word meaning "violet-colored", alluding to the vapors of the element.

The official iodine contains not less than 99.5 per cent of I (126.92).

Preparation—Iodine is a non-metallic element widely distributed in nature. It was formerly exclusively obtained from *kelp*, *barilla*, or *varec*, the ashes of certain sea-weeds. In addition to this source, it is now made from the mother liquors obtained from the crystallization of sodium nitrate in South America. These contain the iodine in the form of sodium iodate. Iodine is precipitated from the sodium iodate by the action of a solution of sodium sulphite and bisulphite in calculated amount.

$$\underset{\text{sodium iodate}}{2NaIO_3} + \underset{\text{sodium sulphite}}{3Na_2SO_3} + \underset{\text{acid sodium sulphite}}{2NaHSO_3} = \underset{\text{sodium sulphate}}{5Na_2SO_4} + \underset{\text{iodine}}{I_2} + \underset{\text{water}}{H_2O}$$

The liberated iodine is then washed and purified by sublimation.

Iodine is prepared from iodides when they are decomposed by chlorine.

$$\underset{\text{sodium iodide}}{2NaI} + \underset{\text{chlorine}}{Cl_2} = \underset{\text{sodium chloride}}{2NaCl} + \underset{\text{iodine}}{I_2}$$

The iodides obtained by lixiviating kelp have long been used as sources of iodine by the above reaction or by distilling with sulphuric acid and manganese dioxide according to the following equation:

$$\underset{\text{sodium iodide}}{2NaI} + \underset{\text{sulphuric acid}}{2H_2SO_4} + \underset{\text{manganese dioxide}}{MnO_2} = \underset{\text{iodine}}{I_2} + \underset{\text{manganese sulphate}}{MnSO_4} + \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{water}}{2H_2O}$$

The separated iodine may then be sublimed in glass or earthenware receivers.

Description and Physical Properties—Heavy, bluish-black, brittle, rhombic plates, having a metallic luster and a distinctive odor.

One Gm. of Iodine is soluble in 2950 cc. of water, 12.5 cc. of alcohol, 80 cc. of glycerin, and in 4 cc. of carbon disulphide, at 25° C. It is freely soluble in chloroform, carbon tetrachloride, and in ether, and is dissolved by aqueous solutions of iodides. Its solution in alcohol and in an aqueous solution of potassium iodide has a reddish-brown color. Its solution (1 in 1000) in chloroform, carbon tetrachloride, and in carbon disulphide is of a violet color.

Tests for Identity—Specific gravity: about 4.66 at 17° C.

Iodine imparts a deep brown, evanescent stain to the skin and slowly destroys vegetable colors.

Iodine volatilizes slowly at ordinary temperatures. When heated to about 114° C., it fuses and gradually vaporizes in the form of violet fumes.

Add starch T.S. to a saturated aqueous solution of Iodine: a blue color is produced. On boiling the mixture, the color vanishes but reappears as it cools, unless it has been subjected to long continued boiling.

Tests for Purity—When volatilized, Iodine leaves not more than 0.05 per cent of residue.

Triturate 0.5 Gm. of finely powdered Iodine with 20 cc. of distilled water, and filter the solution. To one-half of the filtrate carefully add tenth-normal sodium thiosulphate until the solution is just decolorized. Then add a few drops of ferrous sulphate T.S. and subsequently a little sodium hydroxide T.S., and heat the mixture gently: the liquid does not become blue upon the addition of a slight excess of hydrochloric acid (*cyanogen.*)

To the other half of the aqueous filtrate, add, drop by drop, sulphurous acid (free from chloride) previously diluted with several volumes of distilled water, until the iodine color just disappears. Add 5 cc. of ammonia T.S., and follow with 5 cc. of silver nitrate T.S. in small portions. Filter, and acidulate the filtrate with nitric acid: the resulting turbidity is not greater than that produced in a control test made with the same quantities of reagents to which 0.1 cc. of fiftieth-normal hydrochloric acid has been added, but omitting the sulphurous acid (*chloride or bromide*).

Assay—Place about 0.5 Gm. of powdered Iodine in a tared weighing-bottle, stopper, weigh accurately, and add 1 Gm. of potassium iodide dissolved in 5 cc. of distilled water. Dilute this solution with distilled water to about 50 cc., and titrate with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.01269 Gm. of I.

This assay is explained on page 1467.

Preserve in glass-stoppered bottles, in a cool place.

U. S. P. Preparations—Liquor Iodi Compositus; Syrupus Ferri Iodidi; Tinctura Iodi; Unguentum Iodi.

N. F. Preparations—Ampullæ Iodi; Dentilinimentum Aconiti et Iodi Compositum; Liquor Iodi et Zinci Phenolsulphonatis; Liquor Iodi Phenolatus (from Compound Solution); Petroxolinum Iodi; Petroxolinum Iodi Dilutum; Phenol Iodatum; Pilulæ Ferri Iodidum; Sulphuris Iodidum; Syrupus Calcii Iodidi; Syrupus Iodotannicus; Tinctura Iodidorum; Tinctura Iodi Fortior; Unguentum Iodi Denigrescens.

Iodine is largely used in the preparation of iodides, in the aniline color industry, and in the production of organic medicinal agents, such as iodoform.

Iodine is only slightly soluble in water but the addition of iodides greatly increases its solubility. Advantage is taken of this fact in the preparation of Lugol's Solution (see below). The iodides are largely used in medicine. The iodates, like the chlorates and bromates, are produced by combination with the oxyacids of iodine, iodic and periodic acids. They are of little interest pharmaceutically.

Uses—Iodine is very largely used in medicine. Internally it is a valuable alterative, useful in goiter, syphilis, rheumatism, and other chronic diseases. Locally it is used as a counterirritant, and as a germicide for sterilizing the skin and wounds. The average dose is one-twelfth grain (0.005 Gm.).

TINCTURA IODI. U.S. Tincture of Iodine

The formula and assays will be found on page 374.

LIQUOR IODI COMPOSITUS. U.S. Compound Solution of Iodine

[**Liq. Iodi Co.**—Lugol's Solution]

Compound Solution of Iodine is an aqueous solution containing, in each 100 cc., not less than 4.8 Gm. and not more than 5.2 Gm. of I and not less than 9.8 Gm. and not more than 10.2 Gm. of KI.

	Metric	Alternative
Iodine	5 Gm.	183 gr.
Potassium Iodide	10 Gm.	365 gr.
Distilled Water, a sufficient quantity,		
To make	100 cc.	8 fl. oz.

Dissolve the iodine and potassium iodide in a sufficient quantity of distilled water to make the product measure 100 cc. [8 fl. oz.].

The potassium iodide is added only to increase the solubility of the iodine.

Description and Physical Properties—A transparent liquid having a deep brown color, and an odor of iodine.

Test for Identity—A drop of Compound Solution of Iodine added to 1 cc. of starch T.S., diluted with 10 cc. of water, produces a deep blue color.

Assay for Potassium Iodide—Measure exactly 5 cc. of Compound Solution of Iodine, evaporate in a tared dish or watch-glass on a water bath, and add several small successive portions of distilled water, drop by drop, until all of the iodine has volatilized and a white residue remains: the residue should weigh not less than 0.490 Gm. and not more than 0.510 Gm. and should respond to the identity tests under *Potassii Iodidum*.

Assay for Iodine—Dilute exactly 5 cc. of Compound Solution of Iodine with 25 cc. of distilled water, and titrate with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.01269 Gm. of I.

This assay is explained on page 1468.

Preserve the solution in glass-stoppered bottles, protected from light.

N. F. Preparation—Liquor Iodi Phenolatus.

Uses—This Solution, containing about 3 grains of iodine in each fluidrachm, affords an efficient means of administering iodine internally. It is given in three-minim (0.2 cc.) doses, and, to prevent gastric irritation, it must be largely diluted.

SYRUPUS ACIDI HYDRIODICI. U. S. Syrup of Hydriodic Acid

[Syr. Acid. Hydriod.]

This is a syrupy liquid containing not less than 1.3 and not more than 1.45 Gm. of hydriodic acid [HI; 127.93] in each 100 cc. It has the specific gravity 1.185 and is prepared by dissolving 450 Gm. of sucrose in 130 cc. of diluted hydriodic acid and enough distilled water to make 1000 cc. (page 265).

The object of this preparation is to furnish an agreeable mode of administering hydriodic acid, and also a liquid which will be reasonably stable. *Hydriodic acid*, HI, is easily decomposed in simple aqueous solution (unless protected by hypophosphorous acid as in the official process), free iodine being liberated, and if taken internally, when in this condition, it is irritating to the alimentary tract. The sucrose or sugar used in this syrup should be of the highest grade obtainable. In time the syrup usually darkens due to the caramelization of the sucrose by the free acid.

Description and Physical Properties—A transparent, colorless, or not more than pale straw-colored, odorless, syrupy liquid, having a sweet and acidulous taste.

Specific gravity: about 1.185 at 25° C.

Test for Identity—Mix 5 cc. of Syrup of Hydriodic Acid with a few drops of starch T.S. and add 3 drops of chlorine T.S.: the liquid acquires a deep blue color.

Test for Purity—No blue color is produced in the syrup by starch T.S. alone (*free iodine*).

Assay—Place exactly 25 cc. of Syrup of Hydriodic Acid in a flask, dilute it with 100 cc. of distilled water, add 40 cc. of tenth-normal silver nitrate, agitate the mixture, add 5 cc. of diluted nitric acid and 2 cc. of ferric ammonium sulphate T.S., and determine the residual silver nitrate by titration with tenth-normal potassium thiocyanate. Each cc. of tenth-normal silver nitrate corresponds to 0.01279 Gm. of HI.

This assay is explained on page 1462.

Uses—Syrup of hydriodic acid is used as an alterative. The dose is twenty to sixty minims (1.3 to 4 cc.).

LIQUOR IODI ET ZINCI PHENOLSULPHONATIS. N.F. Solution of Iodine and Zinc Phenolsulphonate

[Liq. Iodi et Zinc. Phenolsul.—Pyorrhea Astringent]

	Metric	Alternative
Potassium Iodide	15 Gm.	261 gr.
Iodine	20 Gm.	365 gr.
Zinc Phenolsulphonate	15 Gm.	261 gr.
Glycerin	25 cc.	1 fl. oz.
Distilled Water, a sufficient quantity, To make	100 cc.	4 fl. oz.

Dissolve the potassium iodide in 20 cc. [384 min.] of distilled water, add the iodine and agitate the mixture at frequent intervals until the iodine is completely dissolved. Dissolve the zinc phenolsulphonate in the glycerin and 20 cc. [384 min.] of distilled water, add to the first solution, then add sufficient distilled water to make the product measure 100 cc. [4 fl. oz.].

This Solution should be recently prepared when dispensed.

Uses—For pyorrhea.

LIQUOR IODI PHENOLATUS. N.F. Phenolated Solution of Iodine

[Liq. Iod. Phenol.—Liquor Iodi Carbolatus, Carbolized Solution of Iodine, Boulton's Solution, French Mixture]

	Metric	Alternative
Compound Solution of Iodine	15 cc.	230 min.
Liquefied Phenol	6 cc.	92 min.
Glycerin	165 cc.	5 fl. oz. 134 min.
Water, a sufficient quantity, To make	1000 cc.	2 pints

Mix the liquefied phenol with the compound solution of iodine, add the glycerin and sufficient water to make the product measure 1000 cc. [2 pints]. Then expose the liquid to sunlight until it has become colorless.

Description and Tests—Phenolated Solution of Iodine is a colorless or faintly yellow solution, with a characteristic taste and odor.

Specific gravity: about 1.047 at 25° C.

The solution turns blue with starch T.S.

Evaporate 10 cc. of the Solution at a temperature not exceeding 100° C: it leaves not more than 0.202 Gm. of residue.

Incinerate the residue from 10 cc. of the Solution: it leaves not more than 0.0004 Gm. of ash.

Add mercuric chloride T. S. to a quantity of the solution: a red precipitate is formed.

Uses—This is an antiseptic solution suitable for application to wounds.

Unofficial Preparations of Iodine

A number of unofficial preparations of iodine have been developed within recent years. The more important of these are recognized by the N. N. R. in which they are classified and described, and from which the following facts are taken:

Iodine Preparations Containing Free Iodine—*Iodosticks, Iodoapplicators and Special Iodoapplicators (Iodine 60 per cent and Potassium Iodide 40 per cent)*—Wooden sticks, 3.8, 14.0, 16.5 and 30.5 cm. (1½, 5½, 6½ and 12 inches) long, respectively, tipped with a mixture of iodine, 60 per cent and potassium iodide, 40 per cent. Each stick is to be used but once. Prepared by the Tappan Zee Surgical Co.

Iocamfen—A liquid obtained by the interaction of iodine 10 parts, phenol 20 parts, and camphor 70 parts, containing about 7.25 per cent free of iodine.

A dark, reddish-brown, viscid liquid, having a camphoraceous odor. Insoluble in water, but soluble in all proportions in alcohol, ether, benzine and liquid petrolatum.

It is said to have the antiseptic and germicidal properties of iodine and also the analgesic, stimulating and antiphlogistic properties of camphor and phenol.

It is applied in small quantities directly to wounds, the skin, cavities, etc., or on tampons or drainage material. It should not be applied to wet surfaces. It is also sold as a 50 per cent ointment under the name *Camiofen Ointment*. Manufactured by Schering & Glatz, Inc.

Iodine Dusting Powders—Dusting-powders containing iodine in various combinations are widely used in the treatment of wounds, granulating surfaces, abscess cavities, etc., whether due to syphilis or tuberculosis or to other infections. The virtue of such preparations was formerly attributed to a germicidal action, but investigators have found such action very slight. The clinical results are now ascribed to a slight antiseptic action of the iodine, to a stimulation of phagocytosis, and to a diminished secretion of the wound which renders it a less favorable culture medium for germs. Under this class the U. S. P. Thymol Iodide and *Aristol*, a brand or thymol iodide, are referred to.

Fluorine F; 19.0

Unofficial Substances

FLUORINE

Fluorine is named from the mineral fluorite in which it is found. The name "fluorite" comes from the word "fluor" meaning to flow, because the mineral is easily melted and has long been used as a flux.

Fluorine (F = 19.0) is the most recently isolated member of the halogen group of elements.

Preparation—It is not official, but hydrofluoric acid (HF = 20.01) and some of its salts are proving of value in medicine and in textile trades. It was prepared by Moissan in 1886 by the electrolysis of anhydrous hydrogen fluoride containing acid potassium fluoride which served to conduct the electric current. It is not only the most active of the halogens but is the most reactive of all of the elements, since it combines with nearly all of them and possesses an unparalleled affinity for hydrogen. On account of this unusual activity, fluorine is not found in nature in the free state. In the combined state it is generally found as *fluorspar*, which is *calcium fluoride*, or in *cryolite*, the double *fluoride of aluminum and sodium*. It is also widely but sparingly distributed in other minerals and has been found in the enamel of the teeth.

Fluorine is a greenish-yellow gas, paler and more yellowish than chlorine. Its density is a little more than half that of chlorine. It is known only in the anhydrous condition because of the intensity with which it decomposes water, forming hydrogen fluoride and ozone. It combines with all of non-metals excepting oxygen, chlorine, nitrogen, and the members of the argon, or zenon, group. All metals are attacked by fluorine at ordinary temperatures with the exception of gold and platinum, and some of them, as in the case of copper, become covered with a protective film of fluoride.

Besides displacing chlorine from chlorides, fluorine forms a binary acid and binary salts; its behavior is not typical of the halogens. For example, its valence is practically always one, no compounds with oxygen are known, its silver salt is water-soluble, and its calcium salt is insoluble.

It is interesting to note that glass, if perfectly dry and clean, is not attacked by fluorine (compare the action of hydrofluoric acid).

HYDROGEN FLUORIDE—Hydrofluoric Acid

Hydrogen fluoride (HF = 20.1) is a very penetrating, corrosive gas that dissolves in water with strongly acid properties. The gas fumes strongly in air and can easily be liquefied by lowering its temperature. It is conveniently prepared by heating a mixture of calcium fluoride and strong sulphuric acid in a lead or platinum vessel.

The reaction is expressed by the following equation:

$$\underset{\text{calcium fluoride}}{CaF_2} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{calcium sulphate}}{CaSO_4} + \underset{\text{hydrogen fluoride}}{2HF}$$

The solution of hydrogen fluoride gas in water is commonly called *hydrofluoric acid*. This solution is poisonous and has a caustic action on the skin. Because of its corrosive character, hydrofluoric acid must be kept in bottles made of wax, gutta percha, or bakelite. Larger quantities of the acid are stored and shipped in lead containers.

Hydrofluoric acid is chiefly used for etching designs and various other markings on glass. The object to be etched is first coated with a film of substance impervious to hydrogen fluoride, like wax, paraffin, or a so-called etching varnish. The desired markings are then cut through this coating by means of a sharp instrument and the object is exposed to the hydrogen fluoride gas or dipped into its solution. Upon the removal of the coating the markings are etched upon the glass. The vapor of hydrogen fluoride leaves white and opaque tracings whereas the solution forms transparent lines.

The salts of hydrofluoric acid are known as the *fluorides*, and the soluble fluorides are poisonous. The best known fluoride, namely calcium fluoride, is used as a flux because it is easily melted. Other fluorides are used as preservatives, in various enamels for coating metals, and others are becoming extensively used as moth preventatives. (See Chapter on *Household Pests*.)

Sodium Fluoride (NaF)—A poisonous, soluble white powder. It is used in medicine, and as an antiseptic and antifermentative. It is also used as an insecticide (see Chapter on Household Pests), and has been employed in minute amounts as a food preservative, which, however, is prohibited by all food laws.

Test for Fluorides—When heated with concentrated sulphuric acid fluorides yield the gaseous hydrofluoric acid which, in turn, etches glass.

CHAPTER XLIII

SULPHUR AND PHOSPHORUS

S; 32.06. P; 31.04

THESE two elements furnish many important compounds to medicine. They present several analogies, both physically and chemically.

Sulphur S; 32.06

Sulphur—This name is derived from the Sanscrit "sulveri" through the Latin "sulphurium". It is found uncombined in Sicily and in other parts of the world. Vast deposits have been worked near Charles Lake, Louisiana, and all along the Texas coast. An ingenious method, devised by H. Frasch, has here been introduced whereby the sulphur, from a depth of about 400 feet, is brought to the surface in a molten condition by forcing superheated water, under pressure, at a temperature of about 155° C. (311° F.), down the bored well, through an iron pipe. The heat melts the sulphur deposit and the molten sulphur rises through smaller, enclosed tubes. In order to bring the melted sulphur to the surface, heated air is forced into it, thus lowering the specific gravity and causing the sulphur to rise to the surface without pumps. Then the melted sulphur is collected in large wooden boxes and allowed to solidify. The sulphur from this source is of exceptional quality, showing from 99 to 99.6 per cent pure sulphur. In the form of sulphates and sulphides sulphur is widely distributed. The sulphur found in Sicily is prepared for use by fusing it, allowing it to stand to permit the earthy impurities to settle, and then pouring it into cylindrical molds. The sulphur in cylinders is termed *roll sulphur*.

Large quantities of sulphur are also obtained as by-products from the Leblanc soda process and from gas works.

Three forms of sulphur are official in the U. S. P.,—sublimed, washed, and precipitated.

With hydrogen, sulphur forms a gas with an offensive odor which is known officially as *hydrogen sulphide*, H_2S. It is also termed *sulphuretted hydrogen* and *hydrosulphuric acid*. The formula for its preparation will be found under "Reagents" (see page 1535). It is used for proving the presence or absence of certain metallic salts, lead, bismuth, antimony, copper, mercury, zinc, etc., with which it produces characteristic precipitates. *Sulphides* are compounds of elements with sulphur and may be viewed as salts of hydrosulphuric acid. Some of the sulphides are analogous to acids, others to bases; and these different sulphides, by combining with one another, form compounds, which, from their analogy to salts, were called by Berzelius *sulpho-salts*. With oxygen sulphur forms two well defined oxides, *sulphur dioxide* (*sulphurous anhydride*), SO_2, and *sulphur trioxide* (*sulphuric anhydride*), SO_3. These oxides, by their union with water, form *sulphurous acid*, H_2SO_3, and *sulphuric acid*, H_2SO_4, respectively. These are considered in the chapter on inorganic acids. There is also known *hyposulphurous acid*, H_2SO_2, the corresponding oxide of which is not known, and *thiosulphuric acid* (frequently known as hyposulphurous acid), $H_2S_2O_3$, and a series of acids, $H_2S_2O_6$, $H_2S_3O_6$, $H_2S_4O_6$, $H_2S_5O_6$ and $H_2S_2O_8$, known as the *thionic series*. Sulphurous acid forms with bases salts which

are termed *sulphites*. The salts similarly produced from sulphuric acid are termed *sulphates*. The sulphates are much more important salts. Pharmaceutically and medicinally, the sulphites and sulphates have totally different properties. Those official will be considered under their respective bases.

Tests for Sulphates, Sulphides, and Sulphites

Sulphates—Solutions of sulphates yield with barium chloride T.S. a white precipitate, which is insoluble in hydrochloric or nitric acid.

Sulphides—When treated with an acid, many sulphides yield hydrogen sulphide, recognizable by its characteristic odor and by its blackening moist lead acetate test paper.

Sulphites—When treated with hydrochloric acid, sulphites and bisulphites yield colorless sulphur dioxide, recognizable by its pungent odor which resembles burning sulphur. This gas blackens filter paper moistened with mercurous nitrate T.S.

Unofficial Compounds and Preparations of Sulphur and Phosphorus

Acidum Hyposulphurosum, H_2SO_2 Hyposulphurous Acid	A yellow liquid that rapidly decomposes on exposure to air, forming water, sulphur, and sulphur dioxide. It is a powerful reducing and bleaching agent
Acidum Metaphosphoricum, HPO_3 Metaphosphoric Acid	A glassy, deliquescent, pasty solid. When boiled with water it is converted into orthophosphoric acid
Acidum Phosphorosum, H_3PO_3 Phosphorous Acid	A crystalline mass readily soluble in water. Heat decomposes this acid, forming phosphoretted hydrogen and phosphoric acid. The aqueous solution absorbs oxygen and the acid is a powerful reducing agent. The acid is dibasic in most of its reactions to form salts
Acidum Pyrophosphoricum, $H_4P_2O_7$ Pyrophosphoric Acid	It is generally found as a soft crystalline mass. Its solution, when heated yields orthophosphoric acid. All four of its hydrogen atoms are replaceable to form normal salts
Spiritus Phosphori Spirit of Phosphorus U. S. P. 1890	A volatile, alcoholic solution of phosphorus, made by dissolving yellow phosphorus in dehydrated alcohol. It was formerly used in preparing the elixir of phosphorus. It is prepared by weighing 1.2 Gm. of phosphorus in a tared dish containing water, drying it quickly with the aid of blotting paper, and transferring it at once to a flask containing 1000 cc. of dehydrated alcohol. Having connected the flask with an upright condenser, boil the liquid gently on a water bath until the phosphorus is dissolved, cool, and add enough absolute alcohol to make 1000 cc. Store in small dark-colored vials
Carbonei Disulphidum Carbon Disulphide, CS_2	A colorless, heavy, highly refractive liquid with a disagreeable odor which is largely due to other sulphide impurities. The vapors are poisonous and very imflammable. Carbon disulphide is an excellent immiscible solvent for a great variety of substances. It is widely used as a solvent, as a germicide and an insecticide
Hydrogen Sulphide, H_2S	A colorless gas with an offensive odor and sweetish taste. It is poisonous and inflammable. It is used as a reagent in analytical chemistry to precipitate metallic sulphides
Resina Phosphorata Phosphorated Rosin Phosphoretted Resin	A yellowish solid containing 4 per cent of ordinary phosphorus. It is used as a convenient means of keeping, handling, and incorporating ordinary phosphorus into various preparations such as a pill mass. It is prepared by melting together, by the aid of a sand bath, in a dry bottle having the nearly exact capacity of the ingredients, anhydrous rosin 96 parts, and phosphorus 4 parts. Keep the whole at a temperature of 200° C. until the phosphorus is dissolved, mix thoroughly, cool, and keep in bottles protected from light

SULPHUR SUBLIMATUM. U. S. Sublimed Sulphur

[Sulphur Sublim.—Flowers of Sulphur]

Sublimed Sulphur, when dried to constant weight over sulphuric acid, contains not less than 99.5 per cent of S (32.06).

Preparation—When vapors of sulphur are conducted into a chamber properly cooled, they are condensed in the form of a crystalline powder, which

collects on the sides and bottom of the chamber. The yellowish powder is known as sublimed sulphur, or *flowers of sulphur. Ground roll sulphur* is sometimes sold as "*flour of sulphur*"; it is not identical in physical properties with the official sublimed sulphur.

Description and Physical Properties—A fine, yellow powder having a faint odor and taste. Sublimed Sulphur is practically insoluble in water and nearly insoluble in alcohol. One Gm. dissolves slowly and usually incompletely in about 2 cc. of carbon disulphide. One Gm. is soluble in about 70 cc. of chloroform, in 150 cc. of ether, and in 100 cc. of olive oil.

Tests for Identity—At about 115° C. Sublimed Sulphur fuses to a yellow, mobile fluid, which upon further heating to about 162° C. becomes dark and viscid. In the air it burns to sulphur dioxide, which can be recognized by its characteristic odor.

Test for Purity—The residue on ignition does not exceed 0.5 per cent.

Assay—Dry about 1 Gm. of Sublimed Sulphur to constant weight over sulphuric acid, weigh accurately, and transfer to a flask containing 50 cc. of a solution of potassium hydroxide (1 in 10). Boil the mixture until the liquid is of a transparent, golden-yellow color, and then dilute it with distilled water to measure exactly 250 cc. Oxidize 25 cc. of this diluted solution by the addition of solution of hydrogen dioxide in excess (using about 50 cc.), heat on a water bath for thirty minutes, acidulate the liquid with hydrochloric acid, dilute it with 250 cc. of distilled water, heat to boiling and add hot barium chloride T. S., in small portions, to the resulting liquid until no further precipitation takes place. Heat this mixture on a water bath for thirty minutes, collect the resulting precipitate on a filter, wash, dry, ignite, and weigh the barium sulphate. Carry out a blank determination, using the same amount of all of the reagents but omitting the Sulphur, and before making the final calculation deduct the amount of barium sulphate thus obtained from that obtained in the assay. The weight of the barium sulphate thus obtained, multiplied by 0.1373 indicates its equivalent of sulphur. Each Gm. of Sublimed Sulphur, previously dried, corresponds to not less than 7.243 Gm. of $BaSO_4$.

This assay is explained on page 1480.

U. S. P. Preparations—Sulphur Lotum; Sulphur Præcipitatum; Unguentum Sulphuris.

N. F. Preparations—Liquor Calcis Sulphuratæ; Petroxolinum Sulphuratum; Unguentum Sulphuris Alkalinum; Unguentum Sulphuris Compositum.

Uses—Sublimed sulphur is preferred for the ointment of sulphur, because of the presence of a small quantity of sulphurous acid which renders it more efficient in parasitic skin diseases. It is not used internally as a medicine in its unpurified state.

SULPHUR LOTUM. U. S. Washed Sulphur
[Sulphur Lot.]

Washed Sulphur, when dried to constant weight over sulphuric acid, contains not less than 99.5 per cent of S (32.06).

	Metric	Alternative
Sublimed Sulphur	**100 Gm.**	16 oz. av.
Ammonia Water	**10 cc.**	1½ fl. oz.
Water, a sufficient quantity.		

Pass the sublimed sulphur through a No. 30 sieve, mix it thoroughly with 100 cc. [1 pint] of water, add the ammonia water, and set the mixture aside for three days in a closed vessel, agitating occasionally. Then add 100 cc. [1 pint] of water, transfer the mixture to a strainer, and wash the sulphur with water until the washings cease to impart a blue color to red litmus paper. Then allow it to drain, press the residue strongly, dry it rapidly at a moderate heat in a drying closet, and pass it through a No. 30 sieve.

Sublimed Sulphur is frequently contaminated on exposure with small quantities of sulphurous acid and sulphuric acid, and the object of the ammonia in the above process is to neutralize any acid that may be present, the ammonium salts being subsequently washed out, and also to wash out any arsenic sulphide.

Description and Physical Properties—A fine yellow powder, without odor or taste.

Tests for Identity and Purity—It meets the requirements for solubility and identity under *Sulphur Sublimatum.*

Agitate 2 Gm. of Washed Sulphur with 10 cc. of distilled water and filter: the filtrate is neutral to litmus paper (*acid or alkali*).

The residue on ignition does not exceed 0.5 per cent.

Digest 0.5 Gm. of Washed Sulphur for three hours with 10 cc. of ammonia T.S., filter the liquid, and evaporate the clear filtrate to dryness on a water bath. Add 1 cc. of nitric acid, and again evaporate to dryness. This residue meets the requirements of the test for *arsenic*, page 1512.

Assay—Dry Washed Sulphur to constant weight over sulphuric acid and proceed as directed under *Sulphur Sublimatum*.

This assay is explained on page 1480.

Preserve in well-closed containers.

U. S. P. Preparation—Pulvis Glycyrrhizæ Compositus.

N. F. Preparations—Sulphuris Iodidum; Tabellæ Sulphuris et Potassii Bitartratis.

Uses—Washed sulphur is employed internally as a laxative, especially in compound licorice powder or combined with potassium bitartrate. It was formerly credited with alterative powers and used in rheumatism and other chronic disorders, a tradition which still survives among the laity. Sulphur is also a valuable local agent in various skin diseases. The dose is 1 drachm (4 Gm.).

SULPHUR PRÆCIPITATUM. U. S. Precipitated Sulphur

[**Sulphur Præc.**—Lac Sulphuris, Milk of Sulphur]

Precipitated Sulphur, when dried to constant weight over sulphuric acid, contains not less than 99.5 per cent of S (32.06).

	Metric	Alternative
Sublimed Sulphur	**100 Gm.**	16 oz. av.
Lime	**50 Gm.**	8 oz. av.
Hydrochloric Acid,		
Water, each, a sufficient quantity.		

Slake the lime, and mix it thoroughly with 500 cc. [5 pints] of water. Add the sublimed sulphur, previously sifted, and, after thorough mixing add 1000 cc. [10 pints] of water, and boil the mixture in a porcelain or glass vessel during one hour, stirring or agitating the mixture very frequently, and replacing the water lost by evaporation. Then cover the vessel, and allow it to stand until the contents are cool and the supernatant liquid becomes clear. Carefully draw off the clear solution, and filter the remainder.

To the united liquids add gradually and with constant stirring hydrochloric acid, previously diluted with an equal volume of water, until the liquid is nearly neutralized but still retains an alkaline reaction and a yellow color. Collect the precipitate on a strainer, and wash it until the washings are neutral to litmus paper and no longer give a precipitate upon the addition of ammonium oxalate T.S. Then dry the product rapidly, and keep it in well-closed containers.

In the above process the lime and sulphur react to form soluble polysulphides of calcium. The reaction is usually given as follows:

$$\underset{\text{sulphur}}{6S_2} + \underset{\substack{\text{calcium}\\\text{hydroxide}}}{3Ca(OH)_2} = \underset{\substack{\text{calcium}\\\text{pentasulphide}}}{2CaS_5} + \underset{\substack{\text{calcium}\\\text{thiosulphate}}}{CaS_2O_3} + \underset{\text{water}}{3H_2O}$$

On the addition of hydrochloric acid, the sulphur is precipitated:

$$\underset{\substack{\text{calcium}\\\text{pentasulphide}}}{2CaS_5} + \underset{\substack{\text{calcium}\\\text{thiosulphate}}}{CaS_2O_3} + \underset{\substack{\text{hydrochloric}\\\text{acid}}}{6HCl} = \underset{\substack{\text{calcium}\\\text{chloride}}}{3CaCl_2} + \underset{\text{sulphur}}{6S_2} + \underset{\text{water}}{3H_2O}$$

In some processes sulphuric acid is used instead of hydrochloric acid, and calcium sulphate is precipitated with the sulphur. This furnishes an inferior

article which should not be confused with the official product. In carrying out the official process it is important to follow the instructions exactly. If the mixture is boiled longer than one hour, soluble polysulphides are formed and the final yield is lessened. If the hydrochloric acid is added in excess, the precipitated sulphur becomes coarse, reduced in quantity, and contaminated with arsenic.

A convenient test readily applied to distinguish between the pure and the inferior product consists of simply igniting a small portion of the material on porcelain over a Bunsen flame. The appearance of any residue after the sulphur has burned away is evidence of impurity.

Description and Physical Properties—A fine, amorphous powder, of a pale yellow color, without odor or taste.

Tests for Identity and Purity—Precipitated Sulphur meets the requirements for solubility and identity under *Sulphur Sublimatum*, but it is more readily and completely soluble in carbon disulphide than the other forms of sulphur.

Agitate 2 Gm. of Precipitated Sulphur with 10 cc. of distilled water, and filter: the filtrate is neutral to litmus paper (*acid or alkali*).

The residue on ignition does not exceed 0.3 per cent.

Digest 1 Gm. of Precipitated Sulphur for three hours with 10 cc. of ammonia T.S., and filter the liquid. Evaporate the clear filtrate to dryness on a water bath, add 1 cc. of nitric acid, and again evaporate to dryness: this residue meets the requirements of the test for *arsenic*, page 1512.

Assay—Dry Precipitated Sulphur to constant weight over sulphuric acid and proceed as directed under *Sulphur Sublimatum*

This assay is explained on page 1480.

N. F. Preparations—Pasta Betanaphtholis; Pasta Zinci Sulphurata.

Uses—Precipitated sulphur is much to be preferred to the other forms in liquid mixtures, as the particles are lighter and more easily suspended; the ointments made with it are smoother than those made with sublimed sulphur but are not considered as effective. The dose is 1 drachm (4 Gm.).

SULPHURIS IODIDUM. N. F. Sulphur Iodide

[Sulphur. Iod.]

	Metric	Alternative
Washed Sulphur	**20 Gm.**	60 gr.
Iodine	**80 Gm.**	240 gr.

Mix the sulphur and iodine thoroughly by trituration; introduce the mixture into a flask, close the orifice loosely, and, by means of a water bath, gradually apply a heat not exceeding 60° C. and occasionally agitate until the ingredients combine and become of a uniformly dark color throughout. Then increase the heat to the boiling point of water, so as to fuse the mass. Should any iodine sublime and condense on the glass, incline the flask so as to combine the iodine with the fused mass. Then pour the latter upon a porcelain plate or other suitable cold surface. When it is cold, break it into peices of suitable size, and preserve them in a glass-stoppered bottle, in a cool place.

This compound represents one of the instances of the direct chemical union of two elements, heat being the only agent used to effect the combination; it is sometimes called *subiodide of sulphur*, or *iodine disulphide*, S_2I_2. There is some doubt, however, as to its being a definite chemical compound.

As it is readily decomposed when exposed to air, it should be kept in tightly closed bottles.

Official Description—In brittle masses having a crystalline fracture and a grayish-black, metallic luster.

Odor and Taste—It has the odor of iodine and a somewhat acrid taste.

Solubility—Almost insoluble in water; soluble in about 60 parts of glycerin; very soluble in carbon disulphide. Alcohol, ether, or an aqueous solution of potassium iodide dissolve the iodine, leaving the sulphur. Continued boiling with water vaporizes all of the iodine, leaving about 20 per cent of sulphur as a residue.

Tests for Identity—On exposing sulphur iodide to the air, it gradually loses iodine. On heating it, some iodine sublimes at first; at a somewhat higher temperature a sublimate is formed, containing both iodine and sulphur. At a still higher temperature, it is almost completely volatilized, leaving only a trace of residue.

Assay—Mix 0.5 Gm. of finely powdered Sulphur Iodide with 1 Gm. of potassium iodide, and dissolve the mixture in 20 cc. of distilled water (the sulphur separating); it requires not less than 28 cc. of tenth-normal sodium thiosulphate for complete decolorization of the mixture, starch T.S. being used as an indicator.

This assay is explained on page 1467.

Uses—Sulphur Iodide is principally used externally in skin diseases in the form of an ointment.

Phosphorus P; 31.04

Tests for Phosphates

Phosphates—Neutral solutions of orthophosphates yield with silver nitrate T.S. a yellow precipitate, which is soluble in diluted nitric acid or in ammonia T.S. With ammonium molybdate T.S., a yellow precipitate is produced which is soluble in ammonia T.S.

Tests for Hypophosphites

Hypophosphites—When strongly heated, hypophosphites evolve spontaneously inflammable hydrogen phosphide. Hypophosphites in solution yield a white precipitate with mercuric chloride T.S. This precipitate becomes gray when an excess of hypophosphite is present. Solutions of hypophosphites, acidulated with sulphuric acid and warmed with copper sulphate T.S., yield a red precipitate.

PHOSPHORUS. U. S. Phosphorus
[Phosphor.]

Phosphorus is from the Greek "phos", meaning "light", and "phero", meaning "I carry", being derived from the fact that the ordinary phosphorus is phosphorescent.

The official phosphorus [P = 31.04] is the yellow allotropic form and must be carefully preserved under water, in strong, well-closed containers, in a secure and moderately cool place, protected from light.

Preparation—Phosphorus is now generally prepared by heating a mixture consisting of phosphatic minerals, coke and quartz sand to a high temperature in an electric furnace. The phosphorus vapors are condensed and the slag drawn off at the bottom, the process being continuous, fresh mixture being constantly added at the top of the furnace. The following reaction takes place:

$$\underset{\text{tricalcium phosphate}}{2Ca_3(PO_4)_2} + \underset{\text{carbon}}{10C} + \underset{\text{silicon dioxide}}{6SiO_2} = \underset{\text{carbon monoxide}}{10CO} + \underset{\text{calcium silicate}}{6CaSiO_3} + \underset{\text{phosphorus}}{P_4}$$

Since it is the effect of enormously high temperatures produced by the resistance of the electric current which brings about this decomposition, and not the direct action of the current itself, the reaction is distinctly an electrothermic and not an electrolytic one.

The ordinary phosphorus obtained by this method is white or yellowish-white, has a waxy consistence, and melts at 44° C. It is practically insoluble in water under which it is preserved. Its best solvent is carbon disulphide. Ordinary phosphorus fumes and oxidizes in moist air and is luminous in the dark. It is distinctly poisonous.

Red phosphorus, one of the allotropic forms of phosphorus, was at one time considered to be amorphous but has been crystallized in the hexagonal system and shown to be a polymer of yellow phosphorus. It is obtained by allowing phosphorus to remain for several days in an atmosphere of carbon dioxide at a temperature varying from 215° C. to 250° C.

Red phosphorus, which is extensively used in making safety matches, is not luminous and not poisonous until it is heated to 280° C. when it is converted into ordinary phosphorus.

With oxygen phosphorus forms two oxides,—*phosphorous oxide*, P_2O_3, or *phosphorous trioxide*, P_2O_3, and *phosphoric oxide*, or *phosphorous pentoxide*, P_2O_5. Corresponding to the last of these are three acids, known as *orthophosphoric* (tribasic phosphoric), H_3PO_4, *pyrophosphoric*, $H_4P_2O_7$, and *metaphosphoric*, HPO_3. Orthophosphoric acid is formed by dissolving P_2O_5 in boiling water, or by the action of nitric acid upon phosphorus itself; pyrophosphoric acid, by the heating of the tribasic phosphoric acid to 213° C. and metaphosphoric acid, by the ignition of the tribasic variety, or by dissolving P_2O_5 in the correct proportion of cold water. *Phosphorous acid*, H_3PO_3 is a dibasic acid, containing one hydrogen atom not replaceable by a metal. *Hypophosphorous acid*, H_3PO_2, is not capable of being derived directly from hypophosphorous oxide, but is prepared by heating yellow phosphorus with a concentrated solution of barium or calcium hydroxide to produce barium hypophosphite, as indicated by the following equation:

$$\underset{\text{barium hydroxide}}{3Ba(OH)_2} + \underset{\text{phosphorus}}{2P_4} + \underset{\text{water}}{6H_2O} = \underset{\text{barium hypophosphite}}{3Ba(H_2PO_2)_2} + \underset{\text{hydrogen phosphide}}{2PH_3}$$

The barium is then precipitated with sulphuric acid and the hypophosphorous acid concentrated in vacuo. It is monobasic, containing two hydrogen atoms not replaceable by a metal.

Description and Physical Properties—A translucent, nearly colorless solid, having a waxy luster, and a consistence at ordinary temperatures of about that of beeswax. After long keeping the surface becomes white or red, and occasionally black. It has a distinctive and disagreeable odor.

One Gm. of Phosphorus is soluble in about 400 cc. of dehydrated alcohol in about 40 cc. of chloroform, 102 cc. of absolute ether, 31.5 cc. of benzene, and in 0.9 cc. of carbon disulphide, at 25° C. It is sparingly soluble in fixed oils, and is practically insoluble in water, to which it imparts its characteristic, disagreeable odor and taste.

Specific gravity: about 1.830 at 10° C.

Tests for Identity—When exposed to the air, Phosphorus emits white fumes, which are luminous in the dark, and have an odor somewhat resembling that of garlic. On longer exposure to the air, it often takes fire spontaneously.

Tests for Purity—Add 1 Gm. of Phosphorus to 10 cc. of nitric acid diluted with 10 cc. of distilled water in a flask having a capacity of 50 cc. Digest the mixture at a gentle heat on a water bath until the Phosphorus is dissolved, maintaining an atmosphere of carbon dioxide in the flask during the heating. Transfer this solution to a dish, evaporate until nitrous vapors are no longer given off, and then dilute the solution to 250 cc. with distilled water. One cc. of this solution meets the requirements of the test for *arsenic*, page 1512.

A 50 cc. portion of the latter solution shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1520.

Preserve carefully under water, in strong, well-closed containers, in a secure and moderately cool place, protected from light.

U. S. P. Preparation—Pilulæ Phosphori.

N. F. Preparations—Elixir Phosphori; Liquor Phosphatum Compositus; Oleum Phosphoratum.

Because of the difficulty and danger in handling phosphorus, the pharmacist may advantageously adopt the following plan suggested by C. F. Barth of Louisville, Ky. Instead of keeping the sticks under water, necessitating their drying before weighing and the exposing of the operator to the danger of spontaneous ignition and a possible burn, the sticks of yellow phosphorus are kept in an aqueous solution of copper sulphate. The phosphorus, due to its reducing action, is quickly covered by a coating of metallic copper and then becomes safe to handle and fireproof. The amount required may be easily cut off without danger and the remainder returned to the bottle of solution.

Uses—Phosphorus is administered internally in the treatment of chronic diseases of the bone and of the nervous system in doses of $\frac{1}{120}$ grain

(0.0005 Gm.). Its value in this connection depends upon its being administered in a free state. The oxide of phosphorus, phosphoric acid, does not have the same action; hence all pharmaceutical preparations of phosphorus must be protected from oxidation. (See Pilulæ Phosphori.) In large doses phosphorus is poisonous.

In addition to its use in medicine, phosphorus is largely employed in making compounds of phosphorus, especially the sulphide (P_4S_3) which is an essential ingredient in matches. Because of its combustibility and the readiness with which it combines with oxygen to form dense white clouds of P_2O_5, phosphorus is used as an ingredient of incendiary and smoke screen shells.

LIQUOR PHOSPHORI. N. F. Solution of Phosphorus

[Liq. Phosphor.—Thompson's Solution of Phosphorus]

	Metric	Alternative
Phosphorus	0.07 Gm.	1¼ gr.
Spirit of Peppermint	0.50 cc.	10 min.
Glycerin	64.50 cc.	2 fl. oz. 278 min.
Dehydrated Alcohol, a sufficient quantity,		
To make	100 cc.	4 fl. oz.

Weigh the phosphorus in a dish containing water (which should be counter-balanced after each trial weighing), dry it carefully and quickly with blotting paper, and introduce it into a flask containing 35 cc. [about 1½ fl. oz.] of dehydrated alcohol. Into the neck of the flask insert a perforated cork stopper fitted with a glass tube about 50 cm. [about 20 inches] in length, to serve as a condenser. Place the flask in a water bath and heat it so that the alcohol shall be kept boiling gently, until the phosphorus is dissolved. Allow the solution to cool and then add the spirit of peppermint and glycerin, and sufficient dehydrated alcohol to make the product measure 100 cc. [4 fl. oz.].

Description and Physical Properties—Solution of Phosphorus is a colorless, transparent liquid with the characteristic odor of phosphorus, inflammable with a peculiar silvery flame. Toward the close of the ignition, small particles are thrown off, leaving a trail of white vapor.

Test for Identity—Five cc. of the Solution is ignited in an open vessel, and the residue redissolved in 15 cc. of water, acidulated with 1 cc. of diluted nitric acid. This mixture is then heated almost to boiling and 5 cc. of ammonium molybdate T.S. added to the hot solution. A yellowish precipitate is formed.

Caution—These tests should be made with care, on account of possible danger to the person performing them.

Approximate alcohol content, by volume, 92 per cent.

Average dose—10 minims (0.6 cc.).

One average dose contains about:

0.00042 Gm. or $\frac{1}{160}$ grain of phosphorus.

CHAPTER XLIV

CARBON, BORON, AND SILICON

C; 12.005. B; 10.9. Si; 28.1

THESE three elements present some analogies, and, although the number of pharmaceutical preparations made from them is not great, they are of considerable interest.

Carbon is from the French word "carbone" or the Latin word "carbo" meaning a coal.

Carbon C; 12.005

Carbon is a very widely distributed element. It is a constituent of all organic substances, and is found in nature in the form of the diamond, graphite plumbago, coal, etc.

Two compounds with oxygen are known,—carbon dioxide, CO_2, and carbon monoxide, CO.

Carbon dioxide, CO_2, is a colorless, odorless gas with a slightly acid taste, heavier than ordinary air. It is not combustible, and not a supporter of combustion; indeed, it is used extensively as a means of putting out flames, and is generated for that purpose in fire extinguishers and other contrivances of the same character. Some pharmacists have fastened to the ceiling of their cellars a series of pipes with several outlets; a flexible pipe is connected with a soda water tank or cylinder, and thus one may always have a complete fire extinguisher in the cellar; nothing more is necessary to put out a small fire than to turn on the stop-cock and close all doors and windows. The ordinary "soda fountain" tank is an efficient portable fire extinguisher. Water is capable of absorbing its own volume of carbon dioxide, but several times its volume under pressure. Under a pressure of five atmospheres, water will absorb five volumes of carbon dioxide. This solution was formerly official, under the name of *Aqua Acidi Carbonici*, or carbonic acid water or "*soda water*".

Carbonic acid, H_2CO_3, is produced when carbon dioxide is brought into contact with water, as follows: $CO_2+H_2O=H_2CO_3$. This compound, however, is readily dissociated by heating.

Carbonates are widely distributed in nature, and many chemical processes are based upon their decomposition by strong acids. Carbonic acid is one of the weakest inorganic acids known.

Carbon Dioxide Snow—By allowing compressed CO_2 to escape from a cylinder into a woolen, cone-shaped receptacle, the intense cold causes a portion of it to solidify. This may be pressed into molds and may be kept for some time without sensible evaporation. It melts at about $-54°$ C. and is used for the destruction of warts and moles and in treating malignant ulcers, being applied for from thirty seconds to two minutes.

Carbon monoxide, CO, is of little interest in pharmacy. This is the gas produced by incomplete combustion of fuels. It is present in modern illuminating gas, as it is combustible, furnishing heat units but no light. It is one of the waste products of the internal combustion engine, such as the automobile engine, and is the cause of the death known as *petromortis*, in those who inhale these combustion waste products by remaining in a confined space where a gas or gasoline engine is running.

The compounds of carbon and hydrogen are very numerous, and of great importance. They are mostly obtained from organic substances, and these will be considered under Part V. With nitrogen, carbon forms cyanogen $(CN)_2$, the compound radical of hydrocyanic or prussic acid.

Tests for Carbonates

Carbonates—Carbonates or bicarbonates effervesce with acids, yielding a colorless gas, which when passed into calcium hydroxide T.S. produces a white precipitate. Carbonates in solution produce a reddish-brown precipitate with mercuric chloride T.S., while bicarbonates produce a white precipitate with the same reagent. A cold aqueous solution of a carbonate is reddened by phenolphthalein T.S., while a similar solution of a bicarbonate remains unchanged or is only slightly reddened.

Unofficial Compound of Carbon

Carbon Disulphide (see Sulphur, page 581)

CARBO LIGNI. U. S. Wood Charcoal

[Carbo Lig.—Charcoal]

Wood Charcoal prepared from soft wood, and very finely powdered.

Preparation—It is made by burning wood out of contact with air, either in iron cylinders or in stacks. In the former case, the volatile substances resulting from the destructive distillation are collected by condensation, and contribute valuable products to pharmacy (see *Acidum Aceticum*). In the latter, the charcoal is made in the neighborhood of a cheap wood supply. Billets of wood are piled in a conical form, and covered with earth and sod to prevent the free access of air, several holes being left at the bottom and one at the top of the pile in order to produce a draught to commence the combustion. The wood is kindled from the bottom, and soon after ignition the hole at the top is closed, and when the wood is all ignited the holes at the bottom are stopped. The result is that the combustible portions of the wood, hydrogen, oxygen, water, etc., are dissipated, carbon being left.

Description and Physical Properties—A black, odorless, and tasteless powder, free from gritty matter.

Tests for Purity—Wood Charcoal burns without a luminous flame, yielding not more than 7 per cent of ash.

Boil 1 Gm. of Wood Charcoal with a mixture of 3 cc. of potassium hydroxide T.S. and 10 cc. of distilled water for one-half minute, and filter: the filtrate has only a slight brown color.

Preserve in well-closed vessels.

Uses—Charcoal is used in medicine as an absorbent in stomach and intestinal fermentation. It is also useful as an emergency antidote in many forms of poisoning because of its adsorbing powers. In pharmacy it is used as a clarifying and decolorizing agent. It is given in the form of powder, in doses of fifteen grains to two drachms (1 to 8 Gm.). Owing to its absorbent powers, it should never be kept exposed to the air, as it will become unfit for use if subjected to the atmosphere of a laboratory or pharmacy. Tin cans with tightly fitting covers are appropriate containers.

CARBO ANIMALIS PURIFICATUS. N. F. Purified Animal Charcoal

Charcoal prepared from bone, and purified by removing the substances which were soluble in hot hydrochloric acid and water.

Description and Physical Properties—A dull black powder, odorless, tasteless and insoluble in water, alcohol, or other solvents.

Test for Purity—Boil 1 Gm. of Purified Animal Charcoal during three minutes in a mixture of 3 cc. of potassium hydroxide T.S., and 5 cc. of distilled water and filter: the filtrate is colorless.

The ash from 2 Gm. of Purified Animal Charcoal does not exceed 0.08 Gm. or 4 per cent (limit of Silica and other inorganic matter).

Preparation—Tabellæ Carbonis Animalis.

Uses—An absorbent and decolorizer. Dose, five grains (0.3 Gm.).

Boron B; 11.0

Boron is from the word "borax" which was used by the alchemists in a very vague manner. Like carbon it exists in two allotropic conditions,—amorphous and crystalline. Boron combines with hydrogen and oxygen, and boric (or boracic) acid is produced, H_3BO_3.

Tests for Borates

Borates—Solutions of borates, acidulated with hydrochloric acid, turn turmeric paper brownish-red, the color changing to greenish-black by moistening with ammonia T.S. When a borate is treated with sulphuric acid, alcohol added, and the mixture ignited, it burns with a green bordered flame.

Unofficial Compounds of Boron

Acidum Metaboricum, HBO_2 Metaboric Acid	A white powder of little importance. It is made by heating boric acid to 100° C. Its salts, the metaborates, are met with in blow pipe analysis
Acidum Pyroboricum, $H_2B_4O_7$ Pyroboric Acid	A glassy, brittle mass formed by the prolonged heating of boric acid at 140° C. Ordinary borax is the sodium salt of this acid
Boron Trisulphidum, B_2S_3 Boron Trisulphide	White, crystalline needles decomposed by cold water, forming boric acid and hydrogen sulphide

ACIDUM BORICUM. U. S. Boric Acid

[**Acid. Bor.**—Boracic Acid]

Boric Acid, when dried to constant weight over sulphuric acid, contains not less than 99.5 per cent of H_3BO_3 (61.92).

Preparation—The lagoons of the volcanic districts of Tuscany formerly furnished the greater part of the boric acid and borax of commerce. Borax is now found native in California and in some of the other Western States, and boric acid is produced by decomposing borax with hydrochloric or sulphuric acid.

$$\underset{\text{sodium borate}}{Na_2B_4O_7.10H_2O} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{sodium chloride}}{2NaCl} + \underset{\text{boric acid}}{4H_3BO_3} + \underset{\text{water}}{5H_2O}$$

Boric acid is required in very fine, what is known as *impalpable*, powder for most medicinal uses.

Description and Physical Properties—Transparent, colorless scales of a somewhat pearly luster, or six-sided, triclinic crystals, or a white, bulky powder, slightly unctuous to the touch. It is stable in the air.

One Gm. of boric Acid is soluble in 18 cc. of water, 18 cc. of alcohol, and in 4 cc. of glycerin, at 25° C. One Gm. is soluble in 4 cc. of boiling water and in 6 cc. of boiling alcohol.

Heated to 100° C., Boric Acid loses water, forming metaboric acid (HBO_2), which slowly volatilizes at that temperature. Heated to about 160° C., Boric Acid fuses to a glassy mass of tetraboric or pyroboric acid ($H_2B_4O_7$). At about 185° C. the fused mass swells, loses all of its water, and becomes boron trioxide (B_2O_3), which fuses into a transparent non-volatile, hygroscopic mass.

Boric Acid volatilizes from a boiling aqueous or alcoholic solution.

Tests for Identity—An aqueous solution of Boric Acid (1 in 50) is slightly acid to litmus paper.

Boric Acid responds to the reactions for borates (see above).

Tests for Purity—One Gm. of Boric Acid dissolves completely in 10 cc. of boiling alcohol (*insoluble substances*).

An aqueous solution of Boric Acid meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of Boric Acid meets the requirements of the test for *arsenic*, page 1512.

Assay—Dry about 2.5 Gm. of Boric Acid to constant weight over sulphuric acid, weigh accurately, dissolve in 50 cc. of distilled water and 50 cc. of glycerin, and titrate with normal sodium hydroxide, phenolphthalein T.S. being used as indicator. Each cc. of normal sodium hydroxide corresponds to 0.06192 Gm. of H_3BO_3.

This assay is explained on page 1453.

U. S. P. Preparations—Glyceritum Boroglycerini; Unguentum Acidi Borici.

N. F. Preparations—Cataplasma Kaolini; Liquor Antisepticus; Pulvis Talci Compositus.

Uses—Boric acid is used as a mild antiseptic, either in the form of a wash or an ointment. Its use as a preservative in beverages and foods is prohibited by national and state legislation.

Average dose—8 gr. (0.5 Gm.).

Silicon Si; 28.1

Silicon is from the Latin "silex", or "silicis" meaning "a flint", suggestive of the occurrence of the element in this mineral.

Very few of the compounds of the non-metallic element silicon are used medicinally. Silicon, like carbon and boron, is obtained in two allotropic states,—amorphous and crystalline. In some of its combinations, notably in glass, earthenware, china, mortar, and cements of various kinds, it is of vast importance commercially. Silicon is found in nature combined with aluminum, magnesium, or calcium, in *pumice stone, meerschaum, asbestos, talc, soapstone,* etc.; or as an oxide (*silica*), in *sand, flint, agate, quartz,* etc.

Silica, SiO_2, may be obtained in a pure condition by treating a solution of sodium silicate with hydrochloric acid.

$$\underset{\text{sodium silicate}}{Na_2SiO_3} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{silica}}{SiO_2} + \underset{\text{sodium chloride}}{2NaCl} + \underset{\text{water}}{H_2O}$$

Test for Silicates

Silicates are insoluble in most reagents. If the soluble sodium and potassium silicates, in aqueous solution, are neutralized with hydrochloric acid, and ammonia water added in excess, a gelatinous precipitate of silicic hydroxide will separate.

Unofficial Compounds of Silicon

Silicon Dioxide, SiO_2, Silica	Quartz, used in making pottery and glass
The various physical forms of silicon dioxide are:	Amethyst, a gem. Smoky quartz, a gem
	Rose quartz, a gem. Flint, an abrasive
	Sand, used in the manufacture of pottery, glass, and for many other purposes
	Opal, a gem
	Agate, mortars for chemists' use
Glass, an artificially made product of great variety.[1]	Common glass is made by heating a mixture of sand, lime or limestone, and soda ash
	Blue glass is made by fusing into the glass mixture the oxide or silicate of cobalt
	Flint glass is made by the addition of lead oxide to the fused glass mixture. It is softer and more brilliant than other types and is used for cut glass ware
	Opal glass is made by adding a white insoluble substance to the fused mass such as bone-ash, cryolite or zinc oxide
	Amber glass is made by the introduction of carbon or sulphur to the fusion mixture
	Bohemian or potash-lime glass is made by substituting potassium carbonate in place of the soda ash of the common glass mixture
Meerschaum. Magnesium Silicate, Mg_2SiO_3	Used in making tobacco pipes and ornaments
Asbestos. Magnesium Silicate.	Used for resisting action of fire, or heat

[1] See "The Story of Glass", by J. W. Sturmer, American Journal of Pharmacy, January, 1923, page 8.

Unofficial Compounds of Silicon—*Continued*

Sodium Silicate Liquor Sodii Silicatis Solution of Sodium Silicate. (Water Glass)	Made by fusing one part of fine sand and two parts of dried sodium carbonate, mixed in powder, in an earthenware crucible, pouring out the fused mass on a stone slab to cool, powdering, dissolving the soluble matter in boiling water, filtering and concentrating so as to contain about 30 per cent of sodium silicate. This solution is largely used for the preservation of eggs. The eggs, as fresh as possible, are immersed in a liquid consisting of one volume of the commercial solution and nine volumes of cold, but freshly boiled, water

TALCUM PURIFICATUM. U.S. Purified Talc

[Talc. Purif.]

Purified Talc is a purified, native, hydrous magnesium silicate, sometimes containing a small amount of aluminum silicate.

Native Talc, also called *French chalk*, or *soapstone*, is found in various parts of the world; an excellent quality is now obtained from North Carolina.

Preparation—The U. S. P. VIII gave directions for preparing the purified product as follows: Mix 500 Gm. of powdered native talc with 2500 cc. of boiling water, gradually add 50 cc. of hydrochloric acid, and boil the mixture during fifteen minutes, then allow it to stand for fifteen minutes. Decant, and reject the supernatant liquid containing the finer particles of talc in suspension, and again boil the residue with 2500 cc. of water, mixed with 25 cc. of hydrochloric acid, and allow it to stand for fifteen minutes. Again decant, and reject the finer suspended particles, and wash the coarser residue with water by repeated decantation, until a portion of the wash-water, after filtering and acidifying with nitric acid, fails to become opalescent upon the addition of silver nitrate T.S. Then transfer the magma to a close linen or muslin strainer, allow it to drain, and dry it at 110° C.

Talc, as found in commerce, contains the impurities usually associated with native mineral substances. When treated with hydrochloric acid and water, as in this process, carbonates, aluminum, iron, calcium, and magnesium salts are removed.

Description and Physical Properties—A very fine, white or grayish-white powder. It adheres readily to the skin. It is entirely free from grittiness and is unctuous to the touch.

Test for Identity—Mix 0.5 Gm. of Purified Talc with about 2 Gm. of anhydrous sodium carbonate and 2 Gm. of anhydrous potassium carbonate, heat the mixture in a platinum crucible until fusion is complete, and treat the resulting fused mass with hot distilled water. Then neutralize the liquid with diluted sulphuric acid, add another 10 cc. of the diluted acid, and evaporate the mixture until white fumes of sulphuric anhydride are evolved, and cool. Add 20 cc. of distilled water, boil the mixture and filter. An insoluble residue of *silica* remains. The addition of ammonia T.S. and ammonium chloride T.S. to the filtrate may produce a white gelatinous precipitate of *aluminum hydroxide*, and the filtrate from this mixture on the addition of sodium phosphate T.S. yields a white, crystalline precipitate of magnesium ammonium phosphate.

Tests for Purity—Purified Talc, when ignited at a red heat, loses not more than 5 per cent of its weight.

Boil 10 Gm. of Purified Talc with 50 cc. of distilled water for one-half hour, adding water from time to time to maintain approximately the original volume, and filter. The filtrate is neutral to litmus paper. One-half of this filtrate, when evaporated and dried at 110° C., yields not more than 0.005 Gm. of residue (*soluble substances*). The remaining half of this filtrate, after slightly acidulating with hydrochloric acid, does not yield a blue color upon the addition of potassium ferrocyanide T.S. (*iron*).

Add 1 Gm. of Purified Talc to 20 cc. of diluted hydrochloric acid: no effervescence occurs (*carbonate*). Digest the mixture for fifteen minutes, and filter: a 10 cc. portion of the filtrate, evaporated to dryness and ignited, leaves a residue weighing not more than 0.005 Gm.

NOTE—Purified Talc is intended only as a filtering medium and for this purpose should not be finer than the powder which passes through a No. 80 sieve, but is retained by a No. 100 sieve.

U. S. P. Preparations—Filtering medium where required in aromatic waters, elixirs, syrups, etc.

N. F. Preparations—Pulvis Talci Compositus; also used as a filtering medium.

Uses—Purified Talc is used as a distributing and filtering medium in making medicated waters, elixirs, etc. Its medicinal value depends on its desiccant and lubricating effects.

When perfumed or medicated, it is also used extensively as a toilet powder under the name *talcum powder*. For toilet purposes it should be in the form of an impalpable powder, but when used as a filtering medium, the Pharmacopœia directs that it should not be finer than a No. 100 powder. The coarser powder is directed because the impalpable form passes through the pores of the filter paper and necessitates returning the first portions of the filtrate. As a filtering medium it may be used for all classes of preparations with no danger of adsorption and retention of active principles.

TERRA SILICEA PURIFICATA. U. S. Purified Siliceous Earth

[Ter. Sil. Purif.—Purified Kieselguhr, Purified Infusorial Earth]

A form of silica [SiO_2 60.10] consisting of the frustules and fragments of diatoms, purified by boiling with diluted hydrochloric acid, washing, and calcining. It contains not more than 10 per cent of water.

Large deposits of this substance are found in Virginia, Maryland, Nevada, Oregon, and California, usually in the form of masses of rocks, hundreds of feet in thickness. Under the microscope it is seen to consist largely of the minute siliceous structure of diatoms. It must be carefully purified in a manner similar to that directed for talc (see above) and thoroughly calcined, the latter treatment destroying the bacteria which are present in large quantities in the native earth.

Description and Physical Properties—A very bulky and very fine, odorless powder; white or light gray to pale buff in color. It readily absorbs moisture, retaining about four times its weight of water without the mixture becoming fluid.

Purified Siliceous Earth is insoluble in water, acids, or in dilute solutions of the alkali hydroxides.

Tests for Purity—When ignited its color is not darkened (*organic impurities*), nor does it lose more than 10 per cent of its weight (*moisture*).

Digest 1 Gm. of Purified Siliceous Earth for fifteen minutes with 20 cc. of diluted hydrochloric acid, and filter: a 10 cc. portion of the filtrate, evaporated to dryness and ignited, leaves not more than 0.005 Gm. of residue.

Boil 10 Gm. of Purified Siliceous Earth with 50 cc. of distilled water during ten minutes, replace any water lost by evaporation, and filter: the filtrate is colorless and neutral to litmus paper, and on adding 5 drops of potassium ferrocyanide T.S. to 5 cc. of the filtrate no blue color is produced (*soluble iron*).

Add 1 Gm. of Purified Siliceous Earth to 25 cc. of diluted hydrochloric acid: no effervescence occurs (*carbonate*). Boil the mixture for ten minutes, replacing any water lost by evaporation, and filter: the addition of a few drops of barium chloride T.S. to the filtrate produces no turbidity. (*sulphate*).

Preserve in tightly-closed containers.

U. S. P. Preparation—Filtering medium when required in aromatic waters.

N. F. Preparation—Pasta Zinci Sulphurata.

Uses—It has been introduced into the Pharmacopœia as a distributing and filtering medium for aromatic waters. It is better adapted for the filtration of elixirs. Like talc it may be used with no fear of its exerting an adsorptive power upon active constituents. The native Infusorial Earth is extensively used in metal polishing powders and pastes and as an absorbent for nitroglycerin to produce the explosive known as dynamite. It is difficult to obtain of U. S. P. quality.

KAOLINUM. N. F. Kaolin

A native hydrated aluminum silicate, powdered and freed from gritty particles by elutriation.

The name *Kaolin* is derived from the Chinese word "kaoling", meaning "high ridge"; it is sometimes called *China clay*, or *porcelain clay*, because of its use in pottery, and it is a

valuable commercial product. Besides aluminum silicate, it often contains small quantities of aluminum hydroxide, ferric oxide, magnesium oxide, and calcium carbonate. For pharmaceutical purposes it should be purified by treatment with hydrochloric acid if calcium carbonate is present, and afterwards with diluted sulphuric acid to remove the other impurities; the kaolin should be thoroughly washed with water to remove the chlorides and sulphates.

Official Description—A soft, white or yellowish-white powder, or in lumps.

Solubility—Insoluble in water, and in cold dilute acids and solutions of the alkali hydroxides.

Odor, Taste, and Reaction—It has an earthy or clay-like taste. When moistened with water, Kaolin assumes a darker color and develops a marked clay-like odor.

Tests for Identity—Mix 1 Gm. of Kaolin with 10 cc. of distilled water and 5 cc. of sulphuric acid in a porcelain dish; no effervescence occurs. Evaporate the mixture until the excess of water is removed, and further heat the residue until dense white fumes of sulphuric anhydride appear, then add 20 cc. of distilled water, boil for a few minutes and filter; there remains on the filter a gray residue of impure silica.

To one-half of the filtrate just obtained add ammonia water; a gelatinous precipitate of aluminum hydroxide is obtained which is insoluble in an excess of the reagent.

To the remaining half of the filtrate add sodium hydroxide T.S.; a gelatinous precipitate is produced which is completely or almost completely soluble in an excess of the reagent.

Impurities and Tests for Impurities—*Iron*—Rub 2 Gm. of Kaolin in a mortar with 10 cc. of distilled water; the mixture does not acquire more than a slight reddish tint on the addition of 0.5 Gm. of sodium salicylate.

Ignite Kaolin at a red heat; not less than 85 per cent of a non-volatile residue remains.

N. F. Preparation—Cataplasma Kaolini.

History—The clays were highly esteemed as remedial agents, given internally, since the time of Hippocrates. *Terra sigillata* or "the earth imprinted with a seal" was a form of clay collected, purified and authenticated under official supervision. Dr. Herman Schelenz, the eminent historian of pharmacy says that the use of the seal or imprint upon these clay tablets several thousand years ago was the origin of the trademark. Galen and other early authors wrote voluminously upon their properties. They were considered as *alexipharmics* or *alexiterics* which are terms used in ancient medicine and pharmacy to denote antidotes for certain purposes.

That there was some basis for this belief is shown by the modern theories of the adsorption properties of hydrated siliceous earths.

Uses—Kaolin forms the solid basis for the cataplasm of kaolin (Cataplasma Kaolini). It is occasionally employed as a protective and absorbent in diarrheal disorders. It has been used as a clarifying and decolorizing medium and as a filtering medium, but it must never be used as a filtering agent for liquids containing alkaloids, as it has been shown that it adsorbs alkaloids, separating them completely from the liquids filtered.

CHAPTER XLV

THE ALKALI METALS AND THEIR COMPOUNDS

The alkali metals are bodies having strongly marked physical and chemical properties. The hydroxides of these metals and of the ammonium group, comprise a group of powerful chemicals known as the alkalies. These alkalies combine with acids to form salts. They restore the color of reddened litmus paper, and change the colors of vegetable blues to green, and of vegetable yellows to brown. Their taste is never sour, but it is characteristic, and caustic if the alkali is in concentrated solution. The salts formed by their combinations with acids possess acid, alkaline, or neutral reactions according to the relative strength and proportion of the component parts.

The alkali metals which form compounds of pharmaceutical interest are potassium, sodium, and lithium. Chemically *Rubidium* and *Cæsium* are also classed with this group, but having no pharmaceutical interest they will be given no detailed consideration. The three important alkali metals, potassium, sodium, and lithium, are all univalent, and of a white color resembling that of silver, and are so prone to oxidation that they must be kept constantly immersed in a hydrocarbon, or in a liquid free from oxygen, such as naphtha or petroleum. They are so soft that they can be easily cut with a knife. They float upon water, and immediately react vigorously when brought in contact with it, causing decomposition of the water with the evolution of hydrogen and the production of the hydroxide of the metal. In the case of potassium the heat formed in this reaction is sufficient to ignite the escaping hydrogen.

The alkali metals are often called light metals, on account of their low specific gravity when compared with the others.

Their carbonates are all soluble in water, and each metal forms but one chloride.

Their oxides are strongly basic, quickly changing the color of red litmus to blue. The oxides are also very soluble in water, forming caustic and powerful alkali hydroxides, which cannot be decomposed by heat.

Their sulphates, phosphates, nitrates, sulphides, chlorides, bromides, iodides, and nearly all of their salts are soluble in water, are almost without exception colorless, or of an opaque white color, and many of them, if heated to redness, fuse without decomposition.

The processes for obtaining the metals are very similar, and formerly consisted in exposing their carbonates, intimately mixed with finely powdered charcoal, in suitable iron vessels, to an intense heat; carbon monoxide is liberated, and the vapors of the metals are condensed in flattened receivers. They are now largely made by electrolysis by subjecting the melted alkali hydroxide to a strong electric current.

Ammonium is a compound radical, NH_4, but its compounds have so many analogies with those of the alkali metals that it is classed with them.

Antidotes—See Part XV, Toxicology and Antidotes.

CHAPTER XLVI

THE POTASSIUM SALTS

K; 39.10.

Potassium is from "potash", the name formerly applied to crude potassium carbonate, especially that which was obtained by leaching wood ashes and fusing in iron pots. The salts of potassium are among the most important of any that are used in medicine. They are generally very soluble, and, with a few exceptions, are colorless or of an opaque white color. The sole source of the potassium salts was formerly wood ashes, but at present cheaper sources are employed. The wood ashes were lixiviated, the liquid containing the soluble salts evaporated to dryness, and the residue allowed to cool. This constituted the crude *potash* of commerce.

Potash is now made from the ashes from beet sugar residues, from *suint*, the residue obtained by evaporating the water used to scour the fleeces of sheep, and from impure potassium chloride and potassium sulphate obtained from the Stassfurt mines, which is now the principal source of the potassium compounds.

The impure salts of potash, as obtained from the various sources, may be simply purified or they may be passed through suitable chemical processes for the production of the several official salts. These detailed processes will be found under each title.

Tests for Potassium Salts

Potassium—Potassium compounds impart a violet color to a non-luminous flame, but the presence of small quantities of sodium masks the color. In neutral, concentrated or moderately concentrated solutions of potassium salts (depending upon the solubility and the potassium content of the salt), sodium bitartrate T.S. produces a white crystalline precipitate which is soluble in ammonia T.S., solutions of alkali hydroxides or carbonates. The formation of the precipitate, which is usually slow, is accelerated by stirring or rubbing the sides of the test tube with a glass rod. The addition of a little glacial acetic acid also promotes the formation of the precipitate.

POTASSA SULPHURATA. U. S. Sulphurated Potassa

[Pot. Sulphurat.—Liver of Sulphur]

Sulphurated Potassa is a mixture composed chiefly of potassium polysulphides and potassium thiosulphate and contains not less than 12.8 per cent of sulphur (S) in combination as sulphide.

Preparation—Sulphurated Potassa may be prepared by thoroughly mixing 1 part of sublimed sulphur with 2 parts of potassium carbonate and gradually heating the mixture in a covered iron crucible until the mass ceases to swell and is completely melted. It is then poured on a stone or glass slab and when cold, broken into pieces and preserved in tightly closed bottles. When the heat is properly regulated during its production, the reaction is approximately as follows:

$$\underset{\text{potassium carbonate}}{3K_2CO_3} + \underset{\text{sulphur}}{4S_2} = \underset{\text{potassium trisulphide}}{2K_2S_3} + \underset{\text{potassium thiosulphate}}{K_2S_2O_3} + \underset{\text{carbon dioxide}}{3CO_2}$$

The trisulphide is considered the most advantageous form.

As this product rapidly deteriorates through the absorption of moisture, oxygen, and carbon dioxide, it is desirable for the prescription pharmacist to secure it freshly prepared to produce satisfactory preparations.

Description and Physical Properties—Irregular pieces, liver-brown, when freshly made, changing to a greenish-yellow and finally to gray through absorption of moisture, oxygen, and carbon dioxide. It has an odor of hydrogen sulphide and a bitter, acrid, and alkaline taste.

Sulphurated Potassa is very soluble in water, usually leaving a slight residue. Alcohol dissolves only the sulphides.

Tests for Identity—An aqueous solution of Sulphurated Potassa (1 in 10) is light brown in color and is strongly alkaline to litmus paper. The addition of an excess of acetic acid to this solution causes a brisk evolution of hydrogen sulphide and a precipitation of sulphur. In the liquid thus treated, after filtration, an excess of sodium bitartrate T.S. produces within fifteen minutes an abundant, white, crystalline precipitate.

Assay—Dissolve 1 Gm. of crystallized copper sulphate, accurately weighed, in 15 cc. of distilled water and 1 Gm. of Sulphurated Potassa, accurately weighed, in 10 cc. of distilled water, in a flask. Add the copper sulphate solution to the Sulphurated Potassa solution in a stoppered bottle, stopper, shake for a few minutes, and filter. Acidulate the filtrate with acetic acid, refilter if necessary, and add an equal volume of hydrogen sulphide T.S. No black precipitate is produced.

This assay is explained on page 1482.

Preserve in well-closed containers.

Uses—It is extensively used in dermatologic practice, especially in what is commonly known as *Lotio Alba* or *White Lotion*. This preparation is not official, but the formula given below has been generally adopted. The reaction of the potassium trisulphide in preparing white lotion is as follows:

$$\underset{\text{zinc sulphate}}{ZnSO_4} + \underset{\text{potassium trisulphide}}{K_2S_3} = \underset{\text{zinc sulphide}}{ZnS} + \underset{\text{sulphur}}{S_2} + \underset{\text{potassium sulphate}}{K_2SO_4}$$

The mixture of insoluble zinc sulphide and sulphur gives it the creamy white appearance and the potassium sulphate goes into solution. Even weak acids cause the liberation of H_2S from sulphurated potassa.

White Lotion

(Lotio Alba)

	Metric	Alternative
Zinc Sulphate	**5 Gm.**	**75 gr.**
Sulphurated Potassa	**5 Gm.**	**75 gr.**
Distilled Water or Rose Water, sufficient, To make	**125 cc.**	**4 fl. oz.**

Dissolve the salts each separately in 60 cc. [2 fl. oz.] of distilled water or rose water, filter each solution, and slowly pour the zinc solution into the potassa solution. Finally add enough distilled water or rose water to make 125 cc. [4 fl. oz.].

POTASSII HYDROXIDUM. U. S. Potassium Hydroxide

[**Pot. Hydrox.**—Caustic Potash, Potassium Hydrate]

Potassium Hydroxide contains not less than 85 per cent of KOH (56.11).

Great caution is necessary in handling it, as it rapidly destroys organic tissues.

Preparation—It is prepared by adding milk of lime or calcium hydroxide to a hot solution of potassium carbonate, decanting the KOH solution from the precipitated calcium carbonate and concentrating it. The product of this method is called "*Potash by Lime*". The chemistry involved is explained by the equation:

$$\underset{\text{calcium hydroxide}}{Ca(OH)_2} + \underset{\text{potassium carbonate}}{K_2CO_3} = \underset{\text{potassium hydroxide}}{2KOH} + \underset{\text{calcium carbonate}}{CaCO_3}$$

It is also prepared on a large scale by electrolytic methods through the decomposition of a solution of potassium chloride, chlorine gas being the other product of the reaction. The electrolysis of this solution is carried out in the presence of a porous diaphragm which permits of the passage of the current but does not allow the liberated chlorine to react with the newly formed potassium hydroxide. The chemistry of this method is explained by two equations:

$$\underset{\text{potassium chloride}}{2KCl} = \underset{\text{potassium}}{K_2} + \underset{\text{chlorine}}{Cl_2}$$

$$\underset{\text{potassium}}{K_2} + \underset{\text{water}}{2H_2O} = \underset{\text{potassium hydroxide}}{KOH} + \underset{\text{hydrogen}}{H_2}$$

Potassium Hydroxide, called commercially caustic potash, is prepared in the form of sticks by evaporating a solution of potassium hydroxide rapidly in a silver or clean iron vessel until a fluid of oily consistence remains, a drop of which, when removed on a warm glass rod, solidifies on cooling. The hot caustic is poured into cylindrical molds, and while the sticks are still warm they are bottled quickly, to prevent deliquescence.

Pure caustic potassium hydroxide is sometimes prepared in the form of powder by stirring the fused mass rapidly with a silver spatula until a granulated powder is formed. This must be placed in warm dry bottles and quickly sealed hermetically.

The U. S. P. X has introduced an innovation in the recognition of a concentrated solution of KOH, ten times the strength of normal KOH and known as *Dekanormal Potassium Hydroxide* (see page 1558). It contains 561.1 Gm. of KOH in each 1000 cc. Its use is authorized as an alternative in the manufacture of soft soap, compound solution of cresol, etc. It is claimed that it does not deteriorate rapidly and is more reliable and more satisfactory to use than stick potash.

Potassa by alcohol and *potassa by barytes* are terms used to designate pure caustic potassium hydroxide made by purifying with alcohol and barium hydroxide, the alcohol dissolving only the potassium hydroxide, while the sulphate and carbonate are separated by treatment with baryta water, which is a solution of barium hydroxide, forming the insoluble barium salts of these respective acids.

Description and Physical Properties—Dry, white, or nearly white, fused masses, or sticks, hard and brittle, showing a crystalline fracture. When exposed to the air, it rapidly absorbs carbon dioxide and moisture, and deliquesces.

One Gm. of Potassium Hydroxide is soluble in 0.9 cc. of water, in about 3 cc. of alcohol, and in 2.5 cc. of glycerin, at 25° C. One Gm. is soluble in 0.6 cc. of boiling water. It is very soluble in boiling alcohol.

Tests for Identity—An aqueous solution of Potassium Hydroxide, even when greatly diluted, is strongly alkaline to litmus paper.

An aqueous solution of Potassium Hydroxide (1 in 25) responds to the reactions for potassium, page 596.

Tests for Purity—An aqueous solution of Potassium Hydroxide (1 in 20) is clear and colorless (*organic matter or insoluble impurities*).

An aqueous solution of Potassium Hydroxide (1 in 50) slightly acidulated with hydrochloric acid meets the requirements of the test for *heavy metals*, page 1519.

Assay—Place about 10 Gm. of Potassium Hydroxide in a glass-stoppered weighing bottle, weigh accurately, transfer to a 500 cc. graduated flask, and dissolve it in 250 cc. of recently boiled distilled water. Add 30 cc. of barium chloride T.S., fill the flask to the mark with recently boiled distilled water, and thoroughly agitate the liquid. Filter the liquid in the flask through a dry filter into a dry flask, rejecting the first 20 cc. and titrate 200 cc., of the clear filtrate with normal hydrochloric acid, using phenolphthalein T.S. as indicator. Each cc. of normal hydrochloric acid corresponds to 0.05611 Gm. of KOH.

This assay is explained on page 1459.

Preserve in air-tight containers. If bottles are used, they must be made of hard glass, and cork stoppers should be paraffined.

U. S. P. Preparations—Liquor Cresolis Compositus; Liquor Potassii Hydroxidi; Sapo Mollis.

Uses—Potassium hydroxide is used as a caustic, principally in veterinary practice; the end of the stick may be inserted into a section of rubber tubing, or wrapped several times with tin foil, to avoid cauterizing the finger of the operator. Allowance should be made for the moisture usually present in commercial caustic potash if the U. S. P. article is not available, as the latter product rarely contains less than 30 per cent of water.

Antidote—(see Part XV on Antidotes).

LIQUOR POTASSII HYDROXIDI. U. S. Solution of Potassium Hydroxide

[**Liq. Pot. Hydrox.**—Liquor Potassæ, Solution of Potassa]

Solution of Potassium Hydroxide contains, in each 100 cc., not less than 4.5 Gm. and not more than 5.5 Gm. of KOH.

	Metric	Alternative
Dekanormal Solution of Potassium Hydroxide	**90 cc.**	2 fl. oz. 422 min
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the dekanormal solution (page 1558), with sufficient distilled water to make 1000 cc. [2 pints].

Note—The 90 cc. [2 fl. oz. 422 min.] of dekanormal solution of potassium hydroxide may be replaced by 60 Gm. [2 oz. av.] of potassium hydroxide, containing 85 per cent of KOH.

If potassium hydroxide is used in this process, it should be of the full strength and quality directed by the Pharmacopœia (85 per cent). Potassium hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity is taken, the proper amount for the above formula is ascertained by dividing 5100 by the percentage of absolute potassium hydroxide contained therein.

Description and Physical Properties—A clear, colorless, odorless liquid, strongly alkaline and caustic, readily absorbing carbon dioxide from the air.

Specific gravity: about 1.046 at 25° C.

Tests for Identity and Purity—It meets the requirements of the tests for identity and purity for an aqueous solution of potassium hydroxide under *Potassii Hydroxidum* when suitably concentrated.

Measure exactly 20 cc. of Solution of Potassium Hydroxide into a suitable flask and titrate directly with normal hydrochloric acid, using methyl orange T.S. as indicator: it shows in each 100 cc. not more than 5.5 Gm. of alkali, calculated as KOH (*carbonate*).

Assay—Measure exactly 50 cc. of Solution of Potassium Hydroxide into a 250 cc. measuring flask, add 20 cc. of barium chloride T.S., and fill the flask to the mark with recently boiled distilled water. Thoroughly agitate the liquid, filter it through a filter not previously moistened, reject the first 20 cc. and titrate 100 cc. of the filtrate, representing 20 cc. of the Solution, with normal hydrochloric acid, using phenolphthalein T.S. as indicator. Each cc. of normal hydrochloric acid corresponds to 0.05611 Gm. of KOH.

This assay is explained on page 1459.

Preserve in bottles made of hard glass, and provided with rubber stoppers or with glass stoppers coated with petrolatum.

N. F. Preparations—Elixir Catharticum Compositus; Mistura Copaibæ; Syrupus Eriodictyi Aromaticus.

Uses—Solution of potassium hydroxide is of little use as a medicine, although occasionally employed as a gastric antacid. If a large quantity should be swallowed accidentally, the proper antidotes would be mild acid liquids, like vinegar or lemon juice, accompanied with bland oils.

Average dose—15 minims (1 cc.) largely diluted with water.

POTASSII ACETAS. U. S. Potassium Acetate
[Pot. Acet.]

Potassium Acetate, when dried to constant weight at 150° C., contains not less than 99 per cent of $KC_2H_3O_2$ (98.13).

Preparation—This salt may be made by adding crystals of potassium bicarbonate to pure acetic acid until effervescence ceases, and after acidulating slightly with a few drops of the acid, cautiously evaporating to dryness in a porcelain evaporating dish by means of a sand bath. Great care is necessary to avoid contamination with iron, and it is not safe to use an enameled iron dish.

$$\underset{\text{potassium bicarbonate}}{KHCO_3} + \underset{\text{acetic acid}}{HC_2H_3O_2} = \underset{\text{potassium acetate}}{KC_2H_3O_2} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

The manufacturer nearly always uses the carbonate in making potassium acetate, instead of the bicarbonate, because it is much cheaper. The product from the carbonate requires purification, however, because of the silica, sulphate, chlorides, etc., always present in the ordinary carbonate.

Description and Physical Properties—A white powder, or crystalline flakes, or masses of satin-like luster. It is odorless or has a faint, acetous odor, and a warming saline taste. It is very deliquescent on exposure to the air.

One Gm. of Potassium Acetate is soluble in 0.5 cc. of water and in 2.9 cc. of alcohol, at 25° C. One Gm. is soluble in about 0.2 cc. of boiling water.

Tests for Identity—When slightly heated, the salt fuses. On strong ignition it is decomposed with the evolution of inflammable empyreumatic vapors and leaves a black residue of potassium carbonate and carbon. This residue imparts to a non-luminous flame a violet color, is alkaline to litmus paper, and effervesces with acids.

An aqueous solution of Potassium Acetate (1 in 10) responds to the reactions for potassium, page 596, and for acetates, page 800.

Tests for Purity—An aqueous solution of the salt (1 in 20) is alkaline to litmus paper but does not affect phenolphthalein T.S.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Dry the salt to constant weight at 150° C. and proceed as directed under the assay for alkali salts of organic acids, page 1514. Each cc. of half-normal sulphuric acid corresponds to 0.04907 Gm. of $KC_2H_3O_2$.

This assay is explained on page 1456.

Preserve in air-tight containers.

N. F. Preparations—Elixir Buchu et Potassii Acetatis; Elixir Buchu, Juniperi et Potassii Acetatis.

Uses—Potassium acetate is a diaphoretic and diuretic when given in doses of fifteen grains to one drachm (1 to 4 Gm.). In larger doses it acts as a cathartic.

POTASSII BICARBONAS. U. S. Potassium Bicarbonate
[Pot. Bicarb.]

Potassium Bicarbonate, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of $KHCO_3$ (100.11).

Preparation—This salt is made by passing carbon dioxide through a solution of potassium carbonate until it is fully saturated, then filtering the liquid, and evaporating to the crystallizing point at a temperature below 71° C. (160° F.) to prevent decomposition. The crystals formed should be well washed and dried.

$$\underset{\text{potassium carbonate}}{K_2CO_3} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O} = \underset{\text{potassium bicarbonate}}{2KHCO_3}$$

This salt was formerly made by suspending a dish containing a concentrated solution of potassium carbonate within the fermenting tuns of a

brewery; the carbon dioxide produced during fermentation was thus utilized. The crude salt obtained on evaporation was originally called *salæratus*. When purified by crystallization, it constituted the official bicarbonate.

Description and Physical Properties—Colorless, transparent, monoclinic prisms or a white, granular powder. It is odorless, and has a saline and slightly alkaline taste. It is stable in the air.

One Gm. of Potassium Bicarbonate is soluble in 2.8 cc. of water at 25° C. On Gm. is soluble also in 2 cc. of water at 50° C. It is almost insoluble in alcohol.

When heated above 50° C., an aqueous solution of the salt loses carbon dioxide and water and at boiling heat the salt is almost completely converted into normal carbonate.

The dry salt begins to lose carbon dioxide and water at 100° C., this loss increasing at a higher temperature until at a red heat there remains a residue of carbonate, which imparts a violet color to a non-luminous flame.

Tests for Identity—An aqueous solution of Potassium Bicarbonate (1 in 10) is slightly alkaline to litmus paper, but is neutral or very slightly alkaline to phenolphthalein T.S.

An aqueous solution of Potassium Bicarbonate (1 in 10) responds to the reactions for potassium, page 596, and for carbonates, page 589.

Tests for Purity—Add 2 cc. of tenth-normal hydrochloric acid and 2 drops of phenolphthalein T.S. to 1 Gm. of the salt, dissolved without agitation in 20 cc. of distilled water at a temperature not above 15° C.: a red tint does not appear immediately (*carbonate*).

An aqueous solution of the salt (1 in 50), mixed with a slight excess of hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dry about 4 Gm. of Potassium Bicarbonate to constant weight over sulphuric acid, weigh accurately, dissolve it in 25 cc. of distilled water, and titrate with normal sulphuric acid, methyl orange T.S. being used as indicator. Each cc. of normal sulphuric acid corresponds to 0.1001 Gm. of $KHCO_3$.

This assay is explained on page 1455.

Preserve in well-closed containers.

U. S. P. Preparations—Liquor Magnesii Citratis; Liquor Potassii Arsenitis; Liquor Potassii Citratis.

N. F. Preparation—Liquor Aromaticus Alkalinus.

Uses—This salt is largely used as affording the purest available source of the potassium salts. The large quantity of carbonic acid which it yields on decomposition renders it useful in beverages and laxative draughts, such as solution of magnesium citrate. It is occasionally used as a gastric antacid but less frequently than the sodium salt. The dose is from fifteen to thirty grains (1 to 2 Gm.).

POTASSII BITARTRAS. U. S. Potassium Bitartrate

[**Pot. Bitart.**—Cream of Tartar]

Potassium Bitartrate, when dried to constant weight at 100° C., contains not less than 99.5 per cent of $KHC_4H_4O_6$ (188.16).

Preparation—This well known salt is made by purifying *argol* or *tartar*, a substance deposited in wine casks during the fermentation of grape juice. (See Acid Saccharine Fruits, page 942.)

Description and Physical Properties—Colorless or slightly opaque, rhombic crystals, or a white, somewhat gritty powder. It is odorless, and has a pleasant, acidulous taste. It is stable in the air.

One Gm. of Potassium Bitartrate is soluble in 155 cc. of water and in 8820 cc. of alcohol, at 25° C. One Gm. is soluble in 16 cc. of boiling water.

Tests for Identity—A saturated aqueous solution of the salt is acid to litmus paper.

When Potassium Bitartrate is heated, it chars and emits inflammable vapors, having the odor of burning sugar. At a higher temperature and with free access of air, the carbon of the black residue is consumed, and a white, fused mass of potassium carbonate remains, which has an alkaline reaction, effervesces with acids, and colors a non-luminous flame violet.

A saturated aqueous solution of Potassium Bitartrate yields with sodium cobaltic nitrate T.S. a yellow precipitate.

Neutralize a saturated aqueous solution of the salt with sodium hydroxide T.S. in a test tube, add silver nitrate T.S., then just sufficient ammonia T.S. to dissolve the white precipitate, and boil the solution: silver is deposited on the inner surface of the test tube, forming a mirror.

Tests for Purity—When 0.5 Gm. of the salt is dissolved in 3 cc. of ammonia T.S., no insoluble residue remains (*starch, kaolin, calcium phosphate, or other insoluble matter*).

A 10 cc. portion of an aqueous solution of the salt (1 in 50), made with the aid of just sufficient hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

Ammonia is not evolved on heating the salt with a slight excess of sodium hydroxide T.S.

Mix 1 Gm. of Potassium Bitartrate in a platinum or silica crucible with 0.5 cc. of sulphuric acid and 1 cc. of nitric acid, and heat the mixture until fumes of sulphur trioxide begin to be liberated. Cool the resulting mass, treat it with 10 cc. of distilled water, and filter: the filtrate, made slightly alkaline with sodium hydroxide T.S. does not yield a gelatinous precipitate soluble in excess of the reagent (*alum*).

Heat 10 Gm. of Potassium Bitartrate with 15 cc. of distilled water, add hydrochloric acid until the salt is dissolved, then add 2 cc. of sulphurous acid, and boil the mixture until the odor of sulphur dioxide is barely perceptible. Cool the solution, mix it with 1 cc. of sodium cyanide T.S. and follow this immediately with stronger ammonia water until the precipitate first formed is redissolved and the solution has a slight odor of ammonia. When cold, transfer the solution to a 50 cc. graduated glass-stoppered cylinder, dilute it with sufficient distilled water to measure 50 cc., and add 3 drops of sodium sulphide T.S. After thorough mixing, the color produced in the solution, if any, when viewed downward against a white surface, is not greater than the color of a control solution prepared as follows: Dissolve 2 Gm. of reagent ammonium chloride in 20 cc. of distilled water, add 4 cc. of a solution containing 0.08 Gm. of lead nitrate in 1000 cc. of distilled water, and then 1 cc. of diluted hydrochloric acid. Treat this solution with the same quantities of hydrochloric acid, sulphurous acid, sodium cyanide T.S., and stronger ammonia water, as used above. Transfer it to another 50 cc. glass-stoppered cylinder, then dilute with sufficient distilled water to make 50 cc. and add 3 drops of sodium sulphide T.S. Before adding the sodium sulphide T.S. the liquid must possess a distinct odor of ammonia and the two cylinders used must be matched, be of practically colorless glass, and have the same internal diameter (*lead*).

Assay—Dry about 6 Gm. of Potassium Bitartrate to constant weight at 100° C., weigh accurately, dissolve in 100 cc. of boiling distilled water, and titrate with normal sodium hydroxide, using phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.1882 Gm. of $KHC_4H_4O_6$.

This assay is explained on page 1453.

Preserve in well-closed containers.

The presence of lead, which may be introduced during the manufacturing process, through the use of sulphuric acid containing lead, is limited by the official tests to 10 parts in one million. This is the limit fixed by the U. S. Government for lead in food products and potassium bitartrate is classified as a food through its large use in baking powders.

U. S. P. Preparation—Pulvis Jalapæ Compositus.

N. F. Preparations—Liquor Cocci; Species Laxativæ; Tabellæ Sulphuris et Potassii Bitartratis.

Uses—This salt is the source of tartaric acid and some of the tartrates. It is diuretic and laxative, and is one of the ingredients in compound powder of jalap. The average dose is 30 grains (2 Gm.).

POTASSII BROMIDUM. U. S. Potassium Bromide

[Pot. Brom.]

Potassium Bromide, when dried to constant weight at 100° C., contains not less than 98.5 per cent of KBr (119.02).

Preparation—Two methods are used in making this salt. In the one which was formerly official, ferrous bromide, made by the action of bromine on iron, is treated with potassium carbonate; ferrous carbonate is precipitated, and potassium bromide remains in solution. The latter is filtered and evaporated, to form crystals.

$$\underset{\text{ferrous bromide}}{FeBr_2} + \underset{\text{potassium carbonate}}{K_2CO_3} = \underset{\text{ferrous carbonate}}{FeCO_3} + \underset{\text{potassium bromide}}{2KBr}$$

In the other method, bromine is added to solution of potassium hydroxide, producing potassium bromide and bromate, as illustrated by the following equation:

$$\underset{\text{potassium hydroxide}}{6KOH} + \underset{\text{bromine}}{3Br_2} = \underset{\text{potassium bromide}}{5KBr} + \underset{\text{potassium bromate}}{KBrO_3} + \underset{\text{water}}{3H_2O}$$

The solution is evaporated to dryness, mixed with charcoal, and heated to redness. The bromate is deoxidized and converted into bromide, carbon monoxide escaping.

$$2KBrO_3 + 3C_2 = 2KBr + 6CO$$

potassium bromate — carbon — potassium bromide — carbon monoxide

The presence of chlorides in potassium bromide, often to the extent of 3 per cent, is due to the difficulty of obtaining the bromine, which is used in making it, free from chlorine.

Formerly this salt was imported. It is now made in the United States upon a large scale, and is exported.

Description and Physical Properties—Colorless or white, odorless, cubical crystals or a granular powder. It is stable in the air.

One Gm. of Potassium Bromide is soluble in 1.5 cc. of water, in about 250 cc. of alcohol, and in 4.6 cc. of glycerin, at 25° C. One Gm. is soluble in 1 cc. of boiling water and in about 21 cc. of boiling alcohol.

An aqueous solution of Potassium Bromide (1 in 20) is neutral or faintly alkaline to litmus paper.

When the salt is heated upon platinum foil, it decrepitates; upon further heating (about 750° C.) it fuses without decomposition and at higher temperatures, it volatilizes, imparting a violet color to a non-luminous flame.

Tests for Identity—An aqueous solution of the salt (1 in 5) responds to the reactions for potassium, page 596, and for bromides, page 574.

Tests for Purity—Dissolve 1 Gm. of Potassium Bromide in 10 cc. of distilled water and add 0.1 cc. of tenth-normal sulphuric acid: no color is produced by the subsequent addition of a drop of phenolphthalein T.S. even after heating (*alkali*).

Add a few drops of ferric chloride T.S. to 10 cc. of an aqueous solution of the salt (1 in 20), shake the mixture, and add 1 cc. of chloroform: the latter does not acquire a violet tint (*iodide*).

Drop 1 cc. of diluted sulphuric acid upon about 1 Gm. of the powdered salt: no yellow color appears at once (*bromate*).

A 10 cc. portion of an aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, is not immediately rendered turbid by the addition of 1 cc. of potassium sulphate T.S. (*barium*).

A solution of 2 Gm. of Potassium Bromide in 50 cc. of distilled water shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1520.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dry the salt to constant weight at 100° C. and proceed as directed under the assay for bromides, page 574. Each cc. of tenth-normal silver nitrate corresponds to 0.01190 Gm. of KBr. Each Gm. of Potassium Bromide, previously dried, corresponds to not less than 82.8 cc. and not more than 84.8 cc. tenth-normal silver nitrate.

This assay is explained on page 1462.

Preserve in well-closed containers.

N. F. Preparations—Elixir Bromidorum Quinque; Elixir Bromidorum Trium; Elixir Potassii Bromidi; Mistura Chloralis et Potassii Bromidi Composita; Sal Potassii Bromidi Effervescens Compositum; Syrupus Bromidorum.

Uses—Potassium bromide is largely used as a nerve sedative and anodyne, in doses of fifteen grains (1 Gm.), frequently repeated.

SAL POTASSII BROMIDI EFFERVESCENS COMPOSITUM. N. F. Compound Effervescent Salt of Potassium Bromide

[**Sal Pot. Brom. Eff. Co.**—Pulvis Potassii Bromidi, Effervescens cum Caffeina, Effervescent Potassium Bromide with Caffeine]

	Metric	Alternative
Caffeine	8 Gm.	70 gr.
Potassium Bromide, in crystals	83 Gm.	1 oz. av. 289 gr.
Lithium Carbonate	42 Gm.	368 gr.
Sodium Bicarbonate, dried	587 Gm.	11 oz. av. 324 gr.
Tartaric Acid, dried	180 Gm.	3 oz. av. 263 gr.
Citric Acid, in unefflorescd crystals	250 Gm.	5 oz. av.
To make	1000 Gm.	20 oz. av.

Prepare an effervescent salt as directed in the General Process (see page 475).

Average dose—90 grains (6 Gm.).

Uses—This preparation is intended for the treatment of headache.

POTASSII CARBONAS. U. S. Potassium Carbonate

[Pot. Carb.—Salt of Tartar]

Potassium Carbonate, when dried to constant weight at 180° C., contains not less than 99 per cent of K_2CO_3 (138.21). It contains not more than 15 per cent of water.

Preparation—This salt, known commercially as *Salt of Tartar* (*Sal Tartar*), is made by dissolving pearlash, or impure potassium carbonate, in an equal weight of cold water, allowing the mixture to stand a day or two, filtering the solution, pouring it into a bright iron dish, and evaporating over a gentle fire until it thickens, then removing it from the fire and stirring constantly with an iron spatula, so as to form a granular salt.

A purer carbonate is produced by decomposing potassium bicarbonate by heating to redness, thus driving off water of crystallization and a portion of the carbon dioxide.

$$\underset{\text{potassium bicarbonate}}{2KHCO_3} = \underset{\text{potassium carbonate}}{K_2CO_3} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

Perhaps the largest proportion of potassium carbonate at the present time is, however, obtained from native potassium chloride and sulphate from the Stassfurt mines in Germany. A process similar to that of Leblanc for producing sodium carbonate (see page 624) is used and a very pure potassium carbonate obtained.

Description and Physical Properties—A white, granular powder, odorless, and having a strongly alkaline taste. It is very deliquescent.

One Gm. of Potassium Carbonate is soluble in 0.9 cc. of water at 25° C. One Gm. is soluble in 0.7 cc. of boiling water. It is insoluble in alcohol.

When heated to 180° C., the salt loses all the water which it may have retained or absorbed. At a bright red heat it melts, and at a white heat it is volatilized.

Tests for Identity—An aqueous solution of Potassium Carbonate (1 in 20) is strongly alkaline to litmus paper and to phenolphthalein T.S. and effervesces with acids.

An aqueous solution of the salt (1 in 10) responds to the reactions for potassium, page 596.

Tests for Purity—No residue is left on dissolving 1 Gm. of Potassium Carbonate in 20 cc. of distilled water (*insoluble impurities*).

An aqueous solution of Potassium Carbonate (1 in 50), mixed with a slight excess of hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

Dry about 3 Gm. of Potassium Carbonate, accurately weighed, to constant weight, at 180° C.: the loss does not exceed 15 per cent (*water*).

Assay—Dry Potassium Carbonate to constant weight at 180° C., weigh accurately about 3 Gm. of the dried salt in a stoppered weighing bottle, dissolve the salt in 25 cc. of distilled water, and titrate with normal sulphuric acid, methyl orange T.S. being used as indicator. Each cc. of normal sulphuric acid corresponds to 0.06911 Gm. of K_2CO_3.

This assay is explained on page 1455.

Preserve in air-tight containers.

U. S. P. Preparations—Pilulæ Ferri Carbonatis; Syrupus Rhei; Syrupus Rhei Aromaticus.

N. F. Preparations—Liquor Cocci; Mistura Carminativa; Mistura Rhei Alkalina; Sal Vichyanum Factitium; Syrupus Asari Compositus; Tinctura Guaiaci Composita; Tinctura Rhei Aquosa; Unguentum Sulphuris Alkalinum.

Uses—Potassium carbonate is an antacid, but it is not suitable for internal use. In large doses it is an irritant caustic, the proper antidotes to administer being diluted vinegar, lemon juice, or weak acids.

POTASSII CHLORAS. U. S. Potassium Chlorate

[Pot. Chloras.]

Potassium Chlorate contains not less than 99 per cent of $KClO_3$ (122.56). *Great caution should be observed in handling it,* as dangerous explosions are liable to occur when it is heated or subjected to concussion or to trituration with organic substances such as cork, tannic acid, dust, sucrose, etc., or with

charcoal, sulphur, sulphides, hypophosphites, or other easily oxidizable substances.

Preparation—Chlorate of potash, as it is always termed commercially, was formerly made by passing chlorine gas into a solution of potassium hydroxide.

$$\underset{\text{potassium hydroxide}}{6KOH} + \underset{\text{chlorine}}{3Cl_2} = \underset{\text{potassium chloride}}{5KCl} + \underset{\text{potassium chlorate}}{KClO_3} + \underset{\text{water}}{3H_2O}$$

This is a very wasteful process, as only one-fifth of the potassium hydroxide is obtained as chlorate, the rest passing into potassium chloride. It is now more economically prepared by acting upon milk of lime, $Ca(OH)_2$ suspension, at high temperatures with an excess of chlorine. Any hypochlorite that is formed is promptly changed into chlorate, the reaction being expressed as follows:

$$\underset{\text{calcium hydroxide}}{6Ca(OH)_2} + \underset{\text{chlorine}}{6Cl_2} = \underset{\text{calcium chloride}}{5CaCl_2} + \underset{\text{calcium chlorate}}{Ca(ClO_3)_2} + \underset{\text{water}}{6H_2O}$$

When solution of calcium chlorate is heated in contact with potassium chloride, double decomposition takes place, as shown by the following equation:

$$\underset{\text{calcium chlorate}}{Ca(ClO_3)_2} + \underset{\text{potassium chloride}}{2KCl} = \underset{\text{potassium chlorate}}{2KClO_3} + \underset{\text{calcium chloride}}{CaCl_2}$$

The potassium chlorate is easily separated from the calcium chloride, because it is much less soluble than the latter.

This salt is now made by electrolysis by placing opposite to each other in a solution of potassium chloride, anodes and cathodes, without being separated by a porous diaphragm. The electric current causes the formation of potassium hypochlorite in the solution, which by boiling is converted into potassium chlorate and potassium chloride. The continued action of the electric current decomposes the newly formed chloride, changing it again, in part, into chlorate. By repeatedly passing through this cycle one can easily see how nearly all of the potassium chloride will ultimately become changed into potassium chlorate. The reactions involved may be expressed as follows:

$$\underset{\text{potassium chloride}}{2KCl} = \underset{\text{potassium}}{K_2} + \underset{\text{chlorine}}{Cl_2}$$

$$\underset{\text{potassium}}{K_2} + \underset{\text{water}}{2H_2O} = \underset{\text{potassium hydroxide}}{2KOH} + \underset{\text{hydrogen}}{H_2}$$

$$\underset{\text{potassium hydroxide}}{6KOH} + \underset{\text{chlorine}}{3Cl_2} = \underset{\text{potassium chloride}}{5KCl} + \underset{\text{potassium chlorate}}{KClO_3} + \underset{\text{water}}{3H_2O}$$

Description and Physical Properties—Colorless, odorless, lustrous, monoclinic prisms or plates, or a white, granular powder. It is stable in the air.

One Gm. of Potassium Chlorate is soluble in 16.5 cc. of water at 25° C. One Gm. is soluble in 1.8 cc. of boiling water. It is almost insoluble in alcohol but is soluble in glycerin.

Tests for Identity—When heated to about 360° C., the salt gives off oxygen and finally leaves a residue of potassium chloride which is readily soluble in water and which responds to the reactions for potassium, page 596, and for chlorides, page 567.

Add about 0.2 Gm. of Potassium Chlorate to 1. cc. of hydrochloric acid: the liquid assumes a deep greenish-yellow color, and chlorine and oxides of chlorine are evolved.

Tests for Purity—An aqueous solution of the salt (1 in 20) is neutral to litmus paper.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dissolve about 0.1 Gm. of Potassium Chlorate, accurately weighed, in 10 cc. of distilled water. Transfer to a 250 cc. flask, and add 50 cc. of acid ferrous sulphate T.S. to the solution. Prepare a valve stopper by taking a piece of rubber tubing of convenient diameter and

about 5 cm. in length, placing a piece of glass rod in one end and slipping the other end over a glass tube which passes through a perforated stopper of a convenient size to fit the flask used. Cut a longitudinal slit about 15 mm. long in one side of the rubber tube about half way up. Insert this stopper in the flask and boil the mixture for ten minutes. Cool the mixture, add 10 cc. of manganous sulphate T.S. and titrate the excess of ferrous sulphate with tenth-normal potassium permanganate. Conduct a blank experiment with another portion of 50 cc. of acid ferrous sulphate T.S. and subtract the result of the former titration from that of the latter. Each cc. of tenth-normal potassium permanganate corresponds to 0.002043 Gm. of $KClO_3$.

This assay is explained on page 1475.

Preserve in well-closed containers.

N. F. Preparations—Gargarisma Guaiaci Compositum; Liquor Chlori Compositus.

Uses—Potassium chlorate is used chemically as a source for obtaining oxygen. Medicinally it is employed as a local stimulant in inflammation of the mouth and the throat, etc., in doses of from four to twenty grains (0.25 to 1.3 Gm.).

POTASSII CITRAS. U. S. Potassium Citrate

[Pot. Cit.]

Potassium Citrate, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of $K_3C_6H_5O_7.H_2O$ (324.39).

Preparation—This salt is made by adding potassium bicarbonate to a solution of citric acid until effervescence ceases, filtering the solution, evaporating to dryness, and granulating.

$$\underset{\text{potassium bicarbonate}}{3KHCO_3} + \underset{\text{citric acid}}{H_3C_6H_5O_7} = \underset{\text{potassium citrate}}{K_3C_6H_5O_7} + \underset{\text{water}}{3H_2O} + \underset{\text{carbon dioxide}}{3CO_2}$$

Manufacturers generally use the carbonate as the source of the potassium, as it is much cheaper than the bicarbonate. When carelessly made from the carbonate, silica may be present, which is to be suspected if the potassium citrate is not entirely soluble in water.

Description and Physical Properties—Transparent, prismatic crystals, or a white, granular powder. It is odorless, has a cooling, saline taste, and is deliquescent when exposed to moist air.

One Gm. of Potassium Citrate is soluble in 0.6 cc. of water at 25° C. It is almost insoluble in alcohol and is freely soluble in glycerin.

Tests for Identity—When heated above 100° C., the salt begins to lose water and at about 200° C. the water of crystallization is completely volatilized. At a higher temperature the salt begins to decompose, turns brown, and upon further heating carbonizes and emits inflammable gases which have a very pungent, acrid odor. After heating to redness, there remains a residue of carbon and potassium carbonate which has an alkaline reaction and effervesces with acids.

An aqueous solution of Potassium Citrate (1 in 10) responds to the reactions for potassium, page 596, and for citrates, page 944.

Tests for Purity—An aqueous solution of Potassium Citrate (1 in 20) is alkaline to litmus paper, but a 10 cc. portion of the solution is not reddened by 1 drop of phenolphthalein T.S.

A solution of 1 Gm. of Potassium Citrate in 1 cc. of distilled water does not deposit a crystalline precipitate on the addition of 1 cc. of acetic acid (*tartrate*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Dry the salt to constant weight over sulphuric acid and proceed as directed under the assay for alkali salts of organic acids, page 1514. Each cc. of half-normal sulphuric acid corresponds to 0.05407 Gm. of $K_3C_6H_5O_7.H_2O$.

This assay is explained on page 1456.

Preserve in well-closed containers.

U. S. P. Preparation—Potassii Citras Effervescens.

N. F. Preparations—Liquor Hypophosphitum Compositus; Syrupus Calcii Lactophosphatis et Ferri.

Uses—Potassium citrate is principally employed in medicine as a saline expectorant, diuretic, and diaphoretic. It is also of service as a systemic alkalizer, and in irritable bladder due to hyperacidity of the urine in doses of fifteen grains (1 Gm.). It is found in the official solution of potassium citrate.

POTASSII CITRAS EFFERVESCENS. U. S. Effervescent Potassium Citrate [Pot. Cit. Eff.]

	Metric	Alternative
Potassium Citrate	200 Gm.	4 oz. av.
Sodium Bicarbonate, dried and powdered	477 Gm.	9 oz. av. 236 gr.
Tartaric Acid, dried and powdered	252 Gm.	5 oz. av. 18 gr.
Citric Acid, uneffloresced crystals	162 Gm.	3 oz. av. 105 gr.
To make	1000 Gm.	20 oz. av.

Dry the potassium citrate on a water bath until it ceases to lose weight, and powder the dried salt. Mix intimately with the powdered citric acid and tartaric acid, and thoroughly incorporate the sodium bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish in an oven heated between 93° and 104° C. Manipulate the mixture carefully with a wooden spatula until it becomes moist, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. Immediately transfer the salt to suitable containers and seal them tightly. Care must be taken to prevent the product from coming in contact with air containing moisture.

Uses—This is diaphoretic and mildly laxative, containing sodium tartrate as well as potassium citrate; it is given in cold water in a dose of sixty grains (4 Gm.).

LIQUOR POTASSII CITRATIS. U. S. Solution of Potassium Citrate [Liq. Pot. Cit.]

Solution of Potassium Citrate contains, in each 100 cc. not less than 8 Gm. of $K_3C_6H_5O_7$ (306.37), with small amounts of citric and carbonic acids.

Caution—This preparation must not be dispensed unless it has been recently prepared.

	Metric	Alternative
Potassium Bicarbonate	8 Gm.	292 gr.
Citric Acid	6 Gm.	219 gr.
Distilled Water, a sufficient quantity, To make	100 cc.	8 fl. oz.

Dissolve the potassium bicarbonate and the citric acid, each, in 40 cc. [3 fl. oz.] of distilled water. Filter the solutions separately, and wash the filters with enough distilled water to obtain in each case 50 cc. [4 fl. oz.]. Mix the two solutions, and when effervescence has ceased, transfer to a bottle and stopper tightly.

Description and Physical Properties—A clear, colorless, odorless liquid, slightly acid to litmus paper.

It meets the requirements of the tests for identity and purity of an aqueous solution of potassium citrate under *Potassii Citras* when suitably concentrated.

Assay—Measure exactly 15 cc. of Solution of Potassium Citrate, evaporate to dryness, and proceed as directed under the Assay for alkali salts of organic acids, page 1514. Each cc. of half-normal sulphuric acid corresponds to 0.05106 Gm. of $K_3C_6H_5O_7$.

This assay is explained on page 1455.

For this preparation it will be found convenient in dispensing practice to keep the separate solutions of citric acid and potassium bicarbonate on hand ready to be mixed when the solution of potassium citrate is needed. The solutions keep moderately well.

This preparation is sometimes called *Neutral Mixture*, but in some localities Neutral Mixture is always understood to mean a more agreeable preparation than this solution, which is made by nearly saturating lemon juice with potassium bicarbonate. It was official in the U. S. P. 1880 under the name of *Mistura Potassii Citratis.*

Uses—Solution of potassium citrate is diuretic and diaphoretic, in doses of four fluidrachms (15 cc.).

POTASSII ET SODII TARTRAS. U. S. Potassium and Sodium Tartrate

[Pot. et Sod. Tart.—Rochelle Salt]

Potassium and Sodium Tartrate contains not less than 73.72 per cent and not more than 77.39 per cent of $KNaC_4H_4O_6$ (210.15), corresponding to not less than 99 per cent of the crystallized salt [$KNaC_4H_4O_6.4H_2O = 282.22$].

Preparation—This salt is made by adding potassium bitartrate to a solution of sodium carbonate; the proportions are shown by a former official process, which is as follows:

Take of sodium carbonate, 12 troyounces; potassium bitartrate, in fine powder, 16 troyounces; boiling water, 5 pints. Dissolve the sodium carbonate in the water, and gradually add the potassium bitartrate. Filter the solution, and evaporate until a pellicle begins to form; then set it aside to crystallize. Pour off the mother water, and dry the crystals on bibulous paper. Lastly, evaporate the mother water, that it may furnish more crystals.

It is advantageous to filter the solution after one-half of its volume has been evaporated and it has cooled and settled, in order to free it from the calcium tartrate which separates, otherwise the crystals will be contaminated.

The following equation shows the reaction:

$$\underset{\text{potassium bitartrate}}{2KHC_4H_4O_6} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{potassium and sodium tartrate}}{2KNaC_4H_4O_6} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

The chemical constitution of the tartrates will be fully explained under *Acidum Tartaricum*, but note that tartaric acid is a dibasic acid and is capable of forming double salts of which this is an example.

Description and Physical Properties—Colorless, transparent, rhombic prisms, or a white powder. It is odorless, and has a cooling, saline taste. The crystals effloresce slightly in dry air.

One Gm. of Potassium and Sodium Tartrate is soluble in 0.9 cc. of water at 25° C. It is practically insoluble in alcohol.

Tests for Identity—When heated to about 74° C. the salt fuses to a colorless liquid, which at a higher temperature froths, becomes brown, and is gradually carbonized, emitting inflammable vapors which have the odor of burning sugar. Finally a black residue is left, consisting of a mixture of potassium and sodium carbonates with carbon. To a non-luminous flame this residue imparts an intensely yellow color.

An aqueous solution of the salt (1 in 20) yields a white, crystalline precipitate with an equal volume of acetic acid within fifteen minutes.

An aqueous solution of the salt (1 in 10) responds to the reactions for tartrates, page 942.

Tests for Purity—An aqueous solution of Potassium and Sodium Tartrate (1 in 20) is alkaline to litmus paper, but a 10 cc. portion of the solution is not reddened by a drop of phenolphthalein T.S.

An aqueous solution of Potassium and Sodium Tartrate meets the requirements of the test for *heavy metals*, page 1519.

A 5 cc. portion of an aqueous solution of the salt (1 in 10) heated with sodium hydroxide T.S. does not evolve ammonia.

Dissolve 10 Gm. of Potassium and Sodium Tartrate in 20 cc. of distilled water, add 2 cc. of sulphurous acid, and boil the mixture until the odor of sulphur dioxide is barely perceptible. Cool the solution, mix it with 1 cc. of sodium cyanide T.S. and follow this immediately with stronger ammonia T.S. until the solution has a slight odor of ammonia. When cold, transfer the solution to a 50 cc. graduated glass-stoppered cylinder, dilute it with sufficient distilled water to measure 50 cc. and add 3 drops of sodium sulphide T.S. After thoroughly mixing, the color produced in the solution, if any, when viewed downward against a white surface, is not greater than the color of a control solution prepared as follows: Dissolve 2 Gm. of reagent ammonium chloride in 20 cc. of distilled water, add 4 cc. of a solution containing 0.08 Gm. of lead nitrate in 1000 cc. of distilled water, and then 1 cc. of diluted hydrochloric acid. Treat this solution with the same quantities of sulphurous acid, sodium cyanide T.S. and stronger ammonia T.S. as used above, transfer it to another 50 cc. glass-stoppered cylinder, then dilute it with sufficient distilled water to make 50 cc., and add 3 drops of sodium sulphide T.S. Before adding the sodium sulphide T.S. the liquid must possess a distinct odor of ammonia, and the two cylinders used must be matched and be of practically colorless glass, and have the same internal diameter (*lead*).

Assay—Proceed as directed under the assay for alkali salts of organic acids, page 1514. Each cc. of half-normal sulphuric acid corresponds to 0.05254 Gm. of $KNaC_4H_4O_6$.

This assay is explained on page 1456.

Preserve in well-closed containers.

U. S. P. Preparation—Pulvis Effervescens Compositus.

History—Rochelle Salt was named for the city in which it was first discovered and manufactured by Peter Seignette, an apothecary of the latter half of the 17th century. The secret of its composition was kept undivulged by him and his descendants for nearly a century and it was sold as a proprietary remedy or nostrum. He put it up in individual envelopes and called it *Sal Polychrestum,* or the Salt of Many Virtues. It has also been called Seignette's Salt in honor of its discoverer. The secret of its composition was divulged in 1731 in a paper by Boulduc, a noted Parisian pharmacist, which was deemed of sufficient importance to be published by the French Academy of Sciences and the Transactions of the Philosophical Society of Great Britain. The name Sal Polychrestum had previously been applied to potassium sulphate by Christopher Glaser, apothecary to Louis XIV of France. The first official name of Rochelle salt in the London Pharmacopœia of 1788 was *Natron Tartarizatum,* which in the edition of 1809 was changed to *Soda Tartarizata.*

Uses—Rochelle Salt, as it is habitually termed, is an efficient and not disagreeable saline cathartic. It is given in the dose of one-quarter ounce to an ounce (8 to 31 Gm.). It is an important ingredient in the well-known Seidlitz powders.

POTASSII IODIDUM. U. S. Potassium Iodide
[Pot. Iod.]

Potassium Iodide, when dried to constant weight at 100° C., contains not less than 99 per cent of KI (166.02).

Preparation—An aqueous solution of potassium hydroxide is treated with iodine in slight excess. The result is the formation of two salts, potassium iodide and potassium iodate.

$$\underset{\text{potassium hydroxide}}{6KOH} + \underset{\text{iodine}}{3I_2} = \underset{\text{potassium iodide}}{5KI} + \underset{\text{potassium iodate}}{KIO_3} + \underset{\text{water}}{3H_2O}$$

By evaporating the solution to dryness, the mixed salts are obtained; and if the dry mass is exposed to a red heat, the iodate will be converted into potassium iodide, thus removing this impurity.

The mixed salts, toward the close of their evaporation to dryness, should be mixed with powdered charcoal, which facilitates the reduction of the iodate. This is accomplished at a dull red heat, the potassium iodide being dissolved out of the mass, and the solution set aside to crystallize.

$$\underset{\text{potassium iodate}}{KIO_3} + \underset{\text{carbon}}{3C} = \underset{\text{potassium iodide}}{KI} + \underset{\text{carbon monoxide}}{3CO}$$

It may also be reduced with hydrogen dioxide as follows:

$$\underset{\text{potassium iodate}}{KIO_3} + \underset{\text{hydrogen dioxide}}{3H_2O_2} = \underset{\text{potassium iodide}}{KI} + \underset{\text{water}}{3H_2O} + \underset{\text{oxygen}}{3O_2}$$

It is also prepared by forming ferroso-ferric iodide, through the reaction between iron wire and iodine, adding a solution of pure potassium carbonate until the solution is faintly alkaline, boiling for a few moments, filtering, concentrating the filtrate, and setting it aside to crystallize.

The reactions are expressed separately as follows:

$$\underset{\text{iron}}{3Fe} + \underset{\text{iodine}}{4I_2} = \underset{\text{ferroso-ferric iodide}}{Fe_3I_8}$$

This solution is then decomposed by potassium carbonate which precipitates the iron and leaves potassium iodide in solution, thus:

$$Fe_3I_8 + 4K_2CO_3 = 8KI + Fe_3O_4 + 4CO_2$$

ferroso-ferric iodide — potassium carbonate — potassium iodide — ferroso-ferric oxide — carbon dioxide

Potassium iodide is always crystallized from an alkaline solution if the manufacturer expects to avoid loss through the discoloration of the product from the separation of free iodine. The official test permits the presence of a small excess of alkali.

Description and Physical Properties—Cubical crystals, either transparent and colorless or more or less opaque and white, or a white, granular powder. It is stable in dry air, but slightly deliquescent in moist air.

One Gm. of Potassium Iodide is soluble in 0.7 cc. of water, in 22 cc. of alcohol, and in 2 cc. of glycerin, at 25° C. One Gm. is soluble in 0.5 cc. of boiling water and in 8 cc. of boiling alcohol.

An aqueous solution of the salt (1 in 20) is neutral or slightly alkaline to litmus paper.

When heated, Potassium Iodide decrepitates. At a low red heat (about 684° C.) it fuses, and at a bright red heat (about 720° C.) it is volatilized without decomposition.

Tests for Identity—An aqueous solution of Potassium Iodide responds to the reactions for potassium, page 596, and for iodides, page 575.

Tests for Purity—Dissolve 1 Gm. of the salt in 10 cc. of distilled water and add 0.1 cc. of tenth-normal sulphuric acid: no color is produced by the subsequent addition of a drop of phenolphthalein T.S. (*alkali*).

Dissolve 0.5 Gm. of the salt in 10 cc. of distilled water, which has been previously boiled and cooled, and add two drops of diluted sulphuric acid: no distinct yellow color appears within half a minute (*iodate*), and no turbidity occurs (*thiosulphate*).

Add 5 cc. of sodium hydroxide T.S. and about 0.2 Gm. of aluminum wire to a solution of 1 Gm. of Potassium Iodide in 5 cc. of distilled water contained in a test tube of about 40 cc. capacity. Insert a pledget of purified cotton in the upper portion of the test tube and place a piece of moistened red litmus paper over its mouth: on heating the tube and contents upon a water bath for fifteen minutes, no blue coloration of the paper is discernible (*nitrate or nitrite*).

Acidulate slightly 10 cc. of an aqueous solution of the salt (1 in 20) with hydrochloric acid: it is not rendered turbid by the addition of 1 cc. of potassium sulphate T.S. (*barium*).

A 2 Gm. portion of the salt shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1567.

Heat gently 5 cc. of an aqueous solution of the salt (1 in 10) with one drop of ferrous sulphate T.S. and 0.5 cc. of sodium hydroxide T.S.: no blue color appears after acidulating the mixture with hydrochloric acid (*cyanide*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dry the salt to constant weight at 100° C. and proceed as directed under the assay for iodides, page 1515. Each cc. of tenth-normal silver nitrate corresponds to 0.01660 Gm. of KI. Each Gm. of Potassium Iodide, previously dried, corresponds to not less than 59.6 cc. and not more than 61.0 cc. of tenth-normal silver nitrate.

This assay is explained on page 1462.

Preserve in well-closed containers.

U. S. P. Preparations—Acidum Hydriodicum Dilutum; Liquor Iodi Compositus; Tinctura Iodi; Unguentum Iodi.

N. F. Preparations—Ampullæ Iodi; Elixir Corydalis Compositum; Elixir Sodii Salicylatis Compositum; Liquor Iodi et Zinci Phenolsulphonatis; Liquor Potassii Iodidi; Tinctura Iodidorum; Tinctura Iodi Fortior; Unguentum Potassii Iodidi.

Uses—This is a valuable alterative, useful in a host of chronic diseases including goiter, syphilis, rheumatism, arteriosclerosis, etc. It is used as an alterative in from 5 to 8 grain doses (0.32 to 0.5 Gm.); as an antisyphilitic, four drachms (16 Gm.), largely diluted, may be given.

LIQUOR POTASSII IODIDI. N.F. Solution of Potassium Iodide

[**Liq. Pot. Iod.**—Saturated Solution of Potassium Iodide]

An aqueous solution containing not less than 97 Gm. and not more than 103 Gm. of KI (166.02) in each 100 cc.

	Metric	Alternative
Potassium Iodide	**100.00 Gm.**	1 oz. av. 19 gr.
Sodium Thiosulphate	**0.05 Gm.**	¼ gr.
Distilled Water, a sufficient quantity,		
To make	**100 cc.**	1 fl. oz.

Dissolve the salts in 68 cc. [326 min.] of distilled water, warm the solution to 25° C. and add sufficient distilled water to make the product measure 100 cc. [1 fl. oz.]. Filter if necessary.

Solution of Potassium Iodide is a clear, colorless and odorless solution having a strongly saline taste. It is neutral or slightly alkaline to litmus paper.

Specific gravity: about 1.70 at 25° C.

The Solution when diluted in the proportion of one volume to nineteen volumes of distilled water responds to the general tests under Potassii Iodidum U. S. P. X.

Assay—Dilute 1 cc. of Solution of Potassium Iodide accurately measured, with 25 cc. of distilled water, add 65 cc. of tenth-normal silver nitrate and shake well. Now add 2 cc. of ferric ammonium sulphate T.S. and 2 cc. of nitric acid and titrate with tenth-normal potassium thiocyanate. Each cc. of tenth-normal silver nitrate consumed corresponds to 0.0166 Gm. of KI. Each cc. of Solution of Potassium Iodide corresponds to not less than 57.8 cc. and not more than 62.7 cc. of tenth-normal silver nitrate.

This assay is explained on page 1463.

Preserve the solution in amber-colored bottles.

Average dose—Metric, 0.3 cc.—Apothecaries, 5 minims.

POTASSII NITRAS. U.S. Potassium Nitrate

[**Pot. Nit.**—SALTPETRE]

Potassium Nitrate, when dried to constant weight at 100° C., contains not less than 99 per cent of KNO_3 (101.11).

Preparation—*Nitre* or *Saltpetre* is sometimes a natural product. It was formerly produced artificially in what are known as nitre beds, which are made up of earth and wood ashes, with animal and vegetable refuse; these are protected from rain by sheds. In time the ammonia produced by the decomposition of the organic matter in the mixture is oxidized, nitric acid is formed, and this unites with the potassium hydroxide in the wood ashes, and gradually forms potassium nitrate. The salt is then separated by lixiviation, filtration, evaporation, and crystallization.

Much of the potassium nitrate now on the market is prepared by the "conversion" process. Concentrated solutions of potassium chloride and sodium nitrate are brought together and the mixture evaporated with the aid of heat. Sodium chloride is peculiar in that its solubility is only very slightly changed at high temperatures. On the other hand the solubility of potassium nitrate, under the above conditions, increases to a very high degree. This means that much of the sodium chloride can be removed during the evaporation and the potassium nitrate can be obtained by its separation from the cooled mother liquor. It can then be purified by recrystallization. The reaction involved is expressed as follows:

$$\underset{\text{sodium nitrate}}{NaNO_3} + \underset{\text{potassium chloride}}{KCl} = \underset{\text{potassium nitrate}}{KNO_3} + \underset{\text{sodium chloride}}{NaCl}$$

Description and Physical Properties—Colorless, transparent, six-sided rhombic prisms, or a white, crystalline powder. It is odorless, has a saline taste, and produces a cooling sensation in the mouth. It is slightly hygroscopic in moist air.

One Gm. of Potassium Nitrate is soluble in 2.8 cc. of water, and in 620 cc. of alcohol, at 25° C.

One Gm. is soluble in 0.5 cc. of boiling water. It is soluble in glycerin.

When strongly heated, the salt melts without decomposition. At higher temperatures it evolves oxygen and is partly reduced to nitrate. When Potassium Nitrate is heated with charcoal, the mixture deflagrates.

Tests for Identity—An aqueous solution of the salt (1 in 10) responds to the reactions for potassium, page 596, and for nitrates, page 551.

Tests for Purity—An aqueous solution of Potassium Nitrate (1 in 10) is neutral to litmus paper.

An aqueous solution of Potassium Nitrate meets the requirements of the test for *heavy metals*, page 1519.

No yellow color appears when 0.1 Gm. of the dry salt is sprinkled upon 1 cc. of concentrated sulphuric acid (*chlorate*).

Assay—Dry about 0.4 Gm. of Potassium Nitrate to constant weight at 100° C., weigh accurately, dissolve it in 10 cc. of hydrochloric acid in a small porcelain dish, and evaporate the solution to dryness on a water bath. Dissolve the residue in 10 cc. of hydrochloric acid, and again evaporate to dryness on a water bath, continuing the heat until the residue, when redissolved in distilled water, is neutral to litmus paper. Transfer the residue with the aid of 25 cc. of distilled water to a flask, and proceed as directed under the assay for chlorides, page 1514, deducting from the amount of tenth-normal silver nitrate consumed the amount which would be consumed by the chlorides present in an equivalent weight of the salt originally taken, and previously determined by taking about 2 Gm. of the salt, accurately weighed, and proceeding as directed under the assay for chlorides, page 1514.

Each cc. of tenth-normal silver nitrate corresponds to 0.01011 Gm. of KNO_3.

This assay is explained on page 1463.

Preserve in well-closed containers.

N. F. Preparation—Charta Potassii Nitratis.

Uses—Potassium nitrate was formerly used as a diuretic and diaphoretic, but has largely passed out of vogue. It is used frequently in *asthma powders*, partly because of its local stimulating action on the bronchi but chiefly because of its oxidizing effect, which aids combustion. It is occasionally employed in solution as a local stimulant, similar to the chlorate, in doses of eight to twenty grains (0.5 to 1.3 Gm.). In concentrated solution it is antiseptic. It is extensively used in making gunpowder and in fertilizers.

POTASSII PERMANGANAS. U. S. Potassium Permanganate

[Pot. Permang.]

Potassium Permanganate, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of $KMnO_4$ (158.03).

Great caution should be observed in handling it, as dangerous explosions are liable to occur when it is brought into contact with organic or other readily oxidizable substances, either in solution or in the dry condition.

Preparation—This salt is made by oxidizing a solution of potassium manganate with chlorine or with ozone.

When chlorine is passed into the solution a reaction takes place which is expressed as follows:

$$\underset{\text{potassium manganate}}{2K_2MnO_4} + \underset{\text{chlorine}}{Cl_2} = \underset{\text{potassium permanganate}}{K_2Mn_2O_8} + \underset{\text{potassium chloride}}{2KCl}$$

and the oxidation by ozone is expressed as follows:

$$2K_2MnO_4 + O_3 + H_2O = K_2Mn_2O_8 + O_2 + 2KOH$$
$$2K_2MnO_4 + O + H_2O = K_2Mn_2O_8 + 2KOH$$

Potassium manganate is made by heating manganese dioxide with potassium hydroxide with the aid of an oxidizing agent like potassium chlorate; the potassium hydroxide liberated by the reaction requires neutralization with an acid if all the permanganate is to be obtained, because the latter, in the presence of an excess of alkali, remains in the condition of manganate.

Description and Physical Properties—Odorless, slender, monoclinic prisms, of a dark purple color, almost opaque by transmitted light, and of a blue, metallic luster by reflected light. It is stable in the air.

One Gm. of Potassium Permanganate is soluble in 13.5 cc. of water at 25° C. One Gm. is soluble in 3.5 cc. of boiling water. It is decomposed by alcohol.

Tests for Identity—When heated, the Potassium Permanganate decrepitates, and at about 240° C. it is decomposed, yielding oxygen, potassium manganate and manganese dioxide.

An aqueous solution of the salt is of a deep violet-red color when concentrated, and of a rose color when highly diluted, and responds to the reactions for permanganates, page 706.

Assay—Dry about 0.10 Gm. of Potassium Permanganate to constant weight over sulphuric acid, weigh accurately, and dissolve it in 25 cc. of distilled water. Mix the solution with 1 cc. of

sulphuric acid and 50 cc. of tenth-normal oxalic acid, warm the mixture to about 80° C., and titrate with tenth-normal potassium permanganate. Each cc. of tenth-normal oxalic acid corresponds to 0.003161 Gm. of $KMnO_4$.

This assay is explained on page 1475.

Preserve in glass-stoppered bottles.

Uses—As a therapeutic agent Potassium Permanganate is employed as a disinfectant and deodorant; also as an antidote to morphine, strychnine, and snake poison. Formerly it was employed internally in menstrual disorders but is of little value.

It is one of the most powerful oxidizing agents known. Chemically, it is used as a volumetric test and oxidizer, for which it is admirably adapted on account of the distinctness of its color reactions, although the difficulty of keeping the solution from partial decomposition is a serious annoyance and interferes with the accuracy of the estimation. When potassium permanganate comes in contact with organic matter, it is decomposed with the liberation of oxygen; the reaction is as follows: $K_2Mn_2O_8 = 2MnO + K_2O + 5O$.

In the presence of an acid forming a soluble salt of the manganese, as sulphuric, the reaction is as follows: $K_2Mn_2O_8 + 3H_2SO_4 = 2MnSO_4 + K_2SO_4 + 3H_2O + 5O$. The MnO, in the first of these reactions, is what is deposited as a brown stain when potassium permanganate comes in contact with the skin, and the second reaction illustrates why diluted sulphuric or diluted hydrochloric acid removes the stains produced on organic tissues by permanganate, through the formation of colorless salts of the manganese. The dose is one grain (0.065 Gm.).

POTASSII CHLORIDUM. N.F. Potassium Chloride

[Pot. Chlorid.]

Potassium Chloride contains, when dried to constant weight at 100° C., not less than 99 per cent of KCl (74.56).

Preparation—This salt occurs in sea water and in many mineral springs and is also mined at Stassfurt, Germany, occurring there as *carnallite*, $KCl.MgCl_2 + 6H_2O$, and as *sylvite*, KCl. The carnallite, in aqueous solution, is treated with live steam, the two separate salts form and the less soluble salt, potassium chloride, crystallizes out as the solution cools. It may also be prepared by dissolving potassium carbonate or bicarbonate in hydrochloric acid.

Description and Physical Properties—Potassium Chloride occurs in colorless, elongated, prismatic, or cubical crystals, or as a white, granular powder; permanent in dry air. Odorless; taste saline.

One Gm. dissolves in 2.8 cc. of water at 25° C., slightly more soluble in boiling water; insoluble in alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 10) is clear, and neutral to litmus.

When heated, the dry salt decrepitates. To a non-luminous flame it imparts a violet color unmasked by yellow.

An aqueous solution of the salt yields with silver nitrate T.S. a white, curdy precipitate, insoluble in nitric acid but soluble in an excess of ammonia water.

Tests for Purity—Boil 5 cc. of an aqueous solution of the salt (1 in 10) in a test tube, then add an equal volume of barium hydroxide T.S. and stopper the tube; the solution is not rendered cloudy within fifteen minutes (*calcium or magnesium*).

Dissolve 2 Gm. of the salt in 6 cc. of distilled water, add 1 cc. of chloroform, and then add, drop by drop, with constant agitation, 5 cc. of half-strength chlorine water; the chloroform does not acquire a transient violet or permanent orange color (*iodide or bromide*).

An aqueous solution of the salt meets the requirements of the test for arsenic (see page 1512).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Assay—Dissolve about 0.25 Gm. of Potassium Chloride, previously dried to constant weight at 100° C. and accurately weighed, in 25 cc. of distilled water in a 200 cc. measuring flask. Add 50 cc. of tenth-normal silver nitrate to the solution, then 5 cc. of nitric acid, afterward sufficient distilled water to make 200 cc. and mix thoroughly. Filter the mixture through a dry filter, reject the first 20 cc. of the filtrate, collect the following 100 cc. of filtrate, add to this 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate, until the supernatant liquid remains reddish after it is well shaken.

Each cc. of tenth-normal silver nitrate corresponds to 0.007456 Gm. of KCl. Each Gm. of Potassium Chloride, dried to constant weight, corresponds to not less than 132.8 cc. of tenth-normal silver nitrate.

This assay is explained on page 1463.

N. F. Preparations—Liquor Hydrastinæ Compositus; Sal Kissingense Factitium; Sal Kissingense Factitium Effervescens.

Uses—It has long been used in medicine under the names *sal febrifugum* and *sal digestivum*. It has no medicinal value. It is an ingredient of Locke-Ringer Solution, of importance in the physiologic laboratories. It is chiefly used today in the preparation of other potassium salts, and in the impure form as an ingredient in fertilizer mixtures.

Average dose—15 grains (1 Gm.).

POTASSII HYPOPHOSPHIS. N. F. Potassium Hypophosphite
(U. S. P. IX)
[Pot. Hypophos.]

Potassium Hypophosphite contains, when dried to constant weight over sulphuric acid, not less than 98 per cent of KPH_2O_2 (104.16).

Caution should be observed in dispensing Potassium Hypophosphite, as an explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents.

Preparation—When solutions of calcium hypophosphite and potassium carbonate are mixed, potassium hypophosphite and calcium carbonate are produced by double decomposition, thus:

$$\underset{\text{calcium hypophosphite}}{Ca(H_2PO_2)_2} + \underset{\text{potassium carbonate}}{K_2CO_3} = \underset{\text{potassium hypophosphite}}{2KH_2PO_2} + \underset{\text{calcium carbonate}}{CaCO_3}$$

The calcium carbonate is removed by filtration, and the clear solution is evaporated until a pellicle forms, after which it is constantly stirred, with continuance of the heat, until the salt granulates. The heat employed in the evaporation should be kept considerably below 100° C. for fear of explosion. If the salt is required to be pure, it should be dissolved in the granulated state, in official alcohol, and the solution evaporated and then set aside to crystallize.

Description and Physical Properties—Potassium Hypophosphite occurs as white, opaque, hexagonal plates, or crystalline masses, or as a granular powder; odorless, and having a pungent, saline taste; very deliquescent.

One Gm. of Potassium Hypophosphite dissolves in 0.6 cc. of water and in 9 cc. of alcohol at 25° C.; also in 0.4 cc. of boiling water and in 5 cc. of boiling alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 20) is neutral or slightly alkaline to litmus and yields with sodium bitartrate T.S. a white, crystalline precipitate.

When heated in a dry test tube spontaneously inflammable hydrogen phosphide is evolved which burns with a bright yellow flame.

When an aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, with agitation to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed. Upon the further addition of the solution of Potassium Hypophosphite, the precipitate becomes gray from reduction to metallic mercury.

Tests for Purity—A solution of 1 Gm. of the salt in about 10 cc. of distilled water requires not more than 1.5 cc. of tenth-normal hydrochloric acid for neutralization, methyl orange T.S. being used as indicator.

Heat 5 cc. of an aqueous solution of the salt (1 in 5) with 0.5 cc. of diluted hydrochloric acid in a test tube on a water bath for thirty minutes; no offensive odors are developed.

Measure 5 cc. of an aqueous solution of Potassium Hypophosphite (1 in 25) into a beaker containing 3 cc. of nitric acid diluted with about 10 cc. of distilled water, and evaporate the mixture to dryness on a water bath; the residue meets the requirements of the test for arsenic (see page 1512).

Add magnesia mixture T.S. to 10 cc. of an aqueous solution of the salt (1 in 20) made alkaline with ammonia water; it is not affected within one minute (*phosphates*).

Assay—Dissolve about 1 Gm. of Potassium Hypophosphite, dried to constant weight over sulphuric acid and accurately weighed, in 10 cc. of distilled water, add 10 cc. of nitric acid and evaporate it to dryness on a water bath. Then add 5 cc. of nitric acid and again evaporate it to dryness on a water bath. Dissolve the residue in 20 cc. of distilled water, add a drop of phenolphthalein T.S. and sufficient special potassium hydroxide T.S. (see page 545, U. S. P. IX) to produce a pink color, and then dilute it to exactly 100 cc. with distilled water. Transfer 10 cc. of this solution to a 100 cc. graduate flask, add 50 cc. of tenth-normal silver nitrate and thoroughly agitate the mixture. Gradually add reagent zinc oxide, in small portions, until the liquid is neutral to litmus paper. Then add distilled water to make 100 cc., mix thoroughly, and filter through a filter paper not previously moistened, rejecting the first 25 cc. of filtrate. Collect 50 cc. of the subsequent filtrate, add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate to the production of a permanent red color.

Each cc. of tenth-normal silver nitrate corresponds to 0.003472 Gm. of KPH_2O_2. Each Gm. of Potassium Hypophosphite, previously dried, corresponds to not less than 282.3 cc. of tenth-normal silver nitrate.

This assay is explained on page 1464.

Preserve it in well-closed containers, in a dry place.

N. F. **Preparations**—Emulsum Olei Morrhuæ cum Hypophosphitibus; Liquor Hypophosphitum Compositus; Syrupus Hypophosphitum; Syrupus Hypophosphitum Compositus.

Uses—The official use made of potassium hypophosphite is to form one of the ingredients in the various syrups, elixirs, and solutions named above and in the production of hypophosphorous acid as a preservative in making diluted hydriodic acid. It may be given internally in the dose of eight grains (0.5 Gm.).

POTASSII SULPHAS. N. F. Potassium Sulphate

[Pot. Sulph.]

Potassium Sulphate contains, when dried to constant weight at 100° C., not less than 99 per cent of K_2SO_4 (174.26).

Preparation—This salt occurs in many mineral springs, is a by-product in many chemical processes, but its chief source is *kainite*, the double sulphate of potassium and magnesium with magnesium chloride, $K_2SO_4.MgSO_4.MgCl_2 + 5H_2O$, and *schoenite*, the double sulphate of potassium and magnesium, $K_2SO_4.2MgSO_4 + 6H_2O$, both of which are mined in the Stassfurt salt bed.

In its preparation from kainite, the ore is exposed to the air until the magnesium chloride deliquesces and runs off, the remainder is dissolved in boiling water and the less soluble potassium sulphate crystallizes first.

Description and Physical Properties—Potassium Sulphate occurs as hard, colorless, translucent, six-sided, rhombic prisms terminated by pyramids, or as a white powder; permanent in the air. Odorless; taste saline, somewhat bitter.

One Gm. dissolves in 10 cc. of water at 25° C., and in 4 cc. of boiling water; insoluble in alcohol.

Tests for Identity—When heated the crystals decrepitate. At a bright red heat the salt fuses, and at a white heat partial decomposition occurs.

An aqueous solution of the salt (1 in 20) is neutral to litmus.

A saturated aqueous solution of the salt yields a white, crystalline precipitate with an excess of sodium bitartrate T.S.

An aqueous solution of the salt (1 in 20) yields with barium chloride T.S. a heavy white precipitate, insoluble in hydrochloric acid.

Tests for Purity—Separate portions of 10 cc. of the aqueous solution of the salt (1 in 20) made slightly alkaline with ammonia, are not rendered turbid within one minute by the addition of ammonium oxalate T.S. or of sodium phosphate T.S. (*calcium or magnesium*).

An aqueous solution of Potassium Sulphate does not respond to the test for heavy metals (see page 1519).

An aqueous solution of the salt meets the requirement of the test for arsenic (see page 1512).

Assay—Dissolve about 0.6 Gm. of Potassium Sulphate, previously dried to constant weight at 100° C. and accurately weighed, in 200 cc. of distilled water, acidulate the solution with hydrochloric acid and heat it to boiling. Gradually add an excess of barium chloride T.S., and heat for thirty minutes on a water bath; collect the precipitate of barium sulphate on a filter and wash it with distilled water until silver nitrate T.S. fails to produce an opalescence in 2 cc. of the filtrate, previously acidulated with nitric acid. Dry the precipitate, ignite and weigh the residue.

Each Gm. of Potassium Sulphate corresponds to not less than 1.326 Gm. of $BaSO_4$.

This assay is explained on page 1479.

N. F. **Preparations**—Sal Carolinum Factitium; Sal Carolinum Factitium Effervescens.

Uses—Because of the hardness of the crystals it was at one time used as the diluent in Dover's Powder on the theory that the labor required to reduce the hard crystals to a fine powder would insure a uniform mixture and fine subdivision of the drug. This use has, however, been abandoned. It is used in laxative salts and extensively employed in the production of potash alum and potassium carbonate.

Average dose—15 grains (1 Gm.).

Unofficial Potassium Salts

Potassii Antimonias, $KSbO_3$
Potassium Metantimonate
: A white salt of little importance. When anhydrous it is very sparingly soluble in water but upon prolonged boiling with water it becomes hydrated, and dissolves. By further boiling it is decomposed into an acid potassium antimonate

Potassii Bisulphas, $KHSO_4$
Potassium Bisulphate
: Colorless crystals, soluble in water with an acid reaction. It is used as a flux and as a cleansing agent for platinum ware, since it is a solid substance, which when fused, behaves like strong sulphuric acid

Potassii Bisulphis, $KHSO_3$
Potassium Bisulphite
: A white crystalline powder with an odor of sulphur dioxide; soluble in water, insoluble in alcohol. It is used as an antiseptic and as a source of sulphur dioxide

Unofficial Potassium Salts—*Continued*

Potassii Chromas, K_2CrO_4 Potassium Chromate	Yellow crystals, soluble in water, insoluble in alcohol. Used as a reagent, in leather finishing, dyeing, inks and in the preparation of insoluble chromates by precipitation
Potassii Cyanidum, KCN Potassium Cyanide	White amorphous lumps or crystalline masses, having a faint bitter almond-like odor. It is extremely poisonous. It is used in medicine, in electroplating, in extracting gold and silver from their ores and, as an insecticide. Dose, $\frac{1}{16}$ to $\frac{1}{8}$ gr. (0.004 to 0.008 Gm.)
Potassii Dichromas, $K_2Cr_2O_7$ Potassium Dichromate	Orange-red, transparent crystals. They have a metallic taste. It is poisonous and is water-soluble. This salt is a well-known oxidizing agent in analytical chemistry. It is also used in medicine, in tanning, histology, bleaching, and dyeing
Potassii Ferricyanidum, $K_3Fe(CN)_6$ Potassium Ferricyanide	Commonly called *red prussiate of potash.* Bright red crystals or powder, soluble in water. Used as a reagent for ferrous salts; also used for tempering steel, as a mordant in calico printing, wool dyeing and in the production of pigments
Potassii Ferrocyanidum, $K_4Fe(CN)_6+3H_2O$ Potassium Ferrocyanide	Commonly called *yellow prussiate of potash.* Lemon-yellow crystals or powder, efflorescent on exposure to air. This salt is soluble in water but insoluble in alcohol. It is used as a reagent for the detection of ferric salts. It is also used in medicine, in tempering steel, dyeing, and in the manufacture of pigments, and of potassium ferricyanide
Potassii Hydrargyri Iodidum, K_2HgI_4 Potassium Mercuric Iodide	This is described under the unofficial salts of mercury (page 760)
Potassii Iodas, KIO_3 Potassium Iodate	A white, crystalline powder that resembles potassium chlorate in its properties. It is useful as a reagent in testing for sulphur dioxide.
Potassii Nitris, KNO_2 Potassium Nitrite	A white, deliquescent salt, very soluble in water, insoluble in alcohol. It is generally sold in fused stick form. It is used in medicine and as a source of nitrous acid, although its use is being superseded by the corresponding sodium salt
Potassii Perchloras, $KClO_4$ Potassium Perchlorate	A sparingly soluble white salt. At high temperatures it decomposes yielding potassium chloride and oxygen. It is used as a powerful oxidizing agent
Potassii Platinocyanidum, $2KCN.Pt(CN)_2.3H_2O$ Potassium Platinocyanide	Very soluble crystals, yellow by transmitted light reflecting a blue color. It is used as a reagent, giving a blue precipitate with copper sulphate
Potassii Salicylas, $KC_7H_5O_3$ Potassium Salicylate	A soluble white powder that has been almost entirely replaced by the corresponding sodium salt
Potassii Silicas, K_2SiO_3 Potassium Silicate, Soluble Glass	This salt is the counterpart of ordinary *water glass* which is the corresponding compound of sodium. It is one of the very few water-soluble silicates
Potassii Sulphidum, K_2S Potassium Sulphide	Colorless crystals, when pure, containing five molecules of water in each molecule. These crystals deliquesce in air and are decomposed by carbon dioxide with the evolution of hydrogen sulphide. It is used as a reagent, in solution
Potassii Sulphis, $K_2SO_3+2H_2O$ Potassium Sulphite	A white, somewhat deliquescent salt having a bitter saline taste. It is more soluble in cold than in hot water. Upon standing it gradually becomes oxidized to potassium sulphate
Potassii Sulphocyanas, KCNS Potassium Sulphocyanate	Colorless prisms that are deliquescent and very soluble in water, producing a decided reduction of temperature. It is used as a reagent for detecting ferric salts of iron and in volumetric solutions in quantitative analysis
Potassii Tartras $K_2C_4H_4O_6+\frac{1}{2}H_2O$ Potassium Tartrate	White, crystalline powder, easily soluble in water and in alcohol (difference from potassium acid tartrate). This salt is of no special importance

CHAPTER XLVII

THE SODIUM SALTS

Na; 23.00

Sodium is from the word "soda" which is applied to the crude sodium carbonate obtained from ashes and used for making glass. The sodium salts are generally more frequently used than those having potassium for their base, because they are relatively cheaper, and are often more soluble. The metal *Sodium* is a soft, malleable, ductile solid, which must be protected from the oxygen of the air by being constantly immersed in petroleum or naphtha. The student sometimes confuses this fact with the preserving of phosphorus, which is under water. If sodium is added to water an explosive reaction occurs, during its hydration, which might cause serious burns or injury to the eyes. It should always be handled with great caution. It is now largely and cheaply made by electrolysis.

Test for Sodium

Sodium—Sodium compounds impart an intense yellow color to a non-luminous flame.

SODII HYDROXIDUM. U.S. Sodium Hydroxide

[**Sod. Hydrox.**—Caustic Soda, Sodium Hydrate]

It contains not less than 90 per cent of NaOH (40.01). Preserve it in well-closed containers. If bottles are used as containers, they must be made of hard glass.

Sodium Hydroxide contains not less than 90 per cent of NaOH.

Caution—Great care is necessary in handling it, as it rapidly destroys organic tissues.

Preparation—Owing to the improvements in the manufacture of metallic sodium and the cheapening of the product, sodium hydroxide can be found in commerce which has been made by oxidizing the metal by bringing it in contact with water and evaporating the pure solution of sodium hydroxide.

$$\underset{\text{sodium}}{Na_2} + \underset{\text{water}}{2H_2O} = \underset{\text{sodium hydroxide}}{2NaOH} + \underset{\text{hydrogen}}{H_2}$$

It is also prepared by boiling an aqueous solution of sodium carbonate and milk of lime until the clear liquid no longer effervesces with acids, decanting, then evaporating the clear liquid, in iron dishes, to a specific gravity of 1.170, concentrating in a silver dish, and finally pouring the solution into silver molds. When the pure hydroxide is not needed, the white caustic sodium hydroxide, in sticks, made by evaporating a solution of sodium hydroxide (see Liquor Sodii Hydroxidi) and casting the fused residue into molds, is used. (See Potassii Hydroxidum, page 599.)

The reaction is expressed as follows:

$$\underset{\substack{\text{sodium}\\\text{carbonate}}}{Na_2CO_3} + \underset{\substack{\text{calcium}\\\text{hydroxide}}}{Ca(OH)_2} = \underset{\substack{\text{sodium}\\\text{hydroxide}}}{2NaOH} + \underset{\substack{\text{calcium}\\\text{carbonate}}}{CaCO_3}$$

It is now largely made by the electrolysis of a solution of sodium chloride in the presence of a porous diaphragm as explained under *Potassii Hydroxidum*, page 599, or in such a way as to prevent a secondary reaction between the chlorine and the sodium hydroxide.

Description and Physical Properties—Dry, white, or nearly white, fused masses, or sticks, hard and brittle, showing a crystalline fracture. Exposed to the air, it deliquesces, absorbs carbon dioxide, and becomes covered with a coating of carbonate.

One Gm. of Sodium Hydroxide is soluble in 0.9 cc. of water at 25° C. One Gm. is soluble in about 0.3 cc. of boiling water. It is very soluble in alcohol.

Tests for Identity—A solution of Sodium Hydroxide even when greatly diluted is strongly alkaline to litmus paper.

An aqueous solution of Sodium Hydroxide (1 in 25) responds to the reactions for sodium, page 617.

Tests for Purity—An aqueous solution of Sodium Hydroxide (1 in 20) is clear and colorless (*organic matter or insoluble impurities*), and, after being acidulated with acetic acid, it yields no precipitate on the addition of an excess of tartaric acid T.S., or upon the addition of a few drops of sodium cobaltic nitrate T.S. (*potassium*).

An aqueous solution of Sodium Hydroxide (1 in 50), slightly acidulated with hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

Assay—Place about 10 Gm. of Sodium Hydroxide in a glass-stoppered weighing bottle, and weigh accurately. Transfer it to a 500 cc. graduated flask, dissolve it in 250 cc. of recently boiled distilled water, and add 30 cc. of barium chloride T.S. Fill the flask to the mark with recently boiled distilled water, and thoroughly agitate the liquid. Filter it through a filter, which has not been previously moistened into a dry flask, rejecting the first 20 cc., and titrate 100 cc. of the subsequent clear filtrate with normal hydrochloric acid, using phenolphthalein T.S. as indicator. Each cc. of normal hydrochloric acid corresponds to 0.04001 Gm. of NaOH.

This assay is explained on page 1459.

Preserve in well-closed containers. If bottles are used as containers, they must be made of hard glass, and cork stoppers, if used, should be paraffined.

U. S. P. Preparations—Liquor Cresolis Compositus; Liquor Sodii Hydroxidi; Magma Magnesiæ.

N. F. Preparations—Soda cum Calce; Ferri Oxidum Saccharatum.

History—This was originally called *mineral alkali* as contrasted with potassium hydroxide which was called *vegetable alkali* and ammonium hydroxide which was called *animal alkali*. The origin of these alkalies dates from a very early period, and the alkali carbonates and hydroxides are mentioned by Dioscorides. The word *lixivium* was a Roman term applied to the lye made from wood ashes. The term alkali is of Arabic origin and was first used in the thirteenth century.

Uses—A distinct effort is being made in this country to replace potassium hydroxide and potassium salts, wherever practicable, with the corresponding sodium salt. This is because of the cheap production of sodium in this country, and the necessity of importing practically all of the potassium. For the majority of uses they are interchangeable. *Caustic soda*, as sodium hydroxide is termed commercially, is sometimes preferred to the analogous potassium salt, in the belief that it is milder and less deliquescent. It is usually less expensive than the potassium salt and is used in smaller amounts because of its smaller molecular weight, 40.01 parts of sodium hydroxide being equivalent in reaction to 56.11 parts of potassium hydroxide. It is occasionally used as a caustic but is less popular than the caustic potash.

Antidotes—(See Part XV, on Antidotes).

LIQUOR SODII HYDROXIDI. U. S. Solution of Sodium Hydroxide

[**Liq. Sod. Hydrox.**—Liquor Sodæ, Solution of Soda]

Solution of Sodium Hydroxide contains, in each 100 cc., not less than 4.5 Gm. and not more than 5.5 Gm. of NaOH (40.01).

	Metric	Alternative
Dekanormal Solution of Sodium Hydroxide	**125 cc.**	**4 fl. oz.**
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the dekanormal solution (page 1561) with sufficient distilled water to make 1000 cc. [2 pints].

NOTE—The 125 cc. of dekanormal solution of sodium hydroxide may be replaced by 56 Gm. of sodium hydroxide, containing 90 per cent of NaOH (1 oz. av. 380 gr.).

The sodium hydroxide used in this process should be of the full strength and quality directed by the Pharmacopœia (90 per cent). Sodium hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity is taken, the proper amount for the above formula being ascertained by dividing 5040 by the percentage of absolute sodium hydroxide contained therein.

Description and Physical Properties—A clear, colorless, odorless liquid, strongly alkaline and caustic. It readily absorbs carbon dioxide from the air.

Specific gravity: about 1.056 at 25° C.

It meets the requirements of the tests for identity and purity for an aqueous solution of sodium hydroxide under *Sodii Hydroxidum*, when suitably concentrated.

Measure exactly 20 cc. of Solution of Sodium Hydroxide into a suitable flask and titrate directly with normal hydrochloric acid, using methyl orange T.S. as indicator: it shows, in each 100 cc., not more than 5.5 Gm. of alkali, calculated as NaOH (*carbonate*).

Assay—Measure exactly 50 cc. of Solution of Sodium Hydroxide into a 250 cc. measuring flask, add 20 cc. of barium chloride T.S. and fill the flask to the mark with recently boiled distilled water. Thoroughly agitate the liquid, filter it through a filter not previously moistened, reject the first 20 cc. and titrate 100 cc. of the filtrate, representing 20 cc. of the Solution, with normal hydrochloric acid, using phenolphthalein T.S. as indicator. Each cc. of normal hydrochloric acid corresponds to 0.04001 Gm. of NaOH.

This assay is explained on page 1459.

Preserve in bottles made of hard glass and provided with rubber stoppers or with glass stoppers coated with petrolatum.

U. S. P. Preparation—Oleum Terebinthinæ Rectificatum.

Uses—Solution of sodium hydroxide is of no medicinal value although it is occasionally prescribed as a gastric antacid, in the dose of fifteen minims (1 cc.). See also solution of potassium hydroxide (page 600).

SODII ACETAS. U. S. Sodium Acetate
[Sod. Acet.]

Sodium Acetate contains not less than 59.97 per cent and not more than 62.96 per cent of $NaC_2H_3O_2$ (82.03), corresponding to not less than 99.5 per cent of the crystallized salt [$NaC_2H_3O_2.3H_2O$] (36.08).

Preparation—This salt is obtained on the large scale in the process for making acetic acid, when the crude pyroligneous acid is neutralized with sodium carbonate. For medicinal purposes it may be made conveniently by saturating acetic acid with sodium carbonate, filtering the solution, concentrating it, and obtaining the salt in crystals.

$$\underset{\text{acetic acid}}{2HC_2H_3O_2} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{sodium acetate}}{2NaC_2H_3O_2} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

It is sometimes granulated, and in this form it is more convenient for dispensing purposes than the usual large crystals.

Description and Physical Properties—Colorless, transparent, monoclinic prisms, or a granular crystalline powder. It is odorless, or has a faint, acetous odor. It is efflorescent in warm, dry air.

One Gm. of Sodium Acetate is soluble in 0.8 cc. of water and in 19 cc. of alcohol, at 25° C.

Tests for Identity—Heated to about 58° C., the salt begins to liquefy. At about 120° C. it becomes anhydrous; at a higher temperature it is decomposed, with the evolution of inflammable empyreumatic vapors, leaving a residue of sodium carbonate and carbon.

An aqueous solution of the salt responds to the reactions for sodium, page 617, and for acetates, page 800.

Tests for Purity—Dissolve 2 Gm. of Sodium Acetate in 20 cc. of distilled water, and add 2 drops of phenolphthalein T.S.: the pink color produced, if any, is discharged by the addition of 0.1 cc. of tenth-normal sulphuric acid (*alkalinity*).

A saturated aqueous solution of Sodium Acetate is not rendered turbid by the addition of sodium bitartrate T.S. (*potassium*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Proceed as directed under the assay for alkali salts of organic acids, page 1514. Each cc. of half-normal sulphuric acid corresponds to 0.04102 Gm. of $NaC_2H_3O_2$.

This assay is explained on page 1456.

Preserve in well-closed containers.

Uses—Sodium acetate is used as a diuretic. It is not deliquescent like potassium acetate. The dose is from fifteen to sixty grains (1 to 4 Gm.).

SODII BENZOAS. U. S. Sodium Benzoate
[Sod. Benz.]

Sodium Benzoate, when dried to constant weight at 110° C., contains not less than 99 per cent of $NaC_7H_5O_2$ (144.08).

Preparation—Benzoic acid is added to a hot concentrated solution of pure sodium carbonate until effervescence ceases. The solution is evaporated, cooled, and allowed to crystallize, or preferably, evaporated to dryness and granulated.

$$\underset{\text{benzoic acid}}{2HC_7H_5O_2} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{sodium benzoate}}{2NaC_7H_5O_2} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

The yield of granulated salt is about one and one-third times the quantity of benzoic acid used.

Description and Physical Properties—A white, odorless, amorphous granular or crystalline powder. It is stable in the air.

One Gm. of Sodium Benzoate is soluble in 1.8 cc. of water and in 61 cc. of alcohol, at 25° C. One Gm. is soluble in 1.4 cc. of boiling water.

Tests for Identity—When heated, Sodium Benzoate fuses, emitting vapors having the odor of benzoic acid, then chars, and finally leaves a residue of sodium carbonate and carbon.

It responds to the reactions for sodium, page 617, and for benzoates, page 832.

Tests for Purity—Diluted sulphuric acid added to 5 cc. of an aqueous solution of Sodium Benzoate (1 in 10) produces a voluminous white precipitate of benzoic acid.

Dissolve about 1 Gm. of Sodium Benzoate in 10 cc. of distilled water in a separatory funnel, add 10 cc. of diluted sulphuric acid, and shake out the benzoic acid with two successive 20 cc. portions of ether. Evaporate the ether solution and test for chlorinated compounds as directed under *Acidum Benzoicum*.

Dissolve 2 Gm. of Sodium Benzoate in 20 cc. of hot distilled water, and add 2 drops of phenolphthalein T.S.: the pink color produced, if any, is discharged by the addition of 0.2 cc. of tenth-normal sulphuric acid (*alkalinity*).

Acidulate 10 cc. of an aqueous solution of the salt (1 in 50) with hydrochloric acid and filter: the filtrate does not respond to the test for *heavy metals*, page 1519.

Assay—Dry Sodium Benzoate to constant weight at 110° C. and proceed as directed under the assay for alkali benzoates and salicylates, page 1514. Each cc. of half-normal sulphuric acid corresponds to 0.07204 Gm. of $NaC_7H_5O_2$.

This assay is explained on page 1457.

Preserve in well-closed containers.

U. S. P. Preparation—Mucilago Acaciæ.

Uses—Sodium benzoate has been prescribed as a remedy in rheumatism. It is also used as a urinary antiseptic in cystitis, in fifteen-grain (1 Gm.) doses. It is extensively used as a food preservative as it is the only legally authorized preservative for many classes of food products.

SODII BICARBONAS. U. S. Sodium Bicarbonate
[Sod. Bicarb.]

Sodium Bicarbonate, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of $NaHCO_3$ (84.01).

Preparation—All the processes for making this important salt of sodium, with one exception, consist in the addition of carbon dioxide to sodium carbonate.

$$\underset{\text{sodium carbonate}}{Na_2CO_3} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O} = \underset{\text{sodium bicarbonate}}{2NaHCO_3}$$

Crystallized sodium carbonate contains ten molecules of water of crystallization; sodium bicarbonate contains none, hence provision must be made for the escape of this water, which is thrown out of combination during the process of carbonating. The crystallized sodium carbonate is placed upon perforated diaphragms in chambers arranged so that the water can escape as it is liberated.

Sodium bicarbonate is more largely prepared by the ammonia-soda process, or *Solvay's*, as it is usually called. In this, carbon dioxide is passed into a solution of common salt in ammonia water, double decomposition ensues, sodium bicarbonate is precipitated, and ammonium chloride, being very soluble, remains in solution.

$$\underset{\text{sodium chloride}}{NaCl} + \underset{\text{ammonia}}{NH_3} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O} = \underset{\text{sodium bicarbonate}}{NaHCO_3} + \underset{\text{ammonium chloride}}{NH_4Cl}$$

Formerly commercial sodium bicarbonate contained small quantities of impurities having a disagreeable alkaline taste, such as sodium carbonate, chloride, and sulphate, and ammonium salts. These are much more soluble than the bicarbonate, and are easily washed out with distilled water without serious loss of the bicarbonate. At one time it was customary for the pharmacists to purify the commercial bicarbonate, but at present, because of the enormous use of this salt in baking powder and the necessity for its being of a high degree of purity for that purpose, there is no difficulty in obtaining sodium bicarbonate of U. S. P. standard at a low cost.

Tests for Carbonates and Bicarbonates

Carbonates or bicarbonates effervesce with acids, yielding a colorless gas, which when passed into calcium hydroxide T.S. produces a white precipitate. Carbonates in solution produce a reddish-brown precipitate with mercuric chloride T.S., while bicarbonates produce a white precipitate with the same reagent. A cold aqueous solution of a carbonate is reddened by phenolphthalein T.S., while a similar solution of a bicarbonate remains unchanged or is only slightly reddened.

Description and Physical Properties—A white, opaque, odorless powder. It is stable in dry air, but slowly decomposes in moist air.

One Gm. of Sodium Bicarbonate is soluble in 10 cc. of water at 25° C. It is insoluble in alcohol.

Tests for Identity—An aqueous solution of Sodium Bicarbonate (1 in 20), when freshly prepared with cold distilled water, without shaking, is slightly alkaline to litmus paper. The alkalinity increases upon standing, agitation, or increase in temperature.

When heated above 15° C., an aqueous solution of the salt gradually loses carbon dioxide and at boiling temperature the salt is almost completely converted into normal sodium carbonate.

When heated, the salt is decomposed into sodium carbonate, water, and carbon dioxide, and at 100° C. loses about 36.5 per cent of its original weight.

An aqueous solution of the salt responds to the reactions for sodium, page 617, and for bicarbonates, see above.

Tests for Purity—Dissolve 1 Gm. of Sodium Bicarbonate in 20 cc. of distilled water at 25° C: it yields a clear, colorless solution, leaving no residue.

Heat Sodium Bicarbonate in a test tube: no odor of ammonia is evolved and moist red litmus paper is not colored blue.

Dissolve 1 Gm. of the salt without agitation in 20 cc. of distilled water at a temperature not exceeding 15° C., and add 0.2 cc. of normal hydrochloric acid and two drops of phenolphthalein T. S.: a red tint does not appear immediately (*carbonate*).

An aqueous solution of the salt (1 in 50), mixed with a slight excess of hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dry about 3 Gm. of Sodium Bicarbonate over sulphuric acid to constant weight, weigh accurately, mix it with 25 cc. of distilled water, and titrate with normal sulphuric acid, methyl orange T.S. being used as indicator. Each cc. of normal sulphuric acid corresponds to 0.08401 Gm. of $NaHCO_3$.

This assay is explained on page 1455.

Preserve in well-closed containers, in a cool place.

U. S. P. Preparations—Ferri Carbonas Saccharatus; Potassii Citras Effervescens; Pulvis Effervescens Compositus; Sodii Phosphas Effervescens.

N. F. Preparations—Elixir Catariæ et Fœniculi; Elixir Hydrastis Compositus; Glyceritum Bismuthi; Liquor Pancreatini; Liquor Sodæ et Menthæ; Liquor Sodii Boratis Compositus; Liquor Sodii Citratis; Mistura Rhei Composita; Pulvis Acetanilidi Compositus; Pulvis Pancreatini Compositus; Sal Carolinum Factitium; Sal Carolinum Factitium Effervescens; Sal Kissingense Factitium; Sal Kissingense Factitium Effervescens; Sal Lithii

Citras Effervescens; Sal Magnesii Sulphatis Effervescens; Sal Potassii Bromidi Effervescens; Sal Potassii Bromidi Effervescens Compositus; Sal Vichyanum Factitium; Sal Vichyanum Factitium Effervescens; Tabellæ Sodii Bicarbonatis.

Uses—Sodium bicarbonate is largely used as a safe gastric antacid and is extensively prescribed in many forms of nausea and digestive disorders. It is also used by hypodermic injection in the so-called "acidosis", a state of diminished alkali in the system. It is given in doses of ten to fifteen grains (0.65 to 1 Gm.). It is preferably administered in carbonic acid water, and the draught is popularly known as "extra soda". The misnomer is caused by the erroneous use of the term "soda water". Sodium bicarbonate is also widely used in fire extinguishers and in the manufacture of effervescent salts.

SODII BORAS. U. S. Sodium Borate

[**Sod. Bor.**—Borax, Sodium Tetraborate, Sodium Pyroborate]

Sodium Borate contains not less than 52.32 per cent and not more than 54.92 per cent of $Na_2B_4O_7$ (201.6), corresponding to not less than 99 per cent of the crystallized salt [$Na_2B_4O_7.10H_2O = 381.76$].

Preparation—This salt is found in immense quantities in California as a crystalline deposit at Clear Lake and near Death Valley. It is probable that this will continue to be the principal source of borax for many years to come. The process of purification consists simply of selecting the large and perfect crystals, washing them, and lixiviating the earth, which is strongly impregnated with borax, evaporating the solution, and crystallizing. It is sometimes called *biborate of sodium*. Calcium borate, or "cotton balls", also occurs in the borax deposits of California, and sodium borate is obtained by double decomposition by treating the solution of calcium borate with sodium carbonate. Borax is found native in Thibet, Persia, and other localities. It is sometimes called *tincal*. Crude boric acid, obtained from Tuscany, is fused with dried sodium carbonate, and a hot solution of the residue is crystallized in order to produce borax.

Description and Physical Properties—Colorless, odorless, transparent, monoclinic prisms, or a white powder. It is efflorescent in warm, dry air.

One Gm. of Sodium Borate is soluble in 15 cc. of water and in about 1 cc. of glycerin, at 25° C. One Gm. is soluble in 0.6 cc. of boiling water. It is insoluble in alcohol.

When heated, the salt at first loses part of its water of crystallization, then melts, and, when further heated, swells and forms a white, porous mass. At red heat, Sodium Borate loses all of its water of crystallization and fuses to a colorless, glassy mass or bead.

Tests for Identity—An aqueous solution of Sodium Borate (1 in 20) is alkaline to litmus paper.

An aqueous solution of the salt (1 in 20) responds to the reactions for sodium, page 617, and for borates, page 590.

Tests for Purity—An aqueous solution of Sodium Borate (1 in 20) does not effervesce with acids (*carbonate or bicarbonate*).

An aqueous solution of the salt (1 in 20) meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Dissolve about 5 Gm. of Sodium Borate, accurately weighed, in 100 cc. of distilled water, and titrate the solution with normal hydrochloric acid, methyl orange T.S. being used as indicator. Each cc. of normal hydrochloric acid corresponds to 0.1008 Gm. of $Na_2B_4O_7$.

This assay is explained on page 1459.

Preserve in well-closed containers.

U. S. P. Preparation—Unguentum Aquæ Rosæ.

N. F. Preparations—Liquor Aromaticus Alkalinus; Liquor Sodii Boratis Compositus; Mel Rosæ et Sodii Boratis; Mel Sodii Boratis.

Uses—Borax, as it is almost universally called, is antacid and antiseptic. It enters into many mouth washes, and is frequently applied in the form of powder to ulcers in the mouth, for which purpose it is admirably adapted,

being mildly alkaline and not very soluble. It is used enormously in the household as an ingredient in soaps, cleansers, etc. Pharmaceutically, it is frequently used in small quantity in ointments, particularly the ointment of rose water. It forms a borax soap which serves as an emulsifying agent in the preparation of the ointment. The dose is eight to twelve grains (0.5 to 0.77 Gm.).

SODII BROMIDUM. U. S. Sodium Bromide
[Sod. Brom.]

Sodium Bromide, when dried to constant weight at 100° C., contains not less than 98.5 per cent of NaBr (102.92).

Preparation—The process most used in making this salt consists in decomposing ferroso-ferric bromide by treating it with sodium carbonate. The ferroso-ferric bromide is made by acting on iron wire with bromine in the presence of water, and, after filtering the solution, adding solution of sodium carbonate. The reaction may be thus expressed:

$$\underset{\text{ferroso-ferric bromide}}{Fe_3Br_8} + \underset{\text{sodium carbonate}}{4Na_2CO_3} = \underset{\text{sodium bromide}}{8NaBr} + \underset{\text{ferroso-ferric oxide}}{Fe_3O_4} + \underset{\text{carbon dioxide}}{4CO_2}$$

Sodium bromide may also be made by a method similar to that outlined under potassium bromide (see page 602) in which bromine and sodium hydroxide are combined to form sodium bromide and bromate, the latter being afterward converted into bromide by fusion with charcoal or by first producing ammonium bromide by treating a solution of ammonia with bromine (see *Ammonii Bromidum*), and then by double decomposition with sodium carbonate, forming sodium bromide and ammonium carbonate. The solution, by careful evaporation and granulation, may be made to yield sodium bromide, while ammonium carbonate, being composed of volatile compounds, is dissipated by the amount of heat used to granulate the sodium salt.

Description and Physical Properties—Colorless, or white, odorless, cubical crystals, or a white, granular powder. The salt absorbs moisture from the air without deliquescing.

One Gm. of Sodium Bromide is soluble in 1.1 cc. of water and in 16 cc. of alcohol, at 25° C.

Tests for Identity—When heated to about 760° C., the salt fuses without decomposition and at a somewhat higher temperature it volatilizes.

An aqueous solution of the salt (1 in 10) responds to the reactions for sodium, page 617, and for bromides, page 574.

Tests for Purity—Dissolve 1 Gm. of Sodium Bromide in 10 cc. of distilled water, and add 0.1 cc. of tenth-normal sulphuric acid: no color is produced upon the subsequent addition of a drop of phenolphthalein T.S. even after boiling (*alkali*).

Add a few drops of ferric chloride T.S. and 1 cc. of chloroform to 10 cc. of an aqueous solution of the salt (1 in 20) and shake the mixture: the chloroform does not acquire a violet tint (*iodide*).

Drop 1 cc. of diluted sulphuric acid on about 1 Gm. of the powdered salt: no yellow color appears at once (*bromate*).

A 10 cc. portion of an aqueous solution of the salt (1 in 20) when acidulated with hydrochloric acid, is not rendered turbid by the addition of 1 cc. of potassium sulphate T.S. (*barium*).

A 2 Gm. portion of Sodium Bromide shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1567.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Assay—Proceed as directed under the assay for bromides, page 574, using about 0.4 Gm. of Sodium Bromide, dried to constant weight at 100° C., and accurately weighed. Each cc. of tenth-normal silver nitrate corresponds to 0.01029 Gm. of NaBr. Each Gm. of Sodium Bromide, previously dried, corresponds to not less than 95.7 cc. and not more than 98.3 cc. of tenth-normal silver nitrate.

This assay is explained on page 1462.

Preserve in well-closed containers.

See estimation of bromides under assay methods, page 1515.

N. F. Preparations—Elixir Bromidorum Quinque; Elixir Euphorbiæ Compositus; Elixir Sodii Bromidorum.

Uses—Sodium bromide is used for the same purposes as potassium bromide. The dose is fifteen to sixty grains (1 to 4 Gm.).

SODII CACODYLAS. U. S. Sodium Cacodylate

[Sod. Cacodyl.]

Sodium Cacodylate contains not less than 72 per cent and not more than 75 per cent of $Na(CH_3)_2AsO_2$ (160.02) with variable amounts of H_2O.

Preparation—Prepared by neutralizing cacodylic acid (dimethylarsenic acid) with sodium hydroxide or with sodium carbonate, concentrating the solution, and crystallizing. The acid is prepared by distilling arsenic trioxide with potassium acetate and oxidizing the distillate with mercuric oxide.

Description and Physical Properties—White prisms, or a white, granular powder. It is odorless, and deliquescent.

One Gm. of Sodium Cacodylate is soluble in about 0.5 cc. of water and in about 2.5 cc. of alcohol, at 25° C.

Tests for Identity—An aqueous solution of Sodium Cacodylate (1 in 20) is alkaline to litmus paper.

Sodium Cacodylate melts in its water of crystallization at about 60° C. and becomes anhydrous at 120° C. It burns with a bluish flame, emitting a garlic-like odor, and to a non-luminous flame it imparts an intensely yellow color.

A mixture of a few drops of an aqueous solution of the salt (1 in 100) with 2 cc. of hypophosphorous acid T.S. allowed to stand in a stoppered tube, develops the odor of cacodyl within one hour.

Tests for Purity—A solution of 2 Gm. of Sodium Cacodylate in 50 cc. of distilled water requires not more than 0.5 cc. of tenth-normal acid or 1 cc. of tenth-normal alkali to render it neutral, using 2 drops of phenolphthalein T.S. as indicator.

No turbidity is produced in 10 cc. of an aqueous solution of the salt (1 in 20) by 1 cc. of calcium chloride T.S. either in the cold or on heating (*monomethylarsenate*), or in 5 cc. of the solution by 2 cc. of magnesia mixture T.S. within one hour (*arsenate or phosphate*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

One Gm. of Sodium Cacodylate shows no more *chloride* than corresponds to 0.3 cc. of fiftieth-normal hydrochloric acid.

The addition of 5 drops of barium chloride T.S. to 10 cc. of an aqueous solution of the salt (1 in 50), acidulated with 2 drops of hydrochloric acid, produces no turbidity within one-half minute (*sulphate*).

Assay—Dissolve about 2.5 Gm. of Sodium Cacodylate, accurately weighed, in 30 cc. of distilled water, render the solution neutral to phenolphthalein T.S. if necessary, and then titrate with normal hydrochloric acid, using methyl orange T.S. as indicator. Each cc. of normal hydrochloric acid corresponds to 0.16002 Gm. of $Na(CH_3)_2AsO_2$.

This assay is explained on page 1459.

Preserve in well-closed containers.

N. F. Preparation—Ampullæ Sodii Cacodylatis.

Uses—Its action is similar to other arsenic compounds but claimed to be less likely to produce poisoning because of its slow absorption in the body. Used in anemia and also in syphilis; usually administered hypodermically, in doses of one to three grains (0.065 to 0.2 Gm.).

SODII CARBONAS MONOHYDRATUS. U. S. Monohydrated Sodium Carbonate

[Sod. Carb. Monohyd.]

Monohydrated Sodium Carbonate, when rendered anhydrous by gentle ignition, contains not less than 99.5 per cent of Na_2CO_3 (124.02).

Preparation—Impure sodium carbonate, or soda-ash, is consumed in enormous quantities in the arts, and cheap methods of production have been long sought for. The process elaborated by Leblanc, a French apothecary, in 1784, has been most largely used, and it possesses an historic interest because of the public endorsements which it received from the French Government in 1794. It is remarkable that this process has been successfully worked, without material modifications, for a century, and has supplied the world with cheap soap and cheap glass. Notwithstanding this great service, Leblanc died a pauper in a French asylum, due to his process having been seized by the Government during the Reign of Terror, without return or credit to the inventor. Although the process is being superseded by other methods, it is

worthy of study, and is as follows: Sodium carbonate is made from common salt by two steps, first, by converting the salt by sulphuric acid into sodium sulphate, and, secondly, by decomposing the sulphate by calcium carbonate (lime stone) and charcoal (coal) at a high temperature, so as to yield sodium carbonate. The chemical reactions are as follows:

$$\underset{\text{sodium chloride}}{2NaCl} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{sodium sulphate}}{NaSO_4} + \underset{\text{hydrochloric acid}}{2HCl}$$

$$\underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{carbon}}{C_4} = \underset{\text{sodium carbonate}}{Na_2CO_3} + \underset{\text{calcium sulphide}}{CaS} + \underset{\text{carbon monoxide}}{4CO}$$

The Solvay process for making sodium bicarbonate is given on page 621; the bicarbonate is easily converted into carbonate by heating, and the carbon dioxide is utilized in another part of the process.

$$\underset{\text{sodium bicarbonate}}{2NaHCO_3} = \underset{\text{sodium carbonate}}{Na_2CO_3} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

The cryolite process was formerly used largely in the United States. Cryolite, Al_2F_6+6NaF, consists mainly of a double fluoride of aluminum and sodium, containing, in 100 parts, 13 of aluminum, 34 of sodium, and 53 of fluorine. Sodium carbonate is obtained by heating cryolite with chalk, whereby calcium fluoride is formed, while the sodium and aluminum combine to form sodium aluminate, a weak salt, which is dissolved out by lixiviation. The soda is converted into carbonate by passing carbon dioxide under pressure through the solution; and the alumina, separated from the soda, becomes insoluble, and is deposited.

$$\underset{\text{cryolite}}{(Al_2F_6 + 6NaF)} + \underset{\text{calcium carbonate}}{6CaCO_3} = \underset{\text{sodium aluminate}}{Al_2O_3.3Na_2O} + \underset{\text{calcium fluoride}}{6CaF_2} + \underset{\text{carbon dioxide}}{6CO_2}$$

The second step in the reaction is as follows:

$$\underset{\text{sodium aluminate}}{Al_2O_3.3Na_2O} + \underset{\text{carbon dioxide}}{3CO_2} = \underset{\text{sodium carbonate}}{3Na_2CO_3} + \underset{\text{aluminum oxide}}{Al_2O_3}$$

Monohydrated sodium carbonate was first introduced into the U. S. P. VIII, because it is permanent in both moist and dry atmospheres and is also free from the large amount of water of crystallization found in *sal soda* or ordinary sodium carbonate (63 per cent), which is the cause of the rapid efflorescence in this latter compound in a dry atmosphere. This fact makes the crystal salt inconvenient to use in manufacturing since its strength is indefinite and it must be previously dried and the amount of anhydrous sodium carbonate determined before knowing the amount to use.

The monohydrated form is made by crystallizing a concentrated solution of sodium carbonate at a temperature above 35° C. (95° F.), and stirring the liquid so as to produce small crystals. It contains about 15 per cent of water of crystallization and replaces not only the deka-hydrate (sal soda) but also the exsiccated sodium carbonate of earlier pharmacopœias, which always varied in its water content, being very hygroscopic.

Sodium carbonate is also prepared by the electrolysis of sodium chloride, whereby sodium and chlorine are produced, the former reacting with water to produce sodium hydroxide and this solution treated with carbon dioxide to produce sodium carbonate.

Description and Physical Properties—A white, odorless, crystalline, granular powder. When exposed to the air under ordinary conditions it absorbs only a slight percentage of moisture. When exposed to warm, dry air at or above 50° C., the salt effloresces, and at 100° C. becomes anhydrous.

One Gm. of Monohydrated Sodium Carbonate is soluble in 3 cc. of water, and in 7 cc. of glycerin, at 25° C. One Gm. is soluble in 1.8 cc. of boiling water. It is insoluble in alcohol.

Tests for Identity—An aqueous solution of Monohydrated Sodium Carbonate (1 in 10) is strongly alkaline to litmus paper and to phenolphthalein T.S. and responds to the reactions for sodium (page 617), and for carbonates (page 589).

Tests for Purity—An aqueous solution of Monohydrated Sodium Carbonate (1 in 50), mixed with a slight excess of hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

Weigh accurately about 2 Gm. of Monohydrated Sodium Carbonate and heat it in a crucible at 110° C. to constant weight: the loss is not less than 10 per cent and not more than 15 per cent (*water*).

Assay—Transfer the anhydrous sodium carbonate obtained in the foregoing test to a flask with the aid of 50 cc. of distilled water and titrate with normal sulphuric acid, methyl orange T.S. being used as indicator. Each cc. of normal sulphuric acid corresponds to 0.05301 Gm. of Na_2CO_3.

This assay is explained on page 1455.

Preserve in well-closed containers.

U. S. P. Preparations—Liquor Sodæ Chlorinatæ; Massa Ferri Carbonatis; Suppositoria Glycerini.

N. F. Preparations—Ferri Oxidum Saccharatum; Linimentum Saponato-Camphoratum; Sal Carolinum Factitium.

Uses—Monohydrated sodium carbonate is one of the most useful of the alkaline salts; it is the source of most of the sodium salts made by the pharmacist. It is rarely given internally. The dose is from two to ten grains (0.13 to 0.65 Gm.).

SODII CHLORIDUM. U. S. Sodium Chloride
[Sod. Chlorid.]

Sodium Chloride, when dried to constant weight at 110° C., contains not less than 99 per cent of NaCl (58.46).

Preparation—Common salt is universally distributed over the world, and may be mined, as rock salt, by evaporating the purified solution of saline deposits, or by evaporating sea water, and afterwards purifying. If perfectly free from contaminating salts, it is not hygroscopic.

Description and Physical Properties—Colorless, odorless, transparent, cubical crystals, or a white, crystalline powder. It is usually slightly hygroscopic.

One Gm. of Sodium Chloride is soluble in 2.8 cc. of water, and in 10 cc. of glycerin, at 25° C. One Gm. is soluble in 2.7 cc. of boiling water. It is slightly soluble in alcohol.

Tests for Identity—When heated somewhat above 100° C., the salt decrepitates. At higher temperatures it fuses, and is slowly volatilized and partly decomposed.

An aqueous solution of the salt (1 in 20) responds to the reactions for sodium, page 617, and for chlorides, page 567.

Tests for Purity—An aqueous solution of Sodium Chloride (1 in 10) is neutral to litmus paper.

An aqueous solution of Sodium Chloride meets the requirements of the test for *heavy metals*, page 1519.

Separate portions of 10 cc. each of an aqueous solution of Sodium Chloride (1 in 100) after the addition of 1 cc. of ammonia T.S. shows no immediate turbidity upon the addition of ammonium oxalate T.S. (*calcium*), or of sodium phosphate T.S. (*magnesium*).

Digest 2 Gm. of the finely powdered salt for three hours with 25 cc. of warm alcohol, cool the mixture and remove the undissolved salt by filtration. Evaporate the filtrate to dryness, dissolve the residue in 5 cc. of distilled water, add 1 cc. of chloroform, and cautiously introduce, drop by drop, with constant agitation, chlorine T.S. which has been diluted with twice its volume of distilled water: the chloroform does not acquire a violet, yellow, or orange color (*iodide or bromide*).

Assay—Proceed as directed under the assay for chlorides, page 1514, using about 0.25 Gm. of Sodium Chloride, dried to constant weight at 110° C. and accurately weighed. Each cc. of tenth-normal silver nitrate corresponds to 0.005846 Gm. of NaCl.

This assay is explained on page 1463.

Preserve in well-closed containers.

U. S. P. Preparation—Liquor Sodii Chloridi Physiologicus.

N. F. Preparations—Liquor Pancreatini; Liquor Procainæ Hydrochloridi; Lotio Ammoniacalis Camphorata; Sal Carolinum Factitium; Sal Kissingense Factitium; Sal Vichyanum Factitium.

Uses—Sodium chloride is largely used as a condiment. Most commercial varieties of table salt are unfit for use in pharmacy as they contain foreign substances added to diminish their hygroscopic quantity. It undoubtedly serves a useful purpose in the animal economy, as many animals possess an instinctive craving for it. Salt baths are tonic, and valuable aids in many diseases. It is largely used in surgery in what is commonly called "normal salt solution" (see below). Common salt is used as a styptic in hemorrhage and as an antiseptic.

Average dose—4 drachms (16 Gm.).

LIQUOR SODII CHLORIDI PHYSIOLOGICUS. U. S. Physiological Solution of Sodium Chloride

The formula for this solution, commonly known as *Normal Salt Solution*, is given in the chapter on Sterilization, where it is also discussed.

SODII CITRAS. U. S. Sodium Citrate [Sod. Cit.]

Sodium Citrate contains not less than 98 per cent of $Na_3C_6H_5O_7.2H_2O$ (294.10).

Preparation—This salt is usually prepared by adding sodium carbonate to a solution of citric acid until effervescence ceases, evaporating and granulating the product. It is also prepared by treating sodium sulphate solution with calcium citrate, filtering, concentrating, and crystallizing the product.

Description and Physical Properties—Small crystals, or a white, granular powder. It is odorless and has a cooling, saline taste.

One Gm. of Sodium Citrate is soluble in 1.3 cc. of water at 25° C. and in 0.6 cc. of boiling water. It is insoluble in alcohol.

Tests for Identity—When heated to about 150° C., the salt loses all of its water of crystallization; on ignition at a red heat, it carbonizes and emits inflammable gases which have a very pungent, acrid odor, and a residue remains which is alkaline to litmus paper and strongly effervesces with acids.

An aqueous solution of the salt (1 in 20) responds to the reactions for sodium, page 617, and for citrates, page 944.

Tests for Purity—An aqueous solution of Sodium Citrate (1 in 20) is slightly alkaline to litmus paper, but is not reddened by 1 drop of phenolphthalein T.S.

To a solution of 1 Gm. of Sodium Citrate in 2 cc. of distilled water, add 1 cc. of potassium acetate T.S. and 1 cc. of acetic acid: no crystalline precipitate forms (*tartrate*).

An aqueous solution of Sodium Citrate meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Proceed as directed under the assay for alkali salts of organic acids, page 1514. Each cc. of half-normal sulphuric acid corresponds to 0.04902 Gm. of $Na_3C_6H_5O_7.2H_2O$.

This assay is explained on page 1456.

Preserve in well-closed containers.

U. S. P. Preparations—Glyceritum Acidi Tannici; Glyceritum Phenolis.

N. F. Preparations—Elixir Gentianæ, Liquor Peptonati; Liquor Phosphatum Compositus; Syrupus Hypophosphitum Compositus; Tinctura Ferri Citro-Chloridi.

Uses—Sodium citrate is preferred to potassium citrate by some practitioners, and it is used in making compound syrup of hypophosphites and other preparations containing salts of iron and manganese, these being rendered more soluble in the presence of an alkaline citrate or tartrate. It is also an important ingredient in Tincture of Ferric Citro-Chloride, its presence in iron solutions lessening the tendency to darken when iron is added to tannins. This is illustrated in the Elixir of Gentian and Iron where its presence makes it unnecessary to use a detannated gentian. The dose is four to fifteen grains (0.25 to 1 Gm.).

SODII IODIDUM. U. S. Sodium Iodide
[Sod. Iod.]

Sodium Iodide, when dried to constant weight at 120° C., contains not less than 99 per cent of NaI (149.92). It contains not more than 7 per cent of water.

Preparation—This iodide may be prepared by double decomposition between solutions of ferroso-ferric iodide and sodium carbonate, or by treating a solution of sodium hydroxide with iodine, exactly as in the preparation of potassium iodide. The former process is preferable if working on a small scale.

$$\underset{\text{ferroso-ferric iodide}}{Fe_3I_8} + \underset{\text{sodium carbonate}}{4Na_2CO_3} = \underset{\text{sodium iodide}}{8NaI} + \underset{\text{ferroso-ferric oxide}}{Fe_3O_4} + \underset{\text{carbon dioxide}}{4CO_2}$$

By boiling the solution containing the ferrous carbonate, the latter is rendered less bulky, and it can be easily separated by filtration.

Description and Physical Properties—Colorless, odorless, cubical crystals, or a white, crystalline powder. In moist air Sodium Iodide deliquesces, or at first cakes and then deliquesces, and frequently undergoes decomposition, assuming a brown tint.

One Gm. of Sodium Iodide is soluble in 0.55 cc. of water, in about 2 cc. of alcohol, and in 1 cc. of glycerin, at 25° C. One Gm. is soluble in 0.4 cc. of boiling water.

When heated to about 660° C., Sodium Iodide melts, and at higher temperatures it is slowly volatilized and partly decomposed.

Test for Identity—An aqueous solution of the salt (1 in 20) responds to the reactions for sodium, page 617, and for iodides, page 575.

Tests for Purity—Dissolve 1 Gm. of Sodium Iodide in 10 cc. of distilled water, and add 0.15 cc. of tenth-normal sulphuric acid: no red color is produced by the addition of a drop of phenolphthalein T.S. (*alkali*).

A solution of 1 Gm. of the salt in 2 cc. of distilled water yields no precipitate with 1 cc. of sodium bitartrate T.S. (*potassium*).

Dissolve 0.5 Gm. of the salt in 10 cc. of distilled water which has been previously boiled and cooled, and add 2 drops of diluted sulphuric acid: no distinct, yellow color appears within half a minute (*iodate*), and no turbidity occurs (*thiosulphate*).

Add 5 cc. of sodium hydroxide T.S. and about 0.2 Gm. of aluminum wire to a solution of 1 Gm. of Sodium Iodide in 5 cc. of distilled water contained in a test tube of about 40 cc. capacity. Insert a pledget of purified cotton in the upper portion of the test tube, and place a piece of moistened red litmus paper over its mouth. On heating the tube and contents on a water bath for fifteen minutes, no blue coloration of the paper is discernible (*nitrate or nitrite*).

A 10 cc. portion of an aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is not rendered turbid by the addition of 1 cc. of potassium sulphate T.S. (*barium*).

A 2 Gm. portion of Sodium Iodide shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1567.

Heat gently 5 cc. of an aqueous solution of the salt (1 in 10) with 1 drop of ferrous sulphate T.S., 1 drop of ferric chloride T.S., and 0.5 cc. of sodium hydroxide T.S.: no blue color appears after acidulating the mixture with hydrochloric acid (*cyanide*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Dry the salt to constant weight at 120° C.: the loss in weight does not exceed 7 per cent (*water*).

Assay—Proceed as directed under the assay for iodides, page 575, using about 0.5 Gm. of Sodium Iodide, previously dried to constant weight at 120° C. and accurately weighed. Each cc. of tenth-normal silver nitrate corresponds to 0.01499 Gm. of NaI. Each Gm. of Sodium Iodide, previously dried, corresponds to not less than 66 cc. and not more than 67.7 cc. of tenth-normal silver nitrate.

This assay is explained on page 1462.

Preserve in well-closed containers.

N. F. Preparation—Elixir Euphorbiæ Compositus.

Uses—Medicinally, this salt is preferred to potassium iodide by some practitioners although, apparently, without good reason. The dose is from five to fifteen grains (0.32 to 1 Gm.).

SODII NITRIS. U. S. Sodium Nitrite
[Sod. Nitris]

Sodium Nitrite, when dried to constant weight over sulphuric acid, contains not less than 95 per cent of $NaNO_2$ (69.01).

Preparation—Sodium nitrite is made by heating sodium nitrate in contact with starch, or preferably by adding strips of sheet lead to sodium nitrate,

and heated to the fusing point for several hours, lead oxide being formed at the same time. After cooling, the fused sodium nitrite is lixiviated with water, purified, and recrystallized.

$$\underset{\text{sodium nitrate}}{NaNO_3} + \underset{\text{lead}}{Pb} = \underset{\text{sodium nitrite}}{NaNO_2} + \underset{\text{lead oxide}}{PbO}$$

Description and Physical Properties—White, or nearly white, opaque, fused masses or sticks; or colorless, transparent crystals; or a white or slightly yellow granular powder. It is odorless and has a mild saline taste. When exposed to the air, Sodium Nitrite deliquesces and is gradually oxidized to sodium nitrate, making it unfit for use.

One Gm. of Sodium Nitrite is soluble in 1.5 cc. of water at 25° C. It is sparingly soluble in alcohol, and is very soluble in boiling water.

When heated to about 270° C. the salt melts, and at a red heat it decomposes yielding oxygen, nitrogen, nitrous oxides, and sodium oxide.

Tests for Identity—An aqueous solution of the salt responds to the reactions for sodium, page 617, and for nitrites, page 551.

An aqueous solution of the salt (1 in 20) is slightly alkaline to litmus paper.

Tests for Purity—Dissolve 0.5 Gm. of Sodium Nitrite in 25 cc. of diluted hydrochloric acid, evaporate the solution to dryness, and dissolve the residue in 25 cc. of distilled water, adding a few drops of diluted hydrochloric acid: a 10 cc. portion of the resulting solution meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dry about 1 Gm. of Sodium Nitrite to constant weight over sulphuric acid, weigh accurately in a stoppered weighing-bottle, dissolve the salt in a measuring flask with sufficient distilled water to make 100 cc., and add 10 cc. of this solution, from a pipette, to a mixture of 50 cc. of tenth-normal potassium permanganate, 100 cc. of distilled water, and 5 cc. of sulphuric acid. In adding the sodium nitrite solution, immerse the tip of the pipette beneath the surface of the permanganate mixture. Warm the liquid to 40° C., allow it to stand for five minutes, and then titrate with tenth-normal oxalic acid. Each cc. of tenth-normal potassium permanganate corresponds to 0.003451 Gm. of $NaNO_2$.

This assay is explained on page 1475.

Preserve in well-closed containers.

Uses—This salt is used in the manufacture of spirit of ethyl nitrite, although there is no longer an official process. The average dose is one grain (0.065 Gm.).

SODII PHOSPHAS. U. S. Sodium Phosphate
[Sod. Phos.]

Sodium Phosphate contains not less than 39.25 per cent and not more than 44.00 per cent of Na_2HPO_4 (142.05), corresponding to not less than 99 per cent of the crystallized salt [$Na_2HPO_4.12H_2O = 358.24$].

Preparation—The part of bones which is incombustible is obtained by burning them to whiteness, and consists of tribasic calcium phosphate called *bone-phosphate* or *bone-ash*, associated with some calcium carbonate. *Phosphorite*, the normal calcium phosphate occurring in nature, may also be used. When this is mixed with sulphuric acid, the calcium carbonate is entirely decomposed, giving rise to effervescence, should any carbonate be present. The calcium phosphate undergoes partial decomposition; part of the calcium precipitates as calcium sulphate, while the phosphoric acid remains in solution as an acid calcium phosphate (monobasic calcium phosphate), holding a small portion of calcium sulphate in solution.

$$\underset{\text{calcium phosphate}}{Ca_3(PO_4)_2} + \underset{\text{sulphuric acid}}{2H_2SO_4} = \underset{\text{acid calcium phosphate}}{CaH_4(PO_4)_2} + \underset{\text{calcium sulphate}}{2CaSO_4}$$

In order to separate the acid phosphate from the precipitated mass of calcium sulphate, boiling water is added to the mixture, the whole is strained, and the precipitate washed as long as acid phosphate is removed, which is determined by the water which passes through having an acid reaction. The different liquids are mixed and allowed to stand; upon cooling, a portion of calcium sul-

phate is deposited, which is removed by decantation. The bulk of the liquid is now concentrated by evaporation, and a fresh portion of calcium sulphate is deposited, which is separated by subsidence and decantation as before. The acid calcium phosphate solution, being heated, is now saturated by means of a hot solution of sodium carbonate. The carbonic acid is liberated with effervescence, and sodium phosphate is produced, while the acid calcium phosphate is converted into dibasic calcium phosphate and precipitates.

$$\underset{\text{primary calcium phosphate}}{CaH_4(PO_4)_2} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{secondary calcium phosphate}}{CaHPO_4} + \underset{\text{sodium phosphate}}{Na_2HPO_4} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

The calcium phosphate is separated by filtration, and the filtered liquid, which contains the sodium phosphate, is evaporated to the crystallizing point.

Description and Physical Properties—Large, colorless, odorless, monoclinic prisms, or a granular, crystalline salt. The crystals effloresce in the air.

One Gm. of Sodium Phosphate is soluble in 2.7 cc. of water at 25° C. It is very slightly soluble in alcohol.

When heated to about 40° C., the salt fuses, yielding a colorless liquid. At 100° C. it loses all of its water of crystallization, and at about 300° C. is converted into sodium pyrophosphate.

Tests for Identity—An aqueous solution of Sodium Phosphate (1 in 10) is alkaline to litmus paper and to phenolphthalein T.S.

An aqueous solution of the salt (1 in 20) responds to the reactions for sodium, page 617, and for phosphates, page 586.

Tests for Purity—Dissolve 10 Gm. of Sodium Phosphate in 100 cc. of distilled water: not more than 0.02 Gm. of residue remains (*calcium or aluminum*).

No effervescence occurs on the addition of hydrochloric acid to a solution of the salt (*carbonate*).

One Gm. of Sodium Phosphate shows no more *chloride* than corresponds to 0.2 cc. of fiftieth-normal hydrochloric acid, page 1556, and 0.2 Gm. shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1567.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Place about 0.4 Gm. of Sodium Phosphate, accurately weighed, in a 100 cc. graduated flask, dissolve it in 10 cc. of distilled water, add 50 cc. of tenth-normal silver nitrate, and thoroughly agitate the mixture. Gradually add reagent zinc oxide in small portions until the liquid is neutral to litmus paper. Then add distilled water to make 100 cc., agitate the mixture thoroughly, and filter through a filter which has not been previously moistened, rejecting the first 20 cc. of filtrate. Collect 50 cc. of the subsequent clear filtrate, add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate to the production of a permanent red color. Each cc. of tenth-normal silver nitrate corresponds to 0.004735 Gm. of Na_2HPO_4.

This assay is explained on page 1463.

Preserve in well-closed containers.

U. S. P. Preparation—Sodii Phosphas Exsiccatus.

N. F. Preparation—Liquor Sodii Phosphatis Compositus.

Uses—Sodium phosphate is principally used as a cathartic; it must comply with the official requirements for purity and especially for freedom from arsenic. It may be given in doses of one drachm to half an ounce (4 to 16 Gm.).

SODII PHOSPHAS EFFERVESCENS. U. S. Effervescent Sodium Phosphate [Sod. Phos. Eff.]

	Metric	Alternative
Exsiccated Sodium Phosphate, in fine powder	200 Gm.	4 oz. av.
Sodium Bicarbonate, dried and powdered	477 Gm.	9 oz. av. 236 gr.
Tartaric Acid, dried and powdered	252 Gm.	5 oz. av. 18 gr.
Citric Acid, uneffloresced crystals	162 Gm.	3 oz. av. 105 gr.
To make	1000 Gm.	20 oz. av.

Powder the citric acid, and mix it intimately with the exsiccated sodium phosphate and tartaric acid, and then thoroughly incorporate the sodium bicarbonate.

Place the mixed powders on a plate of glass or in a suitable dish in an oven heated to between 93° and 104° C. Manipulate the mixture carefully with a

wooden spatula, and when it has become moist, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. Immediately transfer the salt to suitable containers and seal them tightly. Care must be taken to prevent the product from coming in contact with air which contains moisture.

An effervescent sodium phosphate, containing no citric or tartaric acid, is sold under the name *Sofos* and is recognized in the 1925 N. N. R. Dihydrogen sodium phosphate, official as sodium biphosphate, which is acid in reaction, is used to produce effervescence in solution through its reaction with the sodium bicarbonate contained in the mixture. It is manufactured by the General Chemical Company, New York City.

Uses—Effervescent Sodium Phosphate furnishes a pleasant means of administering sodium phosphate. Dose, two and one-half drachms (10 Gm.).

SODII PHOSPHAS EXSICCATUS. U. S. Exsiccated Sodium Phosphate
[Sod. Phos. Exsic.]

Exsiccated Sodium Phosphate, when dried to constant weight at 110° C., contains not less than 98 per cent of Na_2HPO_4 (142.05).

Sodium Phosphate, a convenient quantity.

Allow the crystals to effloresce for several days in warm air at a temperature of from 25° to 30° C., then continue the drying in an oven, raising the temperature very gradually until 110° C. has been reached. Maintain this temperature until the salt ceases to lose weight, powder and sift the residue, and transfer to well-closed containers.

Description and Physical Properties—A white powder which readily absorbs moisture. One Gm. of Exsiccated Sodium Phosphate is soluble in 8.1 cc. of water at 25° C., and in 1.1 cc. of boiling water. It is insoluble in alcohol.

Tests for Identity and Purity—Exsiccated Sodium Phosphate meets the requirements of the tests for identity, and, after allowance is made for the loss of water of crystallization, meets the requirements of the tests for purity under *Sodii Phosphas*.

Assay—Proceed as directed under *Sodii Phosphas*, using about 0.15 Gm. of the salt, previously dried to constant weight at 110° C. and accurately weighed. Each cc. of tenth-normal silver nitrate corresponds to 0.004735 Gm. of Na_2HPO_4.

This assay is explained on page 1463.

Preserve in well-closed containers.

U. S. P. Preparations—Liquor Sodæ Chlorinatæ Chirurgicalis; Sodii Phosphas Effervescens.

Uses—This salt is used in making effervescent sodium phosphate, but should be freshly dried, as it otherwise will be variable in its water content, since it rapidly absorbs water if exposed to moist atmosphere, as much as 15 to 20 per cent often being present. It may be given in doses of from fifteen to thirty grains (1 to 2 Gm.). It is also used in preparing the official modified Dakin's solution (see page 570).

SODII BIPHOSPHAS. U. S. Sodium Biphosphate
[Sod. Biphos.—Sodium Dihydrogen Phosphate, Monosodium Orthophosphate]

Sodium Biphosphate, when dried to constant weight at 100° C., contains not less than 98 per cent of NaH_2PO_4. It contains not more than 15 per cent of water.

Sodium Biphosphate is prepared by boiling a solution of disodium phosphate with a calculated amount of nitric acid; or by adding phosphoric acid to a solution of the disodium salt until the liquid ceases to give a precipitate

with barium chloride. The latter method is illustrated by the following equation:

$$\underset{\text{disodium phosphate}}{Na_2HPO_4} + \underset{\text{phosphoric acid}}{H_3PO_4} = 2\underset{\text{monosodium phosphate}}{NaH_2PO_4}$$

The salt is then allowed to crystallize from the strong, hot solution.

Description and Physical Properties—Colorless, transparent crystals or a white, granular, crystalline powder. It is odorless and slightly deliquescent.

It is freely soluble in water and practically insoluble in alcohol, chloroform, and ether.

Tests for Identity—At 100° C. Sodium Biphosphate loses its water of crystallization (13.04 per cent); at 210° C. it is converted into disodium dihydrogen pyrophosphate ($Na_2H_2P_2O_7$). At still higher temperatures it is changed into a mixture of sodium metaphosphate ($NaPO_3$) and modifications of sodium metaphosphate.

An aqueous solution of Sodium Biphosphate is acid to litmus paper and produces effervescence with sodium carbonate.

An aqueous solution of the salt (1 in 20) responds to the reactions for sodium, page 617, and for phosphates, page 586.

Tests for Purity—Dissolve 2 Gm. of Sodium Biphosphate in 40 cc. of distilled water, and add 1 drop of methyl orange T.S. If the solution is pink, it requires not more than 0.3 cc. of normal sodium hydroxide to discharge the pink color (*free acid*). If the solution is yellow, it requires not more than 0.3 cc. of normal sulphuric acid to render it pink (*disodium phosphate*).

An aqueous solution of the salt (1 in 10) does not become turbid when rendered slightly alkaline to litmus paper with ammonia T.S. (*aluminum, calcium*, etc.).

Dissolve 1 Gm. of the salt in 100 cc. of 1 per cent hydrochloric acid: a 10 cc. portion of this solution meets the requirements of the test for *heavy metals*, page 1519.

Dissolve 0.1 Gm. of the salt in 10 cc. of diluted sulphuric acid: the solution meets the requirements of the test for *arsenic*, page 1512.

One Gm. of Sodium Biphosphate shows no more *chloride* than corresponds to 0.2 cc. of fiftieth-normal hydrochloric acid, and 0.2 Gm. shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1567.

Dry about 2 Gm. of the salt, accurately weighed, for one hour at 60° C. Raise the temperature to 100° C., and maintain that temperature until it ceases to lose weight: the loss in weight should not exceed 15 per cent (*water*).

Assay—Dry about 2 Gm. of Sodium Biphosphate to constant weight at 100° C., weigh accurately, and dissolve in 10 cc. of distilled water, add 10 cc. of a cold, saturated solution of sodium chloride, and titrate the solution with normal sodium hydroxide, using phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.1201 Gm. of NaH_2PO_4.

Dry about 0.15 Gm. of the salt to constant weight at 100° C., weigh accurately, dissolve in 10 cc. of distilled water, and neutralize the solution with normal sodium hydroxide (free from chloride), using phenolphthalein T.S. as indicator. Then add 50 cc. of tenth-normal silver nitrate, and thoroughly agitate the mixture. Gradually add reagent zinc oxide in small portions until the mixture is neutral to litmus paper, then dilute the mixture to 100 cc. with distilled water, and filter through a filter which has not been previously moistened. Reject the first 20 cc. of filtrate, collect 50 cc. of the subsequent filtrate, add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate to the production of a permanent red tint. Each cc. of tenth-normal silver nitrate corresponds to 0.004002 Gm. of NaH_2PO_4.

This assay is explained on page 1463.

Preserve in tightly-closed containers.

This is used to render the urine acid in cases of cystitis with ammoniacal decomposition of the urine. Average dose, ten grains (0.6 Gm.).

SODII SALICYLAS. U. S. Sodium Salicylate

[Sod. Salicyl.]

Sodium Salicylate, when dried to constant weight at 100° C., contains not less than 99.5 per cent of $NaC_7H_5O_3$ (160.08).

Preparation—Sodium salicylate may be prepared by mixing one hundred parts of pure salicylic acid with sufficient distilled water to form a paste, and then with one hundred and four parts of pure crystallized sodium carbonate (uneffloresced) in a glass or porcelain vessel; carbon dioxide will be evolved, and sodium salicylate will remain in solution.

$$\underset{\text{salicylic acid}}{2HC_7H_5O_3} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{sodium salicylate}}{2NaC_7H_5O_3} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

The liquid may be strained through thoroughly washed muslin if necessary, and heated in a porcelain dish until the carbon dioxide is expelled.

It should not be filtered through ordinary paper, on account of the impurities generally present in paper; the slightest contact with iron will discolor the product, and for this reason the commercial sodium carbonate is unfitted for use in making this salt by the method just described.

If alkaline to litmus paper, enough salicylic acid must be added to be slightly in excess, and the solution should be evaporated to dryness at a low heat. If the acid is not in excess, the salt will not be white, but gray or lead colored; and if heated too much, the odor of phenol will be noticed.

Sodium salicylate is now commercially prepared from phenol by first converting the phenol into sodium phenolate, with caustic soda, according to the equation.

$$\underset{\text{phenol}}{C_6H_5OH} + \underset{\substack{\text{sodium}\\\text{hydroxide}}}{NaOH} = \underset{\substack{\text{sodium}\\\text{phenolate}}}{C_6H_5ONa} + \underset{\text{water}}{H_2O}$$

The sodium phenolate is then heated with carbon dioxide in an autoclave, the reaction that takes place being expressed as follows:

$$\underset{\substack{\text{sodium}\\\text{phenolate}}}{C_6H_5ONa} + \underset{\substack{\text{carbon}\\\text{dioxide}}}{CO_2} = \underset{\text{sodium salicylate}}{C_6H_4OHCOONa}$$

The salt is dissolved and crystallized, and then purified by recrystallization.

Description and Physical Properties—White, microcrystalline powder, or scales, or an amorphous powder. It is colorless or has not more than a faint pink tinge. It is odorless, or has a faint characteristic odor, and possesses a sweet, saline taste.

One Gm. of Sodium Salicylate is soluble in 0.9 cc. of water and in 9.2 cc. of alcohol, at 25° C. It is very soluble in boiling water and in boiling alcohol, and is soluble in 4 parts of glycerin.

Tests for Identity—When heated, the salt is decomposed, giving off inflammable vapors and an odor of phenol, and finally leaving a residue of sodium carbonate and carbon.

An aqueous solution of Sodium Salicylate (1 in 4) responds to the reactions for sodium, page 617, and for salicylates, page 826.

Tests for Purity—An aqueous solution of Sodium Salicylate (1 in 10) when freshly made is colorless or nearly colorless, and is neutral or slightly acid to litmus paper.

Add 1 cc. of hydrochloric acid to a solution of 1 Gm. of Sodium Salicylate in 20 cc. of distilled water, and filter the liquid: the filtrate does not decolorize 2 drops of tenth-normal iodine (*sulphite or thiosulphate*).

Add a slight excess of hydrochloric acid to an aqueous solution of the salt (1 in 50), and filter: the filtrate meets the requirements of the test for *heavy metals*, page 1519.

Assay—Proceed as directed under the assay for alkali benzoates and salicylates, page 1514, using about 2 Gm. of Sodium Salicylate, previously dried to constant weight at 100° C. and accurately weighed. Each cc. of half-normal sulphuric acid corresponds to 0.08004 Gm. of $NaC_7H_5O_3$.

This assay is explained on page 1457.

Preserve in well-closed containers, protected from heat and light.

N. F. Preparations—Caffeinæ Sodio-salicylas; Elixir Manacæ Compositus; Elixir Sodii Salicylatis; Elixir Sodii Salicylatis Compositus; Elixir Tongæ et Salicylatum; Liquor Ferri Salicylatis.

Uses—This salt is administered in rheumatic and neuralgic affections, in doses of fifteen to thirty grains (1 to 2 Gm.). Its solutions as dispensed upon prescriptions usually darken, especially in the presence of sodium bicarbonate, when the liquid becomes almost black. This is said to be due to a colored compound formed in the presence of traces of ammonia which may be present in the water or may be absorbed from the air.

SODII SULPHAS. U. S. Sodium Sulphate

[**Sod. Sulph.**—GLAUBER'S SALT]

Sodium Sulphate contains not less than 43.64 per cent and not more than 48 per cent of Na_2SO_4 (142.06), corresponding to not less than 99 per cent of the crystallized salt [$Na_2SO_4.10H_2O = 322.22$].

Preparation—This salt is largely obtained as a by-product in the manufacture of soda-ash, hydrochloric and nitric acids, ammonium chloride, etc. A typical reaction showing its production is expressed by the equation:

$$\underset{\text{sodium chloride}}{2NaCl} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{hydrochloric acid}}{2HCl}$$

Description and Physical Properties—Large, colorless, odorless, transparent, monoclinic prisms, or granular crystals. The salt effloresces rapidly in the air.

One Gm. of Sodium Sulphate is soluble in about 1 cc. of water, at 25° C. It is insoluble in alcohol but soluble in glycerin.

When heated to about 33° C., Sodium Sulphate melts in its water of crystallization and on continuing the heat, maintaining it at 100° C., it loses all of its water of crystallization (about 56 per cent). At a red heat, the anhydrous salt fuses without decomposition.

Tests for Identity—An aqueous solution of Sodium Sulphate (1 in 20) responds to the reactions for sodium, page 617, and for sulphates, page 581.

Tests for Purity—An aqueous solution of the salt (1 in 10) is neutral to litmus paper.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Dissolve about 1 Gm. of Sodium Sulphate, accurately weighed, in 250 cc. of distilled water, acidulate the solution with 1 cc. of hydrochloric acid, and heat it to boiling. Gradually add an excess of hot barium chloride T.S., heat for thirty minutes on a water bath, collect the precipitate of barium sulphate on a filter, wash it until it is free from chlorides, then dry, ignite, and weigh. The weight of the barium sulphate thus obtained, multiplied by 0.6086, indicates its equivalent in Na_2SO_4. Each Gm. of Sodium Sulphate corresponds to not less than 0.717 Gm. and not more than 0.789 Gm. of $BaSO_4$.

This assay is explained on page 1479.

Preserve in well-closed containers, in a cool place.

N. F. Preparation—Sal Carolinum Factitium.

In using this salt in formulas, care must be employed to see that it is not effloresced, as such a salt will have lost some of its water of crystallization and therefore be correspondingly stronger than the crystalline salt.

History—This compound was first described by Johann Rudolph Glauber in 1651, who had such a high opinion of its virtues that he called it *sal mirabile*, (the wonderful salt).

Uses—It is largely used in veterinary practice as a purgative but it is not so well suited for administration to human beings, the magnesium sulphate being preferred. It may be given to adults in doses of half an ounce to one ounce (16 to 31 Gm.).

SODII THIOSULPHAS. U. S. Sodium Thiosulphate

[Sod. Thiosulph.—"SODIUM HYPOSULPHITE"]

Sodium Thiosulphate contains not less than 63.07 per cent and not more than 67.48 per cent of $Na_2S_2O_3$ (158.12), corresponding to not less than 99 per cent of the crystallized salt [$Na_2S_2O_3.5H_2O = 248.20$].

Preparation—Sodium thiosulphate, official in the U. S. P. 1890 as *sodium hyposulphite*, is made by decomposing soluble calcium thiosulphate, obtained by the oxidation of alkali waste, with either sodium sulphate or sodium carbonate:

$$\underset{\text{calcium thiosulphate}}{CaS_2O_3} + \underset{\text{sodium sulphate}}{Na_2SO_4} = \underset{\text{sodium thiosulphate}}{Na_2S_2O_3} + \underset{\text{calcium sulphate}}{CaSO_4}$$

Other methods of making "hyposulphite of soda" have been used, but the above process has superseded them because of its economy. It is now made on a very large scale.

Description and Physical Properties—Colorless, odorless, transparent, monoclinic prisms. It is stable in the air below 33° C. but efflorescent in dry air above that temperature. It is slightly deliquescent in moist air.

One Gm. of Sodium Thiosulphate is soluble in 0.5 cc. of water at 25° C. It is insoluble in alcohol.

When rapidly heated, the salt liquefies. When heated slowly until it is effloresced, and afterwards at 100° C., it undergoes partial decomposition, loses all of its water of crystallization, and at about 220° C. is decomposed, sulphur being liberated, while a residue of sodium sulphide and sodium sulphate remains.

Tests for Identity—An aqueous solution of Sodium Thiosulphate responds to the reactions for sodium, page 617, and for thiosulphates, see below.

An aqueous solution of Sodium Thiosulphate readily dissolves many compounds of silver (chloride, bromide, iodide, oxide, etc.) and discharges the color of solutions of iodine or of starch iodide.

The addition of hydrochloric acid to an aqueous solution of Sodium Thiosulphate produces a white precipitate of sulphur (distinction from *sulphite or bisulphite*).

Tests for Purity—An aqueous solution of the salt (1 in 10) is neutral or faintly alkaline to litmus paper.

An aqueous solution of Sodium Thiosulphate (1 in 20) is not rendered turbid by the addition of ammonium oxalate T.S. (*calcium*).

Add 10 cc. of diluted hydrochloric acid to 1 Gm. of the salt, evaporate to dryness on a water bath, heat the residue with 50 cc. of distilled water, and filter: a 10 cc. portion of this filtrate meets the requirements of the test for *heavy metals*, page 1519.

Add 3 cc. of nitric acid to 5 cc. of an aqueous solution of the salt (1 in 25), evaporate the solution cautiously to dryness on a water bath, treat the residue with a few cc. of distilled water, filter the liquid, and evaporate the filtrate and washings to dryness: the residue meets the requirements of the test for *arsenic*, page 1512.

Assay—Dissolve about 1 Gm. of Sodium Thiosulphate, accurately weighed in 20 cc. of distilled water, and titrate with tenth-normal iodine, starch T.S. being used as indicator. Each cc. of tenth-normal iodine corresponds to 0.01581 Gm. of $Na_2S_2O_3$.

This assay is explained on page 1470.

Preserve in well-closed containers.

N. F. Preparations—Liquor Potassii Iodidi; Unguentum Potassii Iodidi.

Uses—This compound is used in the official volumetric test solution of sodium thiosulphate, and occasionally in medicine, as an alterative and resolvent, in doses of ten to thirty grains (0.65 to 2 Gm.). Externally, it is used in baths and also as an ointment, and its saturated, aqueous solution is used in the treatment of ivy posioning. Its principal use is in the arts, as an *antichlor* in paper manufacture; while in photography, under the abbreviated name of *"hypo"*, it is invaluable as a solvent for the unaltered silver chloride or bromide in the film after development.

Tests for Thiosulphates

Thiosulphates—Solutions of thiosulphates yield with hydrochloric acid a white precipitate of sulphur which soon turns yellow, sulphur dioxide being liberated, recognizable by its odor. The addition of ferric chloride T.S. to solutions of thiosulphates, produces a dark violet color which quickly disappears.

SODII ARSENAS. N. F. Sodium Arsenate

(U. S. P. IX)

[**Sod. Arsen.**—Natrii Arsenas, P. I.]

Sodium Arsenate contains not less than 58.98 per cent nor more than 61.92 per cent of anhydrous sodium arsenate (disodium ortho-arsenate), corresponding to not less than 99 per cent of the crystallized salt ($Na_2HAsO_4.7H_2O$ = 312.08).

Preparation—A process for this salt was formerly official; it is as follows:

Take of arsenic trioxide, in fine powder, 960 *grains;* sodium nitrate, in fine powder, 816 *grains;* dried sodium carbonate, in fine powder, 528 *grains;* distilled water, boiling hot, *half a pint.* Having mixed the powders thoroughly, put the mixture into a large clay crucible, and cover it with the lid. Expose it to a full red heat until effervescence has ceased and complete fusion has taken place. Pour the fused salt on a porcelain slab, and as soon as it has solidified, and while it is still warm, put it into the hot water, and stir until it is dissolved. Filter the solution, and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filter paper, keep them in a well-stoppered bottle.

The rationale of this process is that when arsenic trioxide, sodium nitrate, and sodium carbonate are fused together, sodium pyro-arsenate is formed, while nitrous anhydride and carbon dioxide escape as gases.

$$\underset{\text{arsenic trioxide}}{As_2O_3} + \underset{\text{sodium nitrate}}{2NaNO_3} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{sodium pyro-arsenate}}{Na_4As_2O_7} + \underset{\text{nitrous anhydride}}{N_2O_3} + \underset{\text{carbon dioxide}}{CO_2}$$

Sodium pyro-arsenate is converted into the ortho-arsenate (the official salt) by dissolving the former in water, filtering the solution, and crystallizing.

$$\underset{\text{sodium pyro-arsenate}}{Na_4As_2O_7} + \underset{\text{water}}{15H_2O} = 2(\underset{\text{sodium ortho-arsenate}}{Na_2HAsO_4,7H_2O})$$

Description and Physical Properties—Sodium Arsenate occurs as colorless, transparent, monoclinic prisms; odorless. Efflorescent in dry air, and somewhat deliquescent in moist air. *Great caution must be used in tasting it and then only in very dilute solutions.*

One Gm. of Sodium Arsenate dissolves in 1.5 cc. of water at 25° C.; also in about 1 cc. of boiling water; slightly soluble in alcohol at 25° C.; nearly insoluble in boiling alcohol.

Tests for Identity—When gently heated, the salt loses five molecules of water, and is converted into a white powder. At a higher temperature it loses all of its water of crystallization; when strongly heated, the salt fuses, and at a red heat it is converted into pyro-arsenate.

Tests for Purity—Sodium Arsenate responds to the tests for identity and purity prescribed under Sodii Arsenas Exsiccatus, when taken in proportionate amount.

Assay—Dissolve about 0.5 Gm. of Sodium Arsenate, accurately weighed, in 25 cc. of distilled water, heat the solution to 80° C. and add 10 cc. of hydrochloric acid and 3 Gm. of potassium iodide. Allow the mixture to stand for fifteen minutes at 80° C., then cool and titrate it with tenth-normal sodium thiosulphate, starch T.S. being used as indicator.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.0092985 Gm. of Na_2HAsO_4. Each Gm. of Sodium Arsenate corresponds to not less than 63.44 cc. nor more than 66.59 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1469.

Preserve it in well-closed containers.

N. F. Preparation—Sodii Arsenas Exsiccatus.

Uses—This salt exerts the valuable tonic and alterative powers of arsenous acid, although somewhat less certain in its effects than the arsenites. The dose is from one-twelfth to one-third of a grain (0.005 to 0.02 Gm.).

Antidotes—(See Part XV, on Antidotes).

SODII ARSENAS EXSICCATUS. N. F. Exsiccated Sodium Arsenate

(U. S. P. IX)

[Sod. Arsen. Exsic.]

Exsiccated Sodium Arsenate contains, when dried to constant weight at 150° C., not less than 98 per cent of Na_2HAsO_4 (185.97).

Sodium Arsenate, in crystals, a sufficient quantity.

Break the crystals into small fragments, and allow them to effloresce at a temperature between 40° and 50° C., until they are completely disintegrated; then gradually increase the temperature to 150° C., and continue the drying until the product ceases to lose weight. Reduce it to a fine powder, and transfer it to dry, well-closed containers.

Description and Physical Properties—Exsiccated Sodium Arsenate occurs as an odorless, amorphous, white powder. It is slightly hygroscopic. *Great caution must be used in tasting it and then only in very dilute solutions.*

One Gm. of Exsiccated Sodium Arsenate dissolves in 3.1 cc. of water at 25° C.; also in 1.3 cc. of boiling water; slightly soluble in alcohol at 25° C.; nearly insoluble in boiling alcohol.

Tests for Identity—Its aqueous solution (1 in 20) is alkaline to litmus.

It imparts an intensely yellow color to a non-luminous flame.

An aqueous solution of the salt (1 in 20) yields a white precipitate with barium chloride T.S., and a dark red precipitate with silver nitrate T.S.; both of these precipitates are soluble in nitric acid.

Tests for Purity—Add 5 cc. of tenth-normal silver nitrate to 2 cc. of an aqueous solution of the salt (1 in 20), and redissolve the precipitate with the aid of a slight excess of ammonia water; no black precipitate of reduced silver appears on boiling for one minute (*arsenite*).

Add 1 cc. of ammonium sulphide T.S. to 5 cc. of an aqueous solution of the salt (1 in 100), no dark coloration appears (*lead, copper, or iron*).

Assay—Dissolve about 0.3 Gm. of Exsiccated Sodium Arsenate, dried to constant weight at 150° C. and accurately weighed, in 25 cc. of distilled water, in a glass-stoppered bottle, heat the solution to 80° C. and add 10 cc. of hydrochloric acid and 3 Gm. of potassium iodide. Allow the mixture to stand in the stoppered bottle for fifteen minutes at 80° C., then cool and titrate it with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. It shows, in the dried salt, not less than 98 per cent of Na_2HAsO_4.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.0092985 Gm. of Na_2HAsO_4. Each Gm. of Exsiccated Sodium Arsenate, previously dried, corresponds to not less than 105.4 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1469.

Preserve it in well-closed containers.

N. F. Preparations—Liquor Sodii Arsenatis, Liquor Sodii Arsenatis Dilutus.

Uses—Exsiccated Sodium Arsenate is used in making the official solutions (see above). The advantage in using it in preference to sodium arsenate is that greater definiteness is secured; the latter salt as found in commerce is more or less effloresced, and the solution if made from it would be variable in its arsenical strength. Sixty parts of exsiccated sodium arsenate represent about 100 parts of the official crystallized salt. The *dose* is one-twentieth grain (0.003 Gm.).

Antidotes—(See Part XV, on Antidotes).

LIQUOR SODII ARSENATIS. N. F. Solution of Sodium Arsenate
(U. S. P. IX)

[Liq. Sod. Arsenat.]

An aqueous solution containing not less than 0.975 Gm., and not more than 1.025 Gm. of Na_2HAsO_4 (185.97) in each 100 cc.

	Metric	Alternative
Exsiccated Sodium Arsenate, previously dried to constant weight at 150° C.	**10 Gm.**	146 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the exsiccated sodium arsenate in sufficient distilled water to make the product measure 1000 cc. [2 pints].

Solution of Sodium Arsenate is a clear, colorless, odorless liquid, faintly alkaline to litmus paper.

For making the following identity tests, evaporate 500 cc. of the Solution to a volume of 50 cc. and the tests applied to this concentrated solution.

A white precipitate is formed when the Solution is mixed with barium chloride T.S. A reddish brown precipitate is formed when the Solution is added to silver nitrate T.S.

A yellow precipitate is formed when hydrogen sulphide T.S. is added to Solution of Sodium Arsenate previously acidulated with hydrochloric acid.

Assay—Place 25 cc. of Solution of Sodium Arsenate, accurately measured, in a glass-stoppered flask; heat to 80° C. and add 10 cc. of hydrochloric acid and 3 Gm. of potassium iodide. Allow the mixture to stand at 80° C. for fifteen minutes, then cool and titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate consumed corresponds to 0.0092985 Gm. of Na_2HAsO_4.

This assay is explained on page 1469.

Uses—A convenient form for administering sodium arsenate.

Average dose—3 minims (0.2 cc.).

LIQUOR SODII ARSENATIS DILUTUS. N. F. Diluted Solution of Sodium Arsenate

[**Liq. Sod. Arsenat. Dil.**—Liquor Sodii Arsenatis, Pearsonii. N. F. IV., Pearson's Solution of Arsenic, Liquor Arsenicalis Pearsonii]

An aqueous solution containing not less than 0.0975 Gm. and not more than 0.1025 Gm. of Na_2HAsO_4 (185.97) in each 100 cc.

	Metric	Alternative
Exsiccated Sodium Arsenate	**1 Gm.**	14½ gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the exsiccated sodium arsenate in the distilled water and filter the solution.

Note—This preparation must not be confounded with Liquor Sodii Arsenatis, *which is ten times as strong as Pearson's solution.*

Pearson's solution of Sodium Arsenate is a clear, colorless solution without odor and taste. It is neutral to litmus paper.

Specific gravity: about 1.0003 at 25° C.

Evaporate 100 cc. of the Solution at a temperature not exceeding 100° C.; it leaves not less than 0.0999 Gm., nor more than 0.110 Gm. of residue.

Incinerate the residue from 100 cc. of the Solution; it leaves not more than 0.100 Gm. of ash.

Silver nitrate T.S. added to the Solution produces a reddish-brown precipitate, soluble in nitric acid (*Arsenites, Phosphates*).

Assay—Pour into a tared flask 100 cc. of Diluted Solution of Sodium Arsenate, accurately measured, heat to 80° C. and add 3.5 cc. of hydrochloric acid and 1 Gm. of potassium iodide. Allow the mixture to stand for 15 minutes at 80° C., in a glass-stoppered flask, cool and then

titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator.

Each cc. of tenth-normal sodium thiosulphate used corresponds to 0.0092985 Gm. of Na_2HAsO_4. Each Gm. of Pearson's Solution of Sodium Arsenate corresponds to not less than 0.105 nor more than 0.110 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1469.

Uses—A convenient form for administering sodium arsenate. The pharmacist should be familiar with this solution as it is still occasionally prescribed and is only one-tenth as strong as the International standard solution of sodium arsenate (see page 637).

Average dose—Metric, 2 cc.—Apothecaries, 30 minims.

One average dose contains:

0.002 Gm. or $\frac{1}{35}$ grain of Exsiccated Sodium Arsenate.

SODII GLYCEROPHOSPHAS. N. F. Sodium Glycerophosphate

(U. S. P. IX)

[Sod. Glycerophos.—Sodium Glycerinophosphate]

Hydrated Sodium Glycerophosphate containing not less than 68 per cent of the anhydrous salt ($Na_2C_3H_7PO_6$ or $C_3H_5(OH)_2PO_4Na_2 = 216.11$).

Preparation—This salt may be made by double decomposition between barium or calcium glycerophosphate and sodium carbonate or by neutralizing glycerophosphoric acid with sodium carbonate and concentrating the solution *in vacuo*. The *glycerophosphoric acid* is prepared by heating glycerin with phosphoric acid, at a temperature between 105° and 110° C. (221° to 230° F.). It is a clear, colorless, odorless liquid, of an acid taste, containing about 20 per cent of the acid, $PO_3H_9O_6(C_3H_5(OH)_2OPO(OH)_2)$. Specific gravity 1.104.

Description and Physical Properties—Sodium Glycerophosphate occurs as white monoclinic plates or scales, or as a white powder, having a saline taste; odorless.

It is very soluble in cold or hot water; nearly insoluble in alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 20) is alkaline to litmus and to phenolphthalein T.S.

When strongly heated the salt is decomposed, evolving inflammable vapors, and at a red heat is converted into sodium pyrophosphate.

Tests for Purity—Dissolve 1 Gm. of Sodium Glycerophosphate in 10 cc. of distilled water and add 3 drops of phenolphthalein T.S.; the red color produced is discharged by the addition of 1.5 cc. of tenth-normal sulphuric acid (*free alkali*).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Add an equal volume of cold ammonium molybdate T.S. to 10 cc. of an aqueous solution of the salt (1 in 20): no precipitate is formed within one hour (*phosphates*). On heating this mixture a yellow precipitate is formed.

Triturate 1 Gm. of the salt with 20 cc. of dehydrated alcohol, filter the mixture, evaporate the filtrate on a water bath and dry the residue for one hour at a temperature not exceeding 70° C.: the weight of this residue does not exceed 0.01 Gm. (*alcohol-soluble impurities*).

Assay—Dissolve about 3 Gm. of the salt, accurately weighed, in 30 cc. of distilled water and titrate with half-normal hydrochloric acid, using methyl orange T.S. as indicator.

Each cc. of half-normal hydrochloric acid used corresponds to 0.10805 Gm. of $Na_2C_3H_7PO_6$. Each Gm. of Sodium Glycerophosphate corresponds to not less than 6.29 cc. of half-normal hydrochloric acid.

This assay is explained on page 1459.

N. F. Preparations—Elixir Calcii et Sodii Glycerophosphatum, Elixir Glycerophosphatum Compositum, Elixir Terpini Hydratis et Creosoti Compositum.

Uses—It is employed, usually in combination with other glycerophosphates, in syrups or elixirs, in wasting or nervous diseases, as a "nerve tonic". The dose is usually four grains (0.25 Gm.).

SODII HYPOPHOSPHIS. N. F. Sodium Hypophosphite

(U. S. P. IX)

[Sod. Hypophos.]

Sodium Hypophosphite contains not less than 98 per cent of $NaPH_2O_2.H_2O$ (106.07).

Caution should be observed in dispensing Sodium Hypophosphite, as an explosion is liable to occur when it is triturated or heated with nitrates, chlorates or other oxidizing agents.

Preparation—This salt is prepared by mixing a solution of six ounces of calcium hypophosphite in four pints of water with a solution of ten ounces of sodium carbonate in one and a half pints of water.

$$\underset{\text{calcium hypophosphite}}{Ca(H_2PO_2)_2} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{sodium hypophosphite}}{2NaH_2PO_2} + \underset{\text{calcium carbonate}}{CaCO_3}$$

Double decomposition takes place, with the formation of calcium carbonate and sodium hypophosphite, of which the latter is held in solution, and the former precipitated. After filtration to separate the calcium carbonate, the solution is evaporated until a pellicle forms, and then stirred constantly until the salt granulates, the heat being continued. If required quite pure, the granulated salt is dissolved in official alcohol, and the liquid, having been evaporated to a syrupy consistence, is set aside to crystallize.

Sodium hypophosphite has been known to explode with violence during the evaporation of its solution. This has even occurred when the heat was applied by means of a water bath. Evaporation, therefore, should be performed below 100° C. (212° F.).

$$\underset{\text{sodium hypophosphite}}{5NaH_2PO_2} = \underset{\text{sodium pyrophosphate}}{Na_4P_2O_7} + \underset{\text{sodium metaphosphate}}{NaPO_3} + \underset{\text{hydrogen phosphide}}{2PH_3} + \underset{\text{hydrogen}}{2H_2}$$

The gases evolved by heat are hydrogen and hydrogen phosphide. The latter is well known to be spontaneously inflammable.

This acid is a powerful deoxidizer, and as it reduces mercury and silver from their combinations, it should not be prescribed with either.

Description and Physical Properties—Sodium Hypophosphite occurs as small, colorless, transparent, rectangular plates of a pearly luster, or as a white, granular powder; odorless, and having a saline taste. It is deliquescent on exposure to moist air.

One Gm. of Sodium Hypophosphite dissolves in 1 cc. of water at 25° C.; also in about 0.15 cc. of boiling water; soluble in alcohol, slightly soluble in dehydrated alcohol, and freely soluble in glycerin at 25° C.; freely soluble in boiling alcohol.

Tests for Identity—An aqueous solution of Sodium Hypophosphite (1 in 20) is neutral or slightly alkaline to litmus.

When heated in a test tube, the salt at first loses its water of crystallization, and upon further heating is decomposed, evolving spontaneously inflammable hydrogen phosphide, which burns with a bright yellow flame. To a non-luminous flame the salt imparts an intensely yellow color.

When an aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, with agitation, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed. Upon the further addition of the solution of Sodium Hypophosphite, the precipitate becomes gray from reduction to metallic mercury.

Tests for Purity—A solution of 1 Gm. of the salt in about 10 cc. of distilled water requires not more than 1.5 cc. of tenth-normal hydrochloric acid for neutralization, methyl orange T.S. being used as indicator.

Heat 5 cc. of an aqueous solution of the salt (1 in 5) in a test tube with 0.5 cc. of diluted hydrochloric acid on a water bath for thirty minutes; no offensive odor is developed.

Measure 5 cc. of an aqueous solution of the salt (1 in 25) into a beaker containing 3 cc. of nitric acid, diluted with about 10 cc. of distilled water, and evaporate the mixture to dryness on a water bath; the residue meets the requirements of the test for arsenic (see page 1512).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Add magnesia mixture T.S. to 10 cc. of an aqueous solution of the salt (1 in 20), made alkaline with ammonia water; it is not affected within one minute (*phosphate*).

Assay—Dissolve about 1 Gm. of Sodium Hypophosphite, previously dried for twenty-four hours over sulphuric acid and accurately weighed, in 10 cc. of distilled water, add 10 cc. of nitric acid and evaporate the solution to dryness on a water bath. Dissolve the residue in 20 cc. of distilled water, add a drop of phenolphthalein T.S. and sufficient special potassium hydroxide T.S. (See Reagents U. S. P.) to produce a pink color, and then dilute to exactly 100 cc. with distilled water. Transfer 10 cc. of this solution to a 100 cc. graduated flask, add 50 cc. of tenth-normal silver nitrate and proceed from this point as directed in the assay under *Potassii Hypophosphis*.

Each cc. of tenth-normal silver nitrate used corresponds to 0.0035357 Gm. of $NaPH_2O_2.H_2O$. Each Gm. of Sodium Hypophosphite corresponds to not less than 277.2 cc. of tenth-normal silver nitrate.

This assay is explained on page 1464.

Preserve it in well-closed containers.

N. F. Preparations—Emulsum Olei Morrhuæ cum Hypophosphitibus, Liquor Hypophosphitum Compositus, Syrupus Calcii et Sodii Hypophosphitum, Syrupus Hypophosphitum, Syrupus Hypophosphitum Compositus.

Uses—Sodium hypophosphite is used in phthisis and other wasting diseases, and in cases of defective nerve nutrition; pharmaceutically it is an ingredient in the various official and unofficial preparations of the hypophosphites; the dose is 15 grains (1 Gm.).

SODII PERBORAS. N. F. Sodium Perborate

(U. S. P. IX)

[Sod. Perbor.]

Sodium Perborate contains not less than 9 per cent of available oxygen, corresponding to about 86.5 per cent of $NaBO_3.4H_2O$ (154.06).

Preparation—It is made by mixing 248 parts of boric acid with 78 parts of sodium peroxide, pouring the mixture slowly into 2000 parts of cold water, acidified with sulphuric acid, and separating and drying the crystals at 50° C. (122° F.).

Description and Physical Properties—Sodium Perborate occurs as white, crystalline granules or as a powder; odorless, and having a saline taste. It is stable in cool and dry air, but is decomposed with the evolution of oxygen in warm or moist air.

Sodium Perborate is soluble in water.

Tests for Identity—A saturated aqueous solution of the salt is alkaline to litmus or phenolphthalein T.S. In aqueous solution the salt is decomposed into sodium metaborate and hydrogen dioxide, the solution gradually evolving oxygen. Oxygen is evolved more rapidly if the solution is warmed.

The salt imparts an intensely yellow color to a non-luminous flame. Turmeric paper, if moistened with an aqueous solution of the salt which has been acidulated with hydrochloric acid, becomes brown in color, particularly on drying; on moistening the dried test paper with ammonia water, the color is changed to greenish black.

Agitate a mixture of 1 cc. of an aqueous solution of the salt (1 in 50), 1 cc. of diluted sulphuric acid, a few drops of potassium dichromate T.S., and 2 cc. of ether; the ether acquires a blue color.

Tests for Purity—Strongly heat 0.5 Gm. of the salt in a platinum crucible, and dissolve the residue in 25 cc. of distilled water with the aid of a few drops of hydrochloric acid; 10 cc. of the resulting solution does not respond to the test for heavy metals (see page 1519).

Assay—Dissolve about 0.25 Gm. of the salt, accurately weighed, in a mixture of 50 cc. of distilled water and 10 cc. of diluted sulphuric acid and titrate the solution with tenth-normal potassium permanganate.

Each cc. of tenth-normal potassium permanganate corresponds to 0.0008 Gm. of available oxygen. Each Gm. of Sodium Perborate corresponds to not less than 112.5 cc. of tenth-normal potassium permanganate.

This assay is explained on page 1474.

Preserve it in well-closed containers, in a cool place.

N. F. Preparation—Dentifricium.

Uses—It is used as an antiseptic dusting powder or as a wash in aqueous solution for wounds and ulcers, also used in toilet preparations as an antiseptic and bleaching agent. Its activity depends upon the liberation of nascent oxygen when in contact with animal matter or animal ferments. The dose is 1 grain (0.065 Gm.).

LIQUOR SODÆ ET MENTHÆ. N. F. Solution of Soda and Mint

[Liq. Sod. et Menth.—Mistura Sodæ et Menthæ, Soda Mint]

	Metric	Alternative
Sodium Bicarbonate	**50 Gm.**	1 oz. av. 293 gr.
Aromatic Spirit of Ammonia	**20 cc.**	307 min.
Spearmint Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the sodium bicarbonate in 750 cc. [24 fl. oz.] of spearmint water, add the aromatic spirit of ammonia, and then sufficient spearmint water to make the product measure 1000 cc. [2 pints].

Solution of Soda and Mint is a colorless, transparent solution, with an aromatic, mint-like odor and a mint-like, alkaline taste.

Add to 3 cc. of the Solution a few drops of hydrochloric acid: an immediate effervescence ensues.

Heat 5 cc. of the Solution in a test tube with 3 cc. of potassium hydroxide T.S.: a piece of moistened red litmus paper placed inside the mouth of the tube, but not in contact with the side, will turn blue. A pink color is produced if 1 drop of phenolphthalein T.S. is added to 3 cc. of the Solution.

A non-luminous flame is colored intensely yellow when a clean platinum wire is dipped into the Solution and held in the flame.

Approximate alcohol content, by volume, 1 per cent.

Uses—It is used as an antacid in doses of two fluidrachms (8 cc.), and for those who prefer the flavor, the N. F. directs that Peppermint Water may be used in place of the Spearmint Water.

LIQUOR SODII BORATIS COMPOSITUS. N. F. Compound Solution of Sodium Borate

[Liq. Sod. Bor. Co.—Dobell's Solution]

	Metric	Alternative
Sodium Borate	15 Gm.	219 gr.
Sodium Bicarbonate	15 Gm.	219 gr.
Liquefied Phenol	3 cc.	46 min.
Glycerin	35 cc.	1 fl. oz. 58 min.
Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the sodium borate and sodium bicarbonate in about 500 cc. [1 pint] of water, add the glycerin and liquefied phenol, and allow the mixture to stand half an hour or until the effervescence has ceased; then add sufficient water to make the product measure 1000 cc. [2 pints], and filter.

Compound Solution of Sodium Borate is a clear, yellowish liquid, with a phenol-like odor. It is strongly alkaline to litmus paper and phenolphthalein T.S.

Add a few drops of hydrochloric acid to 3 cc. of the Solution: an immediate effervescence results.

The Solution turns turmeric paper red-brown; if this paper is then moistened with ammonia T.S. it is changed to a dark green color.

When prepared as directed in the N. F. an effervescence always occurs, due to the decomposition of the sodium borate by the glycerin and the freed boric acid liberating CO_2 from the bicarbonate. The sodium borate reacts with the glycerin to form glyceryl borate and sodium metaborate, as follows:

$$\underset{\text{sodium tetraborate}}{Na_2B_4O_7} + 2\underset{\text{glycerin}}{C_3H_5OH} = \underset{\text{sodium metaborate}}{2NaBO_2} + \underset{\text{glyceryl orthoborate}}{2C_3H_5BO_3} + \underset{\text{water}}{3H_2O}$$

The glyceryl borate promptly undergoes hydrolysis with the liberation of free boric acid, according to the equation:

$$\underset{\text{glyceryl orthoborate}}{C_3H_5BO_3} + \underset{\text{water}}{H_2O} = \underset{\text{glycerin}}{C_3H_5(OH)_3} + \underset{\text{boric acid}}{H_3BO_3}$$

The boric acid attacks the bicarbonate of soda in the usual manner, liberating carbon dioxide, which causes the effervescence:

$$\underset{\text{boric acid}}{4H_3BO_3} + \underset{\text{sodium bicarbonate}}{2NaHCO_3} = \underset{\text{sodium tetraborate}}{Na_2B_4O_7} + \underset{\text{carbon dioxide}}{2CO_2} + \underset{\text{water}}{7H_2O}$$

Uses—This solution is used as an alkaline, mildly antiseptic nasal wash or spray.

LIQUOR SODII CITRATIS. N. F. Solution of Sodium Citrate

[Liq. Sod. Cit.—Mistura Sodii Citratis, Potio Riverii]

An aqueous solution containing not less than 2.5 Gm. and not more than 3 Gm. of $Na_3C_6H_5O_7.2H_2O$ (94.10) in each 100 cc.

	Metric	Alternative
Citric Acid	2.0 Gm.	73 gr.
Sodium Bicarbonate	2.5 Gm.	91 gr.
Distilled Water	100.0 cc.	8 fl. oz.

Dissolve the citric acid in the distilled water contained in a strong bottle of about 125 cc. [10 fl. oz.] capacity, add the sodium bicarbonate, dissolve it by gentle agitation and immediately stopper the bottle securely.

This preparation should not be dispensed unless it has been recently prepared.

Solution of Sodium Citrate is a slightly effervescent, clear, colorless, and odorless, aqueous liquid, with a pleasantly acidulous and saline taste and a slightly acid reaction.

When a clean platinum wire is moistened with the Solution and held in a non-luminous flame, it imparts an intensely yellow color.

When 10 cc. of the Solution is carefully neutralized with ammonia T.S., and an equal volume of calcium chloride T.S. added, and the mixture boiled, a white precipitate is produced.

Assay—Evaporate 80 cc. of Solution of Sodium Citrate to dryness in a platinum dish, carefully carbonize and proceed as directed for the assay for alkali salts of organic acids.

This assay is explained on page 1456.

Uses—This solution is used as a diuretic and diaphoretic in doses of two to four fluidrachms (8 to 15 cc.). Its uses are similar to those of solution of potassium citrate, although only about one-third the strength.

LIQUOR SODII PHOSPHATIS COMPOSITUS. N. F. Compound Solution of Sodium Phosphate

[Liq. Sod. Phos. Co.]

	Metric	Alternative
Sodium Phosphate, in uneffloresced crystals	**1000 Gm.**	33 oz. av. 167 gr.
Citric Acid	**130 Gm.**	4 oz. av. 149 gr.
Glycerin	**150 cc.**	4 fl. oz. 384 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Heat the mixture of sodium phosphate and citric acid in a glass or porcelain vessel on a water bath until liquefied. Filter the solution while hot into a vessel which has just previously been rinsed with boiling water. Add the glycerin and sufficient distilled water, just previously boiled, to make the product measure 1000 cc. [2 pints].

It is important that *uneffloresced* crystals of sodium phosphate be used in making this solution, as it is nearly saturated. Should an effloresced salt be employed with its greater percentage of anhydrous sodium phosphate, the solution is likely to crystallize.

Should sodium phosphate in partly effloresced form be used, the salt should be first covered or thoroughly washed with distilled water, and, when the efflorescence has disappeared, the clear crystals should be removed from the water and air-dried; or a small quantity of the sample may be dried with heat, as directed under *Sodii Phosphas Exsiccatus* (U. S. P.), and the percentage of moisture determined. When the amount of water present is known, a proportionately smaller quantity of the effloresced salt may be taken.

Compound Solution of Sodium Phosphate is a clear, colorless liquid, of a thick, syrupy consistence, practically odorless and having a cooling, saline taste.

It is acid to litmus paper.

Specific gravity: about 1.385 at 25° C.

Not more than 2.218 Gm. of ash remains on evaporating 10 cc. of the solution and igniting the residue.

Dilute 5 cc. of the solution with 5 cc. of distilled water and add 5 cc. of magnesia mixture T.S.: a white crystalline precipitate is formed.

Preserve the Solution in well-stoppered bottles, in a moderately warm place.

Uses—This solution, which represents the salt in the proportion of 1 Gm. in each cc. furnishes a convenient form for the administration of sodium phosphate, the citric acid is added to prevent the salt from crystallizing and the glycerin assists in its preparation, and especially in preventing the development of micro-organisms. The dose is two fluidrachms (8 cc.).

Unofficial Salts of Sodium

Sodii Ammonii et Hydrogenii Phosphas
$NH_4NaHPO_4+4H_2O$
Sodium, Ammonium, Hydrogen Phosphate

Known as microcosmic salt. It is soluble in water to which it imparts an alkaline reaction. When strongly heated it fuses, evolving water and ammonia, and leaves a transparent glass of sodium metaphosphate

Sodii et Argenti Thiosulphas
$2Na_2S_2O_3+Ag_2S_2O_3$
Sodium and Silver Thiosulphate

A water-soluble crystalline double-salt having a sweet taste. Its solution is decomposed by mineral acids, yielding sulphur, sulphur dioxide, water, and sodium and silver salt of the acid. It forms when sodium thiosulphate dissolves the silver halides

Sodii Bisulphis, $NaHSO_3$
Sodium Bisulphite (U. S. P. VIII)

A white crystalline powder having a disagreeable taste and a slight sulphurous odor. It is soluble in water and insoluble in alcohol. Sodium bisulphite is largely used in paper manufacture, as a disinfectant and antiseptic, and in calico-bleaching

Sodii Chloras, $NaClO_3$
Sodium Chlorate (U. S. P. VIII)

Colorless and odorless crystals with a cooling saline taste; soluble in water and in alcohol. It is a powerful oxidizing agent and should not be triturated with any combustible substance. Sodium chlorate is more soluble and richer in oxygen than potassium chlorate but is less desirable in dry explosives because of its tendency to be hygroscopic in mixtures

Unofficial Salts of Sodium—*Continued*

Sodii Cyanidum, NaCN Sodium Cyanide (U. S. P. IX)	White, amorphous pieces, or a white granular powder, deliquescent in the air and exhaling the odor of hydrocyanic acid. It is very poisonous and should be handled with great caution. It is used in medicine, in electroplating, as an insecticide, in the extraction of gold and silver and in the heat treatment of metals
Sodii Ethylas, C_2H_5NaO Sodium Ethylate	A derivative of ethyl alcohol in which the hydrogen of the hydroxyl is replaced by an atom of sodium. It is used in surgery as a caustic. This compound is decomposed by water with the formation of ethyl alcohol and sodium hydroxide
Sodii Ethylsulphas, $C_2H_5NaSO_4+H_2O$ Sodium Ethylsulphate, Sodium Sulphovinate	A white granular powder having a cooling, rather aromatic taste. It is deliquescent and very soluble in water. This compound makes a very pleasant purgative but is expensive and unstable
Sodii Nitras, $NaNO_3$ Sodium Nitrate (U. S. P. VIII)	Commonly called *chili saltpetre* and *cubic nitre*. Colorless crystals, without odor, and with a saline, slightly bitter taste. It is readily soluble in water, slightly soluble in alcohol. It is largely used in the manufacture of nitric acid and of potassium nitrate and in fertilizers
Sodii Nitro-Prussidum $Na_2Fe(CN)_5NO+2H_2O$ Sodium Nitro-Prusside	Ruby-red transparent crystals, soluble in water. It is used as a reagent for sulphides in analytical chemistry. It is also used in testing silk for the presence of animal hair
Sodii Phenolas, NaC_6H_5O Sodium Phenolate	White deliquescent crystals, soluble in water and alcohol. Sodium phenolate is used as an antiseptic, in a mixture for military gas masks that absorbs phosgene, and in the manufacture of salicylic acid. When acidified with a mineral acid it yields phenol and a sodium salt of the acid used
Sodii Phenolsulphonas, $NaC_6H_5O.SO_3.2H_2O$, Sodium Phenolsulphonate Sodium Sulphocarbolate (U. S. P. IX)	Colorless, transparent crystalline granules; somewhat efflorescent in dry air. It is soluble in water and is used as an antifermentative, or intestinal antiseptic. The dose is from 4 to 20 grains (0.26 to 1.3 Gm.)
Sodium Phosphate, Tribasic, Na_3PO_4	*Trisodium phosphate, sodium orthophosphate* sometimes erroneously called *sodium triphosphate* or simply *triphosphate*, is a cheap compound made and sold upon an enormous scale and used for all purposes where a mild alkali is needed, as in bottle washing, laundrying, scrubbing, etc. It has appeared upon the market in numerous package forms under coined trade names and sold usually at fancy prices, for *cleaning paint brushes, removing old paint and varnish*, and for general washing and cleaning purposes Some of these commercial forms are intensified in power by the addition of caustic soda, others are rendered milder by the addition of sodium bicarbonate. Some of the trisodium phosphate on the market consists simply of a mixture of soda ash and *disodic hydrogen phosphate* in molecular proportions
Sodii et Platini Chloridum $2NaCl.PtCl_4+6H_2O$ Sodium and Platinum Chloride	A yellow to red crystalline substance; very soluble in water and alcohol—differing in this respect from the corresponding salt of potassium
Sodii Pyrophosphas, $Na_4P_2O_7+10H_2O$ Sodium Pyrophosphate (U. S. P. VIII)	Colorless, transparent crystals without odor and with a cooling saline taste. It is soluble in water and insoluble in alcohol. It is used in the manufacture of pyrophosphate of iron
Sodium Sesquicarbonate, $Na_4H_2(CO_3)_3.3H_2O$	Under this name there has appeared upon the market a crystalline salt used for cleaning paint brushes, removing old paint and varnish and for general cleaning purposes, as a substitute for and milder than soda ash. It is made by boiling a solution of sodium bicarbonate to remove a portion of the CO_2 and then crystallizing
Sodii Silicas, Na_2SiO_3 Sodium Silicate, Water Glass, Soluble Glass	White to grayish-white lumps or powder, soluble in water, insoluble in alcohol. It is used as an egg preservative, for fire proofing fabrics, stiffening bandages, filling for soaps, and for a variety of other purposes
Sodii Silicofluoridum, Na_2SiF_6 Sodium Silico-Fluoride	A white, odorless and tasteless granular powder; very slightly soluble in cold water, insoluble in alcohol. It is used in ceramics and has been used in medicine
Sodii Stannas, Na_2SnO_3 Sodium Stannate	Commonly called *preparing salt*. White powder or lumps soluble in water, insoluble in alcohol. It is used as a mordant in dyeing
Sodii Sulphis Exsiccatus, Na_2SO_3 Exsiccated Sodium Sulphite (U. S. P. IX)	A white powder, tending to oxidize to sodium sulphate when exposed to the air. It is soluble in water. Exsiccated sodium sulphite is an antifermentative. The dose is from 10 to 30 grains (0.65 to 1.9 Gm.). It is sometimes used as a bleaching agent in confectionery, or as a food preservative, although such use is illegal
Sodii Tartras, $Na_2C_4H_4O_6+2H_2O$ Sodium Tartrate	A white crystalline substance; soluble in water and insoluble in alcohol. It has been used in medicine but is of very little importance
Sodii Valeras, $NaC_5H_9O_2$ Sodium Valerate	A white, deliquescent, very soluble salt having a disagreeable odor and sweetish taste. It has been used in medicine but more largely in the preparation of other valerates by double decomposition

CHAPTER XLVIII

THE LITHIUM SALTS

Li; 6.94

Lithium is from a Greek word meaning "stone", indicating its discovery in a mineral.

The lithium salts resemble those of potassium and sodium. The metal lithium is comparatively rare, for although the element is widely distributed in nature, it occurs in such small quantities that the necessary labor to extract it makes it comparatively expensive; it is found as a silicate in combination with other metals in certain minerals as *lithium mica, lepidolite, petalite,* and *spodumene,* and in a few mineral waters.

Lithium is a metal resembling potassium and sodium, although much less prone to oxidation; it is soft, *and is the lightest of all known metals,* having a specific gravity of about 0.5891. Heated in the air, lithium ignites at a temperature above its fusing point, burning with a bright white light, but its salts burn with an intense red flame; when thrown on water, it oxidizes, but does not fuse like sodium. Chemically, lithium is a monad, like sodium and potassium.

Tests for Lithium

Lithium salts moistened with hydrochloric acid impart an intense, crimson color to a non-luminous flame. Solutions of lithium salts are not precipitated by diluted sulphuric acid or soluble sulphates (*difference from strontium*).

LITHII BENZOAS. N. F. Lithium Benzoate
[Lith. Benz.]

Lithium Benzoate contains, when dried for 24 hours over sulphuric acid, not less than 98.5 per cent of $LiC_7H_5O_2$ (128.01).

It is prepared by decomposing lithium hydroxide with benzoic acid according to the following equation:

$$\underset{\text{lithium hydroxide}}{Li(OH)} + \underset{\text{benzoic acid}}{HC_7H_5O_2} = \underset{\text{lithium benzoate}}{LiC_7H_5O_2} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—A white powder or small crystalline scales. It is odorless, and is stable in the air.

One Gm. of Lithium Benzoate dissolves in about 3 cc. of water and in about 16 cc. of alcohol at 25° C. It is slightly more soluble in these solvents when hot.

Tests for Identity—When heated the salt at first fuses, then at higher temperatures it chars, emitting inflammable vapors having a benzoin-like odor and finally leaves a residue of lithium carbonate and carbon. This residue is alkaline to litmus paper, effervesces with acids and colors a non-luminous flame crimson.

The addition of mineral acids to an aqueous solution of Lithium Benzoate (1 in 20) produces a voluminous white precipitate of benzoic acid. Ferric chloride added to the aqueous solution produces a flesh colored precipitate of ferric benzoate.

Tests for Purity—Dissolve 0.6 Gm. of Lithium Benzoate in 25 cc. of water, add 5 cc. of diluted hydrochloric acid, filter and wash the precipitate with about 25 cc. of distilled water. Evaporate the combined filtrate and washings on a water bath to a small volume in a beaker or dish, then transfer completely with the aid of a little water into a flat-bottomed flask of about 50 cc. capacity and evaporate almost to dryness on a water bath. Add 10 cc. of amyl alcohol and cautiously heat the mixture until all the water has evaporated. The removal of the water from the amyl alcohol mixture may be facilitated by passing a current of air through the hot solution. Then add three drops of hydrochloric acid and boil the solution for three minutes. If any insoluble residue remains, collect it on a filter, wash it with amyl alcohol and dry at 110° C. to constant weight. The weight of the residue should not exceed 0.004 Gm. (*other alkalies*).

Dissolve about 1 Gm. of Lithium Benzoate in 20 cc. of water in a separatory funnel, add 10 cc. of diluted sulphuric acid, extract the precipitate of benzoic acid by shaking with two portions of

20 cc. each of ether, and evaporate the ether solution to dryness at a low temperature. One half Gm. of the residue of benzoic acid thus obtained complies with the test for *chlorine* described in the U. S. P. under *Acidum Benzoicum*.

The aqueous layer from the above test, warmed to expel ether and diluted to 50 cc. does not respond to the test for *heavy metals*.

Assay—Weigh accurately about 0.5 Gm. of Lithium Benzoate, which has previously been dried for 24 hours over sulphuric acid, mix it with 1 Gm. of dried and powdered ammonium sulphate and cautiously ignite in a porcelain crucible to constant weight. The weight of the residue of lithium sulphate thus obtained, multiplied by 2.328, represents its equivalent of Lithium Benzoate.

This assay is explained on page 1480.

N. F. Preparation—Elixir Hydrangeæ et Lithii.

Uses—A diuretic and antirheumatic. It is given in fifteen grain (1 Gm.) doses.

LITHII BROMIDUM. N. F. Lithium Bromide

(U. S. P. IX)

[Lith. Brom.]

Lithium Bromide contains, when dried for twenty-four hours over sulphuric acid, not less than 85 per cent of LiBr (86.86).

Preparation—Lithium bromide is best prepared by carefully neutralizing lithium carbonate, or lithium hydroxide, with hydrobromic acid, and by subsequent crystallization of the salt from solution.

$$\underset{\text{lithium carbonate}}{Li_2CO_3} + \underset{\text{hydrobromic acid}}{2HBr} = \underset{\text{lithium bromide}}{2LiBr} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

$$\underset{\text{lithium hydroxide}}{LiOH} + \underset{\text{hydrobromic acid}}{HBr} = \underset{\text{lithium bromide}}{LiBr} + \underset{\text{water}}{H_2O}.$$

It is also prepared by placing 300 grains of iron and 2 fluidounces of water in a flask, and adding gradually 1 oz. av. of bromine, shaking with the application of moderate heat until the mixture has acquired a green color and lost the odor of bromine; the solution of ferrous bromide is then filtered, heated, and 200 grains of lithium carbonate are added. The solution is filtered, and evaporated until the salt granulates.

$$\underset{\text{ferrous bromide}}{FeBr_2} + \underset{\text{lithium carbonate}}{Li_2CO_3} = \underset{\text{lithium bromide}}{2LiBr} + \underset{\text{ferrous carbonate}}{FeCO_3}$$

Description and Physical Properties—Lithium Bromide is a white, granular salt, odorless and having a sharp, slightly bitter taste; very deliquescent.

One Gm. of Lithium Bromide dissolves in 0.6 cc. of water at 25° C.; also in 0.4 cc. of boiling water; freely soluble in alcohol and soluble in ether.

Tests for Identity—An aqueous solution of the salt (1 in 20) is neutral or slightly alkaline to litmus.

At a low red heat the salt fuses, and at a higher heat it is slowly volatilized. It imparts a crimson color to a non-luminous flame.

Silver nitrate T.S., added to an aqueous solution of the salt (1 in 10) produces a yellowish white precipitate insoluble in nitric acid or in a moderate excess of ammonia water.

Tests for Purity—Add a few drops of ferric chloride T.S. and 1 cc. of chloroform to 10 cc. of an aqueous solution of the salt (1 in 20) and shake the mixture. The chloroform does not acquire a violet tint (*iodide*).

Drop 1 cc. of diluted sulphuric acid on about 1 Gm. of the powdered salt; no yellow color appears at once (*bromate*).

Dissolve about 0.1 Gm. of Lithium Bromide in 5 cc. of distilled water, add an excess of silver nitrate T.S. and a few drops of nitric acid; filter and wash the precipitate with distilled water, then digest it for ten minutes with 5 cc. of ammonium carbonate T.S. and filter. On supersaturating the filtrate with nitric acid, not more than a slight turbidity is produced at once (*chloride*).

Five cc. of an aqueous solution of the salt (1 in 100) acidulated with 4 drops of hydrochloric acid shows no immediate turbidity with 1 cc. of barium chloride T.S. (*sulphate*).

Add 5 cc. of hydrochloric acid and 5 cc. of chlorine T.S. to 0.4 Gm. of Lithium Bromide contained in a flat-bottomed flask of 50 cc. capacity, evaporate the mixture almost to dryness on a water bath, add 10 cc. of amyl alcohol and cautiously heat the mixture until the lower aqueous layer has evaporated. Then add three drops of hydrochloric acid and boil the solution for three minutes; the resulting insoluble residue, if any, when collected on a filter, washed with amyl alcohol and dried at 110° C., weighs not more than 0.002 Gm. (*other alkalies*). The removal of water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Assay—Introduce into a tared weighing-bottle about 0.35 Gm. of Lithium Bromide, previously dried for twenty-four hours over sulphuric acid, stopper, weigh accurately, and proceed as directed under the Assay for bromides (see page 1515).

Each cc. of tenth-normal silver nitrate corresponds to 0.008686 Gm. of LiBr. Each Gm. of Lithium Bromide corresponds to not less than 97.9 cc. of tenth-normal silver nitrate.

This assay is explained on page 1462.

Preserve it in air-tight containers.

N. F. Preparations—Elixir Bromidorum Quinque, Syrupus Bromidorum.

Uses—Lithium bromide is used as a nerve sedative. Because of the low atomic weight of the metallic lithium, it contains a larger proportion of bromine than any other salt. The dose is fifteen grains (1 Gm.).

LITHII CARBONAS. N. F. Lithium Carbonate

(U. S. P. IX)

[Lith. Carb.]

Lithium Carbonate contains, when dried to constant weight at 100° C., not less than 98.5 per cent of Li_2CO_3 (73.89).

Preparation—Lithium carbonate may be prepared from lepidolite, one of the minerals in which it is found, in the following manner: 10 parts of finely powdered lepidolite, 10 parts of barium carbonate, 5 parts of barium sulphate, and 3 parts of potassium sulphate are fused at a very high temperature in a blast furnace. The heavy silicate and barium sulphate sink to the bottom, and a layer of potassium and lithium sulphate is found at the top of the fused mass. These can be extracted by simple lixiviation, and then the carbonate prepared by double decomposition with ammonium carbonate. It may also be prepared by treating a solution of ammonium carbonate, or of sodium carbonate, with a hot concentrated solution of lithium chloride. The reaction may be expressed by the equation

$$\underset{\text{lithium chloride}}{2LiCl} + \underset{\text{ammonium carbonate}}{(NH_4)_2CO_3} = \underset{\text{lithium carbonate}}{Li_2CO_3} + \underset{\text{ammonium chloride}}{2NH_4Cl}$$

Description and Physical Properties—Lithium Carbonate is a light, white powder, odorless, and having an alkaline taste; permanent in the air.

One Gm. of Lithium Carbonate dissolves in 78 cc. of water at 25° C.; also in 140 cc. of boiling water; almost insoluble in alcohol; dissolved by diluted acids with effervescence.

Tests for Identity—At a low red heat the salt fuses; at a higher temperature it loses some of its carbon dioxide, and is partially converted into lithium oxide. It imparts a crimson color to a non-luminous flame.

A saturated aqueous solution of the salt is alkaline to litmus.

Tests for Purity—Lithium Carbonate when dissolved in 40 parts of diluted acetic acid, leaves not more than 0.15 per cent of insoluble residue.

Mix 1 part of Lithium Carbonate with 20 parts of distilled water and add hydrochloric acid, drop by drop, with agitation until solution takes place. The resulting solution, after boiling and cooling, responds to the following tests when applied to separate portions:

The addition of ammonia water to 5 cc. of this solution until it has an alkaline reaction produces neither turbidity nor precipitation either before or after boiling (*iron, aluminum*).

Dilute another portion of 4 cc. of this solution with 6 cc. of distilled water; it does not respond to the test for heavy metals (see page 1519).

Add a slight excess of diluted hydrochloric acid to 0.2 Gm. of Lithium Carbonate contained in a flat-bottomed flask of 50 cc. capacity, evaporate the mixture almost to dryness on a water bath, add 10 cc. of amyl alcohol and cautiously heat the mixture until the lower aqueous layer has evaporated. Then add three drops of hydrochloric acid and boil the solution for three minutes. The resulting insoluble residue, if any, when collected on a filter, washed with amyl alcohol and dried at 110° C., weighs not more than 0.002 Gm. (*other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

Assay—Dissolve about 1.5 Gm. of Lithium Carbonate, previously dried to constant weight at 100° C. and accurately weighed, in 50 cc. of normal sulphuric acid and titrate the solution with normal potassium hydroxide, methyl orange T.S. being used as indicator.

Each cc. of normal sulphuric acid corresponds to 0.03694 Gm. of Li_2CO_3. Each Gm. of Lithium Carbonate, previously dried, corresponds to not less than 26.7 cc. of normal sulphuric acid.

This assay is explained on page 1458.

N. F. Preparation—Sal Potassii Bromidi Effervescens Compositum.

Uses—This salt is the source of the lithium salts, and it is prescribed in gout, in doses of five to fifteen grains (0.32 to 1 Gm.).

LITHII CITRAS. N.F. Lithium Citrate

(U. S. P. IX)

[Lith. Cit.]

Lithium Citrate contains not less than 98.5 per cent of $Li_3C_6H_5O_7.4H_2O$ (281.95).

Preparation—The process formerly official may be usefully employed in making this salt:

Take of lithium carbonate 100 grains; citric acid, in crystals, 200 grains; distilled water 2 fl. oz. Dissolve the citric acid in the water gently heated, and to the solution gradually add the lithium carbonate until perfectly dissolved, heating the solution so long as effervescence is produced. Evaporate, by means of a steam- or sand-bath, to a viscid consistence, dry the residue in an oven, at a temperature of about 115.5° C. (240° F.), then rapidly pulverize it, and preserve the powder in a well-stoppered bottle.

$$\underset{\text{lithium carbonate}}{3Li_2CO_3} + \underset{\text{citric acid}}{2H_3C_6H_5O_7} = \underset{\text{lithium citrate}}{2Li_3C_6H_5O_7} + \underset{\text{water}}{3H_2O} + \underset{\text{carbon dioxide}}{3CO_2}$$

Description and Physical Properties—Lithium Citrate occurs as a white powder, or in the granular form; odorless and having a cooling, faintly alkaline taste. It is deliquescent on exposure to moist air and loses its water of crystallization when heated to 150° C.

One Gm. of Lithium Citrate dissolves in 1.4 cc. of water at 25° C.; very slightly soluble in alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 20) is faintly alkaline to litmus but is not reddened by one drop of phenolphthalein T.S.

At a red heat the salt chars, emits inflammable vapors having a pungent odor, and finally leaves a black residue of lithium carbonate mixed with carbon. It imparts a crimson color to a non-luminous flame.

Boil an aqueous solution of Lithium Citrate (1 in 20) with an equal volume of calcium chloride T.S.; a white precipitate forms.

Tests for Purity—Treat the residue obtained by igniting 0.4 Gm. of the salt at a red heat with a slight excess of diluted hydrochloric acid, filter, wash the residue with distilled water, evaporate the filtrate and washings almost to dryness on a water bath, in a flat-bottomed flask of 50 cc. capacity, add 10 cc. of amyl alcohol and cautiously heat the mixture until the lower aqueous layer has evaporated. Then add three drops of hydrochloric acid and boil the solution for three minutes. The resulting insoluble residue, if any, when collected on a filter, washed with amyl alcohol and dried at 110° C., weighs not more than 0.004 Gm. (*other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Assay—Proceed as directed under the Assay for alkali salts of organic acids (see page 1514).

Each cc. of half-normal sulphuric acid corresponds to 0.04699 Gm. of $Li_3C_6H_5O_7.4H_2O$. Each Gm. of Lithium Citrate corresponds to not less than 21 cc. of half-normal sulphuric acid.

This assay is explained on page 1456.

Preserve it in air-tight containers.

N. F. Preparation—Sal Lithii Citratis Effervescens.

Uses—Lithium citrate is eliminated in the urine as a carbonate and may be used for the same purpose as lithium carbonate; it is more soluble than the latter. The dose is from five to twenty grains (0.32 to 1.3 Gm.).

SAL LITHII CITRATIS EFFERVESCENS. N.F. Effervescent Salt of Lithium Citrate

[Sal. Lith. Cit. Eff.]

	Metric	Alternative
Lithium Citrate	**50 Gm.**	1 oz. av.
Sodium Bicarbonate, dried and powdered	**570 Gm.**	11 oz. av. 175 gr.
Tartaric Acid, dried and powdered	**300 Gm.**	6 oz. av.
Citric Acid, unefflorescd crystals	**195 Gm.**	3 oz. av. 394 gr.
To make about	**1000 Gm.**	20 oz. av.

Prepare an effervescent salt as directed in the General Process (see page 475).

Uses—This salt forms a pleasant mode of administering a lithium salt; the dose is one to two drachms (4 to 8 Gm.).

LITHII SALICYLAS. N.F. Lithium Salicylate

[Lith. Salicyl.]

Lithium Salicylate contains, when dried to constant weight at 120° C., not less than 98.5 per cent of $LiC_7H_5O_3$ (144.02).

Preparation—This salt may be prepared by adding 60 grains of lithium carbonate to 1 fluidounce of distilled water and heating the mixture to boiling, then adding 220 grains of salicylic acid and continuing the heat until effervescence ceases, filtering, and evaporating. As in the case of sodium salicylate contact with metal should be avoided.

$$\underset{\text{lithium carbonate}}{Li_2CO_3} + \underset{\text{salicylic acid}}{2HC_7H_5O_3} = \underset{\text{lithium salicylate}}{2LiC_7H_5O_3} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

Description and Physical Properties—Lithium Salicylate occurs as a white or grayish white powder; deliquescent in a moist atmosphere; odorless; taste sweetish.

It is very soluble in water and in alcohol.

Tests for Identity and Purity—When heated, the salt is decomposed, emitting the odor of phenol, and finally leaving a residue of lithium carbonate and carbon. It imparts a crimson color to a non-luminous flame.

An aqueous solution of the salt (1 in 20) is neutral or slightly acid to litmus, and when freshly made is colorless (*iron and organic coloring matter*); it does not effervesce upon the addition of diluted acids (*carbonate*).

Copper sulphate T.S. added to an aqueous solution of the salt (1 in 20) produces a bright green color.

Add a few drops of ferric chloride T.S. to an excess of an aqueous solution of the salt (1 in 4); a deep red color is produced. In a dilute solution of the salt (1 in 100) ferric chloride T.S. produces a deep violet-blue color.

Hydrochloric acid added to an aqueous solution of the salt (1 in 20) produces a voluminous white precipitate of salicylic acid.

Dissolve 0.7 Gm. of the salt in 10 cc. of distilled water, add an excess of hydrochloric acid and filter. Evaporate the filtrate almost to dryness on a water bath, in a 50 cc. Erlenmeyer flask, and then add 10 cc. of amyl alcohol and cautiously heat until the lower aqueous layer is evaporated; then add three drops of hydrochloric acid and boil the liquid for three minutes; the insoluble residue weighs not more than 0.005 Gm. (*other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

Dissolve 1 Gm. of the salt in 50 cc. of distilled water, precipitate the salicylic acid by the addition of a slight excess of hydrochloric acid and filter; the filtrate does not respond to the test for heavy metals (see page 1519).

Assay—Weigh accurately 1 Gm. of Lithium Salicylate, which has previously been dried for twenty-four hours over sulphuric acid, mix it with 2 Gm. of powdered ammonium sulphate in a porcelain crucible, and cautiously ignite it. The weight of the residue of lithium sulphate, multiplied by 2.629, represents its equivalent in Lithium Salicylate.

This assay is explained on page 1456.

Preserve it in well closed containers, protected from heat.

N. F. **Preparations**—Elixir Hydrangeæ et Lithii, Elixir Manacæ Compositum.

Uses—This salicylate is used, like sodium salicylate, for rheumatism and gout; it is given in doses of fifteen to forty grains (1 to 2.6 Gm.).

Unofficial Salts of Lithium

Lithii Borocitras Lithium Borocitrate	A white powder; soluble in water. It is used as an antarthritic in a dose of from 1 to 5 grains (0.06 to 0.32 Gm.)
Lithii Carbonas, Li_2CO_3 Lithium Carbonate	A light, white, alkaline powder; sparingly soluble in water. It is readily dissolved by acids with the evolution of carbon dioxide. It is used as an antilithic, diuretic, and antirheumatic. Dose, from 5 to 15 grains (0.32 to 1 Gm.)
Lithii Chloridum, LiCl Lithium Chloride	Colorless, deliquescent crystals; soluble in water, and having a sharp, saline taste. It is used for rheumatic and gouty conditions
Lithii Iodidum, LiI Lithium Iodide	A white, deliquescent coarse powder; very soluble in water. It is used as an antirheumatic and alterative. The dose is from 1 to 5 grains (0.32 to 1 Gm.)
Lithii Nitras, $LiNO_3$ Lithium Nitrate	Transparent crystals; very soluble in water. It is deliquescent and should be kept in well-stoppered bottles. Its uses and dose are similar to those for other lithium compounds
Lithii Phosphas, Li_3PO_4 Lithium Phosphate	A white, crystalline powder; very slightly soluble in water. It resembles the other lithium compounds in its medicinal uses. The dose is from 10 to 30 grains per day (0.6 to 2 Gm.)
Lithii Sulphas, $Li_2SO_4.H_2O$ Lithium Sulphate	Colorless crystals or a white crystalline powder; soluble in water. It is used for constipation with torpid liver or gravel. The dose is from 10 to 30 grains (0.6 to 2 Gm.)

CHAPTER XLIX

AMMONIUM

NH_4; 18.04

The ammonium salts resemble those of the alkali metals so closely in their physical and chemical properties that they are appropriately considered in this place.

The metal ammonium has not yet been isolated in the free state, so that its appearance cannot be described. An *ammonium amalgam* is known, however, and is made by dissolving potassium in mercury and adding a strong solution of ammonium chloride to it. It is a spongy, metallic appearing substance, which quickly decomposes into ammonia, mercury, and hydrogen upon exposure.

Tests for Ammonium Salts

Ammonium salts are decomposed by the addition of an excess of sodium hydroxide T.S. with the evolution of ammonia, recognizable by its odor and by its alkaline effect upon moistened red litmus paper, exposed to the vapor.

At high temperatures ammonium compounds are volatilized.

Ammonia darkens the blue color of paper moistened with solution of copper sulphate. Ammonia forms a white cloud with vapor of hydrochloric acid.

Solution of platinic chloride, with a few drops of hydrochloric acid, if added to a solution of an ammonium salt, produces a yellow precipitate.

Ammonium salts are mostly colorless, and generally very soluble in water.

Chloroplatinic acid gives with ammonium salts a yellow crystalline precipitate of ammonium chloroplatinate, only slightly soluble in water.

AQUA AMMONIÆ. U. S. Ammonia Water

[Aq. Ammon.]

Ammonia Water is an aqueous solution of ammonia (NH_3), containing not less than 9.5 per cent and not more than 10.5 per cent by weight of NH_3 (17.03). This solution deteriorates rapidly and must be assayed frequently.

Preparation—This useful liquid is rarely prepared by the pharmacist, for the reason that it can be made more economically by the manufacturer. A former official process directed that it be made by mixing and heating ammonium chloride with milk of lime in a retort, and collecting the distillate beneath the surface of distilled water contained in the receiver; the reaction was as follows:

$$\underset{\text{ammonium chloride}}{2NH_4Cl} + \underset{\text{calcium hydroxide}}{Ca(OH)_2} = \underset{\text{ammonia}}{2NH_3} + \underset{\text{calcium chloride}}{CaCl_2} + \underset{\text{water}}{2H_2O}$$

The manufacturer, however, rarely uses ammonium chloride; the sulphate is cheaper, and it is employed instead. Upon the large scale the ammonia liquor obtained from gas works is used directly as the source of ammonia, being mixed with milk of lime and heated; the gaseous ammonia is then passed through a series of tubes filled with charcoal, which retain the empyreumatic products. If the tubes are long enough, and sufficient charcoal is employed, a

pure product is assured; but much of the commercial ammonia water is empyreumatic through defective purification. Ammonia is also produced in enormous quantities by synthetic methods, either by the direct union of atmospheric nitrogen and hydrogen, by passing the mixture over a catalytic agent, at a temperature between 500° and 700° C., and under a pressure of two hundred atmospheres, or else from cyanamide, when it is decomposed by superheated steam as follows:

$$\underset{\text{calcium cyanamide}}{CaCN_2} + \underset{\text{steam}}{3H_2O} = \underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{ammonia}}{2NH_3}$$

Ammonia is also produced by destructively distilling waste animal matter.

Ammonia gas may be expelled from ammonia water by simply applying heat to the solution.

Description and Physical Properties—A colorless, transparent liquid, having a very pungent, characteristic odor.

Specific gravity: about 0.958 at 25° C.

Tests for Identity—Ammonia Water is strongly alkaline to litmus paper.

Dense, white fumes are produced on bringing a glass rod dipped into hydrochloric acid near the surface of the Ammonia Water. (This is due to the condensation in moist air of tiny particles of ammonium chloride.)

Tests for Purity—A 25 cc. portion of Ammonia Water, evaporated to dryness in a platinum or porcelain dish and dried to constant weight at 120° C., leaves not more than 0.005 Gm. of residue.

Add 0.1 cc. of tenth-normal potassium permanganate to 10 cc. of Ammonia Water to which a slight excess of diluted sulphuric acid has been added: the pink color is not completely destroyed within ten minutes (*oxidizable substances*).

When neutralized and then made slightly acid with hydrochloric acid, a 10 cc. portion of the Water meets the requirements of the test for *heavy metals*, page 1519.

Assay—Pour into a weighing bottle about 10 cc. of distilled water, tare the bottle and its contents, add about 5 cc. of Ammonia Water, and weigh accurately. Then titrate with normal sulphuric acid, using methyl orange T.S. as indicator. Each cc. of normal sulphuric acid corresponds to 0.01703 Gm. of NH_3.

This assay is explained on page 1455.

Preserve in a cool place in glass-stoppered or rubber-stoppered bottles made of hard glass, free from lead.

U. S. P. Preparations — Fluidextractum Senegæ; Spiritus Ammoniæ Aromaticus; Sulphur Lotum; Syrupus Senegæ.

N. F. Preparations—Elixir Ammoniæ Valeratis; Elixir Ferri Pyrophosphatis, Quininæ et Strychninæ; Linimentum Ammoniæ; Linimentum Opii Compositum; Linimentum Saponato-Camphoratum; Liquor Carmini; Liquor Ferri Citratis; Lotio Ammoniacalis Camphorata; Magma Bismuthi; Olea Infusa; Spiritus Ammonii Anisatus.

Uses—Ammonia water is occasionally employed hypodermically as a circulatory stimulant; it is also used for syncopal attacks by inhaling. It is rarely given by mouth, the aromatic spirit being preferred. The dose is ten to twenty minims (0.6 to 1.2 cc.), largely diluted. Externally, it is caustic and stimulating. It is a common ingredient in stimulating liniments. Pharmaceutically, ammonia water is frequently used to precipitate iron salts by combining with the acid radicals, ferric hydroxide being thrown down. Its advantage over the fixed alkalies consists in its volatility, any excess being readily detected by the odor. It is largely used for cleaning fabrics. The strength technically known as "Aqua Ammoniæ F. F. F.", or "20° ammonia", is employed most frequently in the arts; it may be diluted with water, according to the formula given on page 88, if it is desirable to make official ammonia water from it. In round numbers, three parts of 20° ammonia water requires two parts of water to reduce it to the strength of official ammonia water. This is one of the instances where the Baumé hydrometer degrees are still used commercially in designating the strength of liquids. In addition to the "20° ammonia", which represents about 17.5 per cent of NH_3, a "16° ammonia",

which corresponds to the official 10 per cent Ammonia water, and "26° ammonia", which represents the U. S. P. stronger ammonia water, are used technically and are commercial terms. The old name *spirits of hartshorn* is derived from an early origin of the product, as it was made by collecting the gases resulting from the destructive distillation of the horns of the variety of European deer known as the hart. This name is almost entirely supplanted by the modern name, "ammonia" which originated from the fact that *sal ammoniac* was obtained as a residue from the evaporation and decomposition of camels' urine in the hot sands of the Libyan Desert, near the temple of Ammon.

AQUA AMMONIÆ FORTIOR. U. S. Stronger Ammonia Water

[Aq. Ammon. Fort.]

Stronger Ammonia Water is an aqueous solution of ammonia (NH_3), containing not less than 27 per cent and not more than 29 per cent by weight of NH_3 (17.03). This solution deteriorates rapidly and must be assayed frequently.

Caution—Great care should be used in handling the liquid because of its caustic and irritating properties.

Preparation—Stronger ammonia water is prepared as already described under ammonia water, the only difference being that of relative strength.

Description and Physical Properties—A colorless, transparent liquid, having an excessively pungent, characteristic odor, and a very caustic and alkaline taste. *Stronger Ammonia Water must never be tasted nor smelled unless greatly diluted.*

Specific gravity: about 0.897 at 25° C.

Tests for Identity and Purity—Stronger Ammonia Water is strongly alkaline to litmus paper.

Stronger Ammonia Water diluted with twice its volume of distilled water conforms to the tests for identity and purity under *Aqua Ammoniæ*.

Assay—Pour into a weighing bottle about 25 cc. of distilled water, tare the bottle and its contents, add about 2 cc. of Stronger Ammonia Water, and weigh accurately. Then titrate with normal sulphuric acid, using methyl orange T.S. as indicator. Each cc. of normal sulphuric acid corresponds to 0.01703 Gm. of NH_3.

This assay is explained on page 1455.

Preserve in a cool place in partly filled, strong, glass-stoppered bottles made of hard glass, free from lead.

N. F. Preparations—Lotio Ammoniacalis Camphorata and the Petroxolins.

Uses—This liquid is used only for chemical and pharmaceutical purposes and for making ammonia water by dilution and in the preparation of the petroxolins of the N. F., where it forms an ammonium oleate, also in spirit of ammonia. It is too strong for internal administration.

SPIRITUS AMMONIÆ AROMATICUS. U. S. Aromatic Spirit of Ammonia

[Sp. Ammon. Arom.]

For the details of the formula see page 307.

Description and Physical Properties—A nearly colorless liquid when freshly prepared, but gradually acquiring a yellow color.

It has the taste of ammonia and an aromatic and pungent odor.

Specific gravity: about 0.900 at 25° C.

Preserve in glass-stoppered bottles, in a cool place.

Alcohol content, by volume, 62 to 68 per cent.

Uses—This is a very valuable and largely used antacid and stimulant. It is useful in cases of nausea, faintness, and other similar conditions. The dose is from twenty to sixty minims (1.2 to 4 cc.), largely diluted with water.

LIQUOR AMMONII ACETATIS. U. S. Solution of Ammonium Acetate

[Liq. Ammon. Acet.—Spirit of Mindererus]

Solution of Ammonium Acetate contains, in each 100 cc., not less than 6.5 Gm. and not more than 7.5 Gm. of $NH_4C_2H_3O_2$, with small amounts of acetic and carbonic acids.

Caution—Only a recently prepared Solution of Ammonium Acetate should be dispensed.

	Metric	Alternative
Ammonium Carbonate, in hard, translucent pieces	**5 Gm.**	183 gr.
Diluted Acetic Acid	**100 cc.**	8 oz. av.

Dissolve the ammonium carbonate in the diluted acetic acid without strong agitation.

Solution of Ammonium Acetate may also be prepared as follows:

Solution No. 1

	Metric	Alternative
Ammonium Carbonate, in hard, translucent pieces	**50 Gm.**	1 oz. av. 292 gr.
Distilled Water, a sufficient quantity,		
To make	**500 cc.**	1 pint

Solution No. 2

	Metric	Alternative
Acetic Acid	**160 cc.**	5 fl. oz. 60 min.
Distilled Water, a sufficient quantity,		
To make	**500 cc.**	1 pint

Cautiously mix the two solutions in equal volumes in a capacious vessel, in quantities sufficient to produce the amount of Solution of Ammonium Acetate needed.

The reaction involved in this process depends upon the decomposition of the ammonium carbonate with acetic acid; the free carbonic acid is a desirable addition to the solution, which should be dispensed in a slightly effervescent condition.

$$\underset{\text{acid ammonium carbonate and carbamate}}{NH_4HCO_3.NH_4NH_2CO_2} + \underset{\text{acetic acid}}{3HC_2H_3O_2} = \underset{\text{ammonium acetate}}{3NH_4C_2H_3O_2} + \underset{\text{carbon dioxide}}{2CO_2} + \underset{\text{water}}{H_2O}$$

It will be found in practice that the second formula is much more satisfactory than the first. The separate solutions keep well, and it is very convenient to mix them at the time of dispensing, and thus always be enabled to send out a fresh preparation, which retains sufficient carbonic acid to be agreeable to the patient.

Description and Physical Properties—A clear, colorless liquid, free from empyreumatic odor. It has a mildly saline, acidulous taste, and an acid reaction.

Test for Identity—Solution of Ammonium Acetate responds to the reactions for ammonium, page 649, and for acetates, page 800.

Test for Purity—Not more than 0.003 Gm. of ash remains on evaporating 20 cc. of the Solution and igniting the residue.

Assay—Transfer 25 cc. of Solution of Ammonium Acetate to a distilling flask, dilute with 100 cc. of distilled water, add 25 cc. of 10 per cent sodium hydroxide solution, and distil the liquid until all of the ammonia has been driven over (about 100 cc. of distillate), receiving the distillate under the surface of 50 cc. of normal sulphuric acid contained in a flask. Titrate the excess of acid with normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of normal sulphuric acid corresponds to 0.07707 Gm. of $NH_4C_2H_3O_2$.

This assay is explained on page 1457.

U. S. P. Preparation—Liquor Ferri et Ammonii Acetatis.

History—Ramond Minderer was one of the most famous physicians of his time which was early in the seventeenth century. He lived in Augsburg, Germany, and was medical adviser to the Fuggers, the great international financiers of the period. He devised the preparation which bears his name today and first prepared it from vinegar and hartshorn.

Uses—This solution is used as a diaphoretic and diuretic, in the dose of half a fluidounce (15 cc.).

AMMONII BENZOAS. U. S. Ammonium Benzoate
[Ammon. Benz.]

Ammonium Benzoate, when dried for twenty-four hours over sulphuric acid, contains not less than 98 per cent of $NH_4C_7H_5O_2$ (139.12).

Preparation—This salt may be advantageously prepared by a former official process, which is as follows:

Take of benzoic acid 480 gr.; ammonia water, 3½ fl. oz., or a sufficient quantity; distilled water, 4 fl. oz. Dissolve the acid in 3½ fl. oz. of the ammonia water, previously mixed with the distilled water; evaporate with a gentle heat, occasionally adding ammonia water, if necessary, to maintain a slight excess of the alkali; then set aside to crystallize, and dry the crystals without heat.

The process is one of direct combination, the reaction being as follows:

$$\underset{\text{benzoic acid}}{HC_7H_5O_2} + \underset{\text{ammonia water}}{NH_4OH} = \underset{\text{ammonium benzoate}}{NH_4C_7H_5O_2} + \underset{\text{water}}{H_2O}$$

The object of retaining an excess of alkali in the process is to prevent the formation of the acid benzoate, which is less soluble than the official salt.

Description and Physical Properties—Thin, white, laminar crystals, or a crystalline powder, gradually losing ammonia on exposure to air. It is odorless, or has a slight odor of benzoic acid.

One Gm. of Ammonium Benzoate is soluble in 10 cc. of water, 35.5 cc. of alcohol, and in 8 cc. of glycerin, at 25° C.

Tests for Identity—When Ammonium Benzoate is heated to about 200° C., ammonia and benzoic acid are given off.

An aqueous solution of Ammonium Benzoate (1 in 10) responds to the reactions for ammonium, page 649, and for benzoates, page 832.

Tests for Purity—An aqueous solution of the salt (1 in 20) is neutral or not more than slightly acid to litmus paper. Ash: not more than 0.05 per cent.

Acidulate 10 cc. of an aqueous solution of the salt (1 in 50) with hydrochloric acid, and filter: the filtrate meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dry about 0.5 Gm. of Ammonium Benzoate for twenty-four hours over sulphuric acid, weigh accurately, and dissolve in 10 cc. of distilled water in a separator. Add to the solution 5 cc. of diluted sulphuric acid, and extract the liberated benzoic acid by shaking out with three successive portions of 25, 15 and 10 cc., respectively, of chloroform, passing the chloroform solution through a filter previously moistened with chloroform, and removing any benzoic acid adhering to the stem of the funnel and filter paper with a few cc. of chloroform. Evaporate the chloroform solution at a temperature not above 40° C. to about 5 cc., add 25 cc. of a mixture of equal volumes of neutralized alcohol and distilled water, and titrate this solution with tenth-normal barium hydroxide, using phenolphthalein T.S. as indicator. Each cc. of tenth-normal barium hydroxide corresponds to 0.01391 Gm. of $NH_4C_7H_5O_2$.

This assay is explained on page 1456.

Preserve in well-closed containers, in a cool place.

Uses—Ammonium benzoate is used as a urinary antiseptic, in doses of five to twenty grains (0.32 to 1.3 Gm.).

AMMONII BROMIDUM. U. S. Ammonium Bromide

[Ammon. Brom.]

Ammonium Bromide, when dried for twenty-four hours over sulphuric acid, contains not less than 98.5 per cent of NH_4Br (97.96).

Preparation—Several methods have been employed in making this salt; 1. By double decomposition between hot, concentrated solutions of ammonium sulphate and potassium bromide. Most of the potassium sulphate separates out as the mixture cools, leaving ammonium bromide in solution. Alcohol is usually added to facilitate this separation. 2. By adding ammonia water to a solution of ferrous bromide and removing the precipitate of ferrous hydroxide. 3. By the gradual addition of ammonia water to a supersaturated aqueous solution of bromine. When all of the ammonia water is added and the solution is free from the odor of bromine, it is evaporated and the salt granulated. The reaction may be expressed as follows:

$$\underset{\text{bromine}}{6Br} + \underset{\text{ammonia}}{8NH_3} = \underset{\text{ammonium bromide}}{6NH_4Br} + \underset{\text{nitrogen}}{N_2}$$

It may also be made by the action of hydrobromic acid on ammonium hydroxide and subsequent crystallization.

$$\underset{\substack{\text{ammonia}\\\text{water}}}{NH_4OH} + \underset{\substack{\text{hydrobromic}\\\text{acid}}}{HBr} = \underset{\substack{\text{ammonium}\\\text{bromide}}}{NH_4Br} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Colorless crystals, or a white, crystalline or granular powder, having no odor. It is somewhat hygroscopic.

One Gm. of Ammonium Bromide is soluble in 1.3 cc. of water and in 12 cc. of alcohol, at 25° C. One Gm. is soluble in 0.9 cc. of boiling water and in 1.2 cc. of boiling alcohol.

Tests for Identity—When heated, Ammonium Bromide volatilizes without fusing.

An aqueous solution of the salt (1 in 10) responds to the reactions for ammonium, page 649, and for bromides, page 574.

Tests for Purity—An aqueous solution of the salt (1 in 20) is neutral or not more than slightly acid to litmus paper.

Add 2 cc. of nitric acid to about 2 Gm. of Ammonium Bromide, evaporate the mixture to dryness in a porcelain dish on a water bath, and ignite: not more than 0.05 per cent of residue remains.

Add a few drops of ferric chloride T.S. and 1 cc. of chloroform to 10 cc. of an aqueous solution of the salt (1 in 20) and shake the mixture: the chloroform does not acquire a violet tint (*iodide*).

Drop 1 cc. of diluted sulphuric acid upon about 1 Gm. of the powdered salt: no yellow color appears at once (*bromate*).

A blue color is not immediately produced on adding potassium ferrocyanide T.S. to 20 cc. of an aqueous solution of the salt (1 in 250) (*iron*).

Add 1 cc. of potassium sulphate T.S. to 10 cc. of an aqueous solution of Ammonium Bromide (1 in 20) acidulated with hydrochloric acid: no turbidity is produced immediately (*barium*). The addition of barium chloride T.S. to a similar solution of the salt acidulated with hydrochloric acid produces no turbidity (*sulphate*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Assay—Proceed as directed under the assay for bromides, page 1515, using about 0.4 Gm. of Ammonium Bromide, previously dried for twenty-four hours over sulphuric acid, and accurately weighed. Each cc. of tenth-normal silver nitrate corresponds to 0.009796 Gm. of NH_4Br. Each Gm. of Ammonium Bromide, previously dried, corresponds to not less than 100.5 cc. and not more than 103.4 cc. of tenth-normal silver nitrate.

This assay is explained on page 1462.

Preserve in well-closed containers.

N. F. Preparations—Elixir Ammonii Bromidi; Elixir Bromidorum Quinque; Elixir Bromidorum Trium; Syrupus Bromidorum; Syrupus Thymi Compositus.

Uses—Ammonium bromide is sometimes preferred to potassium bromide as a hypnotic and sedative. The dose is from ten to sixty grains (0.65 to 4 Gm.).

AMMONII CARBONAS. U. S. Ammonium Carbonate

[Ammon. Carb.]

Ammonium Carbonate consists of acid ammonium carbonate [$NH_4HCO_3 = 79.03$] and ammonium carbamate [$NH_4NH_2CO_2 = 78.07$] in varying proportions, and yields not less than 30 per cent and not more than 32 per cent of NH_3 (17.03).

Preparation—The large consumption of this salt of ammonium has led to several methods of preparation. The one which is most used at present is the dry sublimation of ammonium sulphate with chalk or calcium carbonate; by double decomposition calcium sulphate and ammonium carbonate are produced.

$$\underset{\text{ammonium sulphate}}{2(NH_4)_2SO_4} + \underset{\text{calcium carbonate}}{2CaCO_3} = \underset{\text{acid ammonium carbonate and carbamate (official)}}{NH_4HCO_3.NH_4NH_2CO_2} + \underset{\text{water}}{H_2O} + \underset{\text{ammonia}}{NH_3} + \underset{\text{calcium sulphate}}{2CaSO_4}$$

The advantage claimed for the use of ammonium sulphate over ammonium chloride is simply that of greater economy.

Official ammonium carbonate is, chemically, a mixed salt. It consists approximately of one molecule of acid ammonium carbonate or bicarbonate, and one of ammonium carbamate, the latter may be regarded as ammonium carbonate minus a molecule of water. If ammonium carbamate is dissolved in water, it is soon changed to normal ammonium carbonate.

$$\underset{\text{ammonium carbamate}}{NH_4NH_2CO_2} + \underset{\text{water}}{H_2O} = \underset{\text{normal ammonium carbonate}}{(NH_4)_2CO_3}$$

Hence an aqueous solution of commercial ammonium carbonate contains both the neutral and acid carbonates. If the official ammonium carbonate is exposed to the air, it is soon changed into the acid carbonate or bicarbonate, through loss of ammonia, and it is thus depreciated in quality. The bicarbonate may be converted back into the carbonate by treating it with ammonia water. This fact is officially recognized in the preparation of aromatic spirit of ammonia. The reaction is as follows:

$$\underset{\text{ammonium bicarbonate}}{NH_4HCO_3} + \underset{\text{ammonia}}{NH_3} = \underset{\text{normal ammonium carbonate}}{(NH_4)_2CO_3}$$

The principal impurities in the commercial salt are empyreumatic substances; the U. S. P. test excludes these.

Description and Physical Properties—White, hard, translucent, columnar masses, having a strong odor of ammonia, without empyreuma, and a sharp, ammoniacal taste. On exposure to the air, the salt loses both ammonia and carbon dioxide, becoming opaque, and is finally converted into friable, porous lumps, or a white powder. For medicinal purposes, use only the translucent portions.

One Gm. of Ammonium Carbonate is very slowly soluble in 4 cc. of water at 25° C. It is decomposed by hot water, with the evolution of carbon dioxide and ammonia. By prolonged boiling with water, the salt is completely decomposed and volatilized. Alcohol dissolves the carbamate, leaving the acid carbonate.

Tests for Identity—When heated, Ammonium Carbonate is volatilized without charring, the vapor being strongly alkaline to moistened litmus paper.

An aqueous solution of the salt (1 in 20) effervesces with acids, and is alkaline to litmus paper.

Tests for Purity—When heated until volatilized, not more than 0.05 per cent of residue remains.

An aqueous solution of the salt (1 in 50) to which a slight excess of hydrochloric acid has been added meets the requirements of the test for *heavy metals*, page 1519.

A 10 cc. portion of an aqueous solution of the salt (1 in 20), on the addition of a slight excess of silver nitrate T.S., followed by a slight excess of nitric acid, does not assume a brown color (*thiosulphate*).

A 2 Gm. portion of the salt shows no more *chloride* than corresponds to 0.1 cc. of fiftieth-normal hydrochloric acid, page 1556, and no more *sulphate* than corresponds to 0.1 cc. of fiftieth-normal sulphuric acid, page 1567.

Add a slight excess of nitric acid to an aqueous solution containing 1 Gm. of the salt, and evaporate to dryness on a water bath: a colorless, odorless residue is obtained (*empyreumatic matter*).

Assay—Place in a weighing bottle about 10 cc. of distilled water, tare the bottle and its contents, add about 2 Gm. of unaltered, translucent Ammonium Carbonate, and weigh accurately. Transfer the contents of the bottle to a 200 cc. flask, add 50 cc. of normal sulphuric acid, and, when solution is effected, titrate the excess of acid with normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of normal sulphuric acid corresponds to 0.01703 Gm. of NH_3.

This assay is explained on page 1455.

Preserve in well-closed containers, in a cool place.

U. S. P. Preparations—Liquor Ammonii Acetatis; Spiritus Ammoniæ Aromaticus.

N. F. Preparations—Liquor Ferri Salicylatis; Magma Bismuthi; Mistura Pectoralis, Stokes'.

Uses—Ammonium carbonate is given hypodermically as a circulatory stimulant. By mouth it is used as an expectorant, especially for children. It is the basis of "smelling salts" so valuable as a restorative in hysterical syncope (see page 1232). The dose is three to five grains (0.2 to 0.32 Gm.). It is generally administered in mucilaginous syrups. It is occasionally used as a leavening agent and in consequence is sometimes called "bakers' ammonia".

AMMONII CHLORIDUM. U. S. Ammonium Chloride
[Ammon. Chlor.]

Ammonium Chloride, when dried for twenty-four hours over sulphuric acid, contains not less than 99.5 per cent of NH_4Cl (53.50).

Preparation—*Sal ammoniac*, as it is termed commercially, is chiefly made from *gas liquor*, the ammoniacal liquid obtained from gas works during the destructive distillation of coal. The ammonia is generally neutralized with hydrochloric acid, the solution evaporated, and the dry mass sublimed in iron pots. The tough, fibrous sublimate is fitted for pharmaceutical and medicinal purposes by purification. It nearly always contains traces of iron, due to the contact of the salt with the cast iron dome. This may be separated by treatment with ammonia water by the following process of purification:

Purification of Commercial Ammonium Chloride—Take of commercial ammonium chloride, in small pieces, 22 oz. av.; ammonia water, 5 fl. dr.; water, 2 pints. Dissolve the ammonium chloride in the water, in a porcelain dish, with the aid of heat; add the ammonia water, and continue the heat for a short time; filter the solution while hot, and evaporate to dryness, with constant stirring, at a moderate heat, until it granulates; the ferrous or ferric chloride is converted into insoluble ferric hydroxide, which is filtered out. If the amount of ammonia water specified is not sufficient to precipitate all of the iron, more must be added.

Description and Physical Properties—A white, crystalline or granular powder, without odor, and having a cooling, saline taste. It is somewhat hygroscopic.

One Gm. of Ammonium Chloride is soluble in 2.6 cc. of water, 100 cc. of alcohol, and in 8 cc. of glycerin, at 25° C. One Gm. is soluble in 1.4 cc. of boiling water.

Tests for Identity—Ammonium Chloride on ignition is volatilized without fusing.

An aqueous solution of the salt (1 in 10) responds to the reactions for ammonium, page 649, and for chlorides, page 567.

Tests for Purity—An aqueous solution of the salt (1 in 20) does not show an immediate acid reaction with 1 drop of methyl orange T.S.

An aqueous solution of Ammonium Chloride meets the requirements of the test for *heavy metals*, page 1519.

Acidulate 10 cc. of an aqueous solution of the salt (1 in 10) with hydrochloric acid and add a few drops of ferric chloride T.S.: no red color should be produced (*thiocyanate*).

Add 2 cc. of nitric acid to 2 Gm. of the salt, and evaporate the mixture to dryness in a porcelain dish on a water bath: a white residue is obtained which, when ignited, yields not more than 0.1 per cent of *non-volatile substances*.

Assay—Proceed as directed under the assay for chlorides, page 1514, using about 0.2 Gm. of Ammonium Chloride, previously dried for twenty-four hours over sulphuric acid and accurately weighed. Each cc. of tenth-normal silver nitrate corresponds to 0.005350 Gm. of NH_4Cl.

This assay is explained on page 1463.

U. S. P. Preparation—Trochisci Ammonii Chloridi.

History—This salt is mentioned by Pliny under the name of *Hammoniacus Sal*. He said that it received its name from being found as a residue from the natural evaporation of camel urine in the hot sands of the Libyan Desert near the temple of Ammon. Later it was found to be prepared by the Arabs by sublimation from the soot which resulted from burning camel's dung.

Uses—Ammonium chloride is used chiefly as an expectorant in bronchitis. It is occasionally employed in digestive diseases. The dose is from five to ten grains (0.32 to 0.65 Gm.). It is sometimes used as an inhalation in catarrh, after drawing the vapors of hydrochloric acid and ammonia into a bottle, where they combine to form ammonium chloride in colloidal ærial suspension. It should never be combined with potassium chlorate, particularly in compressed tablets; for, although the combination is often desirable from a therapeutic standpoint, in time the tablets explode and serious results have been experienced. The crude form of this salt, *sal ammoniac*, is used largely in solution as an electrolyte for voltaic batteries.

AMMONII SALICYLAS. U. S. Ammonium Salicylate

[Ammon. Salicyl.]

Ammonium Salicylate, when dried for twenty-four hours over sulphuric acid, contains not less than 98 per cent of $NH_4C_7H_5O_3$ (155.12).

Preparation—This salt may be made by adding salicylic acid to ammonia water until nearly saturated, evaporating the solution, crystallizing, and purifying the product by recrystallization.

$$\underset{\text{ammonia water}}{NH_4OH} + \underset{\text{salicylic acid}}{HC_7H_5O_3} = \underset{\text{ammonium salicylate}}{NH_4C_7H_5O_3} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Colorless, lustrous, monoclinic prisms, or plates, or a white, crystalline powder. It is odorless, and has at first a slightly saline, bitter taste, with a sweetish after-taste. It is stable in dry air.

One Gm. of Ammonium Salicylate is soluble in 1 cc. of water and in 3 cc. of alcohol, at 25° C.

Tests for Identity—When heated, Ammonium Salicylate fuses with decomposition, giving off inflammable vapors and the odor of phenol, and is finally volatilized.

Ammonium Salicylate responds to the reactions for ammonium, page 649, and for salicylates, page 826.

Tests for Purity—An aqueous solution of the salt (1 in 10) is colorless and neutral or slightly acid to litmus paper.

Ash: not more than 0.1 per cent.

Acidulate 10 cc. of an aqueous solution of Ammonium Salicylate (1 in 50) with hydrochloric acid, and filter: the filtrate meets the requirements of the test for *heavy metals*, page 1519.

Assay—Dry about 0.5 Gm. of Ammonium Salicylate over sulphuric acid, weigh accurately, and dissolve in 10 cc. of distilled water in a separatory funnel. Add to the solution 5 cc. of diluted sulphuric acid, and extract the liberated salicylic acid by shaking out with three successive portions of 25, 15 and 10 cc., respectively, of chloroform, passing the chloroform solutions through a filter previously moistened with chloroform and removing any salicylic acid adhering to the stem of the funnel and filter paper with a few cc. of chloroform. Evaporate the chloroform solution to about 5 cc., add 25 cc. of a mixture of equal volumes of neutralized alcohol and distilled water, phenolphthalein T.S. being used as indicator, and titrate this solution with tenth-normal barium hydroxide. Each cc. of tenth-normal barium hydroxide corresponds to 0.01551 Gm. of $NH_4C_7H_5O_3$.

This assay is explained on page 1456.

Preserve in well-closed containers, protected from heat and light.

Uses—Ammonium salicylate is preferred to sodium salicylate by many physicians; it is used in gout and rheumatism in doses of three to eight grains (0.2 to 0.5 Gm.).

AMMONII HYPOPHOSPHIS. N. F. Ammonium Hypophosphite
[Ammon. Hypophos.]

Ammonium hypophosphite contains, when dried over sulphuric acid for 24 hours, not less than 97.5 per cent of $NH_4PH_2O_2$ (83.10).

Preparation—It may be prepared by neutralizing hypophosphorous acid with ammonia, concentrating and crystallizing. The reaction is explained by the following equation:

$$\underset{\text{ammonia}}{NH_3} + \underset{\text{hypophosphorous acid}}{HH_2PO_2} = \underset{\text{ammonium hypophosphite}}{NH_4H_2PO_2}$$

Description and Physical Properties—Ammonium Hypophosphite occurs in deliquescent, colorless, hexagonal plates, or as a granular powder, odorless and having a saline and bitter taste.

One Gm. dissolves in about 1 cc. of water, and in about 20 cc. of alcohol at 25° C.; very soluble in boiling water or boiling alcohol.

Tests for Identity—When heated, the salt is decomposed with the evolution of hydrogen phosphide, which is spontaneously inflammable.

An aqueous solution of the salt (1 in 20) is neutral or slightly acid to litmus and when heated with sodium hydroxide gives off ammonia.

An aqueous solution of the salt (1 in 20) slightly acidulated with sulphuric acid, yields with silver nitrate T.S. a white precipitate, which rapidly turns brown or black through the separation of metallic silver. A similar portion of the solution, slightly acidulated with sulphuric acid, yields, on heating with copper sulphate T.S. a reddish brown precipitate.

Tests for Purity—Ten cc. of an aqueous solution of the salt (1 in 20) remains clear for five minutes after the addition of 5 cc. of ammonium oxalate T.S. and a few drops of ammonia water (*calcium salt*).

Add 1 cc. of calcium chloride T.S. to 10 cc. of the aqueous solution of the salt (1 in 20) previously acidulated with 1 cc. of acetic acid; no turbidity is produced (*oxalate*).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Boil 5 cc. of an aqueous solution of the salt (1 in 25) with 3 cc. of sodium hydroxide solution until the ammonia is expelled, add 5 cc. of nitric acid, and evaporate to dryness on a water bath; the residue meets the requirements of the test for arsenic (see page 1512).

Assay—Dissolve about 0.2 Gm. of Ammonium Hypophosphite, previously dried over sulphuric acid for 24 hours and accurately weighed, in 10 cc. of distilled water, add 3 cc. of sodium hydroxide T.S. and boil until the ammonia is expelled. Then add 5 cc. of nitric acid and evaporate the solution to dryness on a water bath. Add 1 cc. of nitric acid and again evaporate it to dryness on a water bath. Dissolve the residue in 20 cc. of distilled water, transfer it to a 200 cc. graduated flask, add a drop of phenolphthalein T.S. and sufficient sodium hydroxide T.S. (free from chlorine) to produce a pink color, and then add 100 cc. of tenth-normal silver nitrate and agitate well. Now gradually add zinc oxide (free from chloride) in small portions until the liquid is neutral to litmus, and then sufficient distilled water to make the mixture measure 200 cc. Agitate the mixture thoroughly, filter it through a dry filter and collect 100 cc. of the filtrate (representing one-half of the Ammonium Hypophosphite taken). Add to this 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate to the production of a permanent red color.

Each cc. of tenth-normal silver nitrate used corresponds to 0.00277 Gm. of $NH_4PH_2O_2$. Each gram of Ammonium Hypophosphite corresponds to not less than 352.0 cc. of tenth-normal silver nitrate.

This assay is explained on page 1464.

Preserve it in well-closed containers.

N. F. Preparation—Syrupus Ammonii Hypophosphitis.

Uses—It is used as an alterative in doses of three grains (0.2 Gm.).

AMMONII PHOSPHAS. N. F. Ammonium Phosphate
[Ammon. Phos.]

Ammonium phosphate contains diammonium hydrogen phosphate ($(NH_4)_2HPO_4$ = 132.13) and ammonium dihydrogen phosphate ($NH_4H_2PO_4$ = 115.09), corresponding to not less than 22 per cent of combined ammonia (NH_3 = 17.03).

Preparation—It is made by evaporating a solution prepared by adding an excess of ammonia to phosphoric acid.

The reaction is explained by the following equation:

$$\underset{\text{ammonia}}{2(NH_3)} + \underset{\text{phosphoric acid}}{H_3PO_4} = \underset{\text{diammonium phosphate}}{(NH_4)_2HPO_4}$$

Description and Physical Properties—Ammonium Phosphate occurs in colorless crystals or as a white crystalline powder, losing ammonia on exposure to the air.

One Gm. dissolves in about 4 cc. of water; it is insoluble in alcohol. The aqueous solution (1 in 20) is neutral or alkaline to litmus.

Tests for Identity—Separate portions of an aqueous solution of the salt (1 in 20) yield with magnesia mixture T.S. a white precipitate, with silver nitrate T.S. a yellow precipitate, and, upon warming with ammonium molybdate T.S., a yellow precipitate.

Tests for Purity—Dissolve 1 Gm. of Ammonium Phosphate in 20 cc. of distilled water; the resulting solution is not more than slightly turbid (*calcium, aluminum*).

Ten cc. of an aqueous solution of the salt (1 in 100) acidulated with nitric acid, is not rendered more than slightly opalescent by silver nitrate T.S. (*chloride*).

Ten cc. of an aqueous solution of Ammonium Phosphate (1 in 100), mixed with 2 cc. of hydrochloric acid, is not rendered turbid at once by the addition of a few drops of barium chloride T.S. (*sulphate*).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Five cc. of a solution of Ammonium Phosphate in diluted nitric acid (1 in 25), heated with 1 cc. of sulphuric acid until fumes of sulphur trioxide appear, meets the requirements of the test for arsenic (see page 1512).

Assay—Transfer about 1 Gm. of Ammonium Phosphate, accurately weighed, to a distilling flask, dissolve it in 200 cc. of distilled water and add 25 cc. of an aqueous solution of sodium hydroxide (1 in 4). Connect the flask with a small glass condenser, the lower outlet tube of which is inserted beneath the surface of 50 cc. of half-normal sulphuric acid, contained in a flask of about 500 cc. capacity and distil the liberated ammonia into the acid. Titrate the excess of acid with half-normal sodium hydroxide, using methyl orange T.S. as an indicator, and calculate the percentage of ammonia in the salt.

Each cc. of half-normal sulphuric acid corresponds to 0.008515 Gm. of NH_3. Each Gm. of Ammonium Phosphate corresponds to not less than 23.5 cc. of half-normal sulphuric acid.

This assay is explained on page 1457.

Preserve it in well-closed containers in a cool place.

N. F. Preparation—Liquor Phosphatum Compositus.

Uses—It is almost never prescribed except as an ingredient of the solution of phosphates. Dose, five grains (0.3 Gm.).

AMMONII VALERAS. N. F. Ammonium Valerate

(U. S. P. IX)

[**Ammon. Valer.**—Ammonium Valerianate]

Ammonium valerate is a compound of ammonia with valeric acid, having a somewhat varying composition.

Preparation—This valerate, formerly called valerianate, may be prepared by passing dried gaseous ammonia into monohydrated valeric acid.

The salt which is found in commerce is usually the acid salt; hence, in making a solution of it, as in the process for elixir of ammonium valerate, the excess of acid should be neutralized by the addition of sufficient ammonia water.

Description and Physical Properties—Ammonium Valerate occurs in colorless, or white, quadrangular plates, emitting the odor of valeric acid; it is deliquescent in moist air, and has a sharp and sweetish taste.

One Gm. of Ammonium Valerate dissolves in 0.3 cc. of water and in 0.6 cc. of alcohol at 25° C.; soluble in ether.

Tests for Identity—When heated, the salt fuses, gives off vapors of ammonia and valeric acid, and is finally volatilized, leaving not more than 0.05 per cent of residue.

An aqueous solution of the salt (1 in 20) is acid to litmus and when heated with potassium hydroxide T.S. evolves ammonia.

Supersaturate slightly a concentrated aqueous solution of Ammonium Valerate with sulphuric acid; an oily layer of valeric acid rises to the surface.

Tests for Purity—Precipitate completely 10 cc. of an aqueous solution of the salt (1 in 20) with ferric chloride T.S.; the filtrate does not possess a deep red color (*acetate*).

An aqueous solution of the salt (1 in 50), when slightly acidulated with hydrochloric acid and filtered through a small, wetted filter, does not respond to the test for heavy metals (see page 1519).

Preserve it in well-closed containers.

N. F. Preparation—Elixir Ammonii Valeratis.

Uses—Ammonium valerate is used in hysteria, neuralgia, and similar diseases as a nervine, in doses of 2 to 20 grains (0.14 to 1.3 Gm.).

Unofficial Salts of Ammonium

Ammonii Arsenas, $(NH_4)_2HAsO_4$ Ammonium Arsenate	A poisonous, white, crystalline powder; soluble in water. It is used as an alterative, chiefly in skin diseases. Dose, $\frac{1}{20}$ grain (0.003 Gm.)
Ammonii Bicarbonas, NH_4HCO_3 Ammonium Bicarbonate	Large, white crystals; soluble in water; easily decomposed by heat. It is used in the production of other ammonium salts and as an antacid and stimulant. Dose, 5 to 15 grains (0.3 to 1 Gm.)

Unofficial Salts of Ammonium—*Continued*

Ammonii Boras, $(NH_4HB_4O_7)+3H_2O$ Ammonium Borate	White crystals, soluble in water. Ammonium borate is employed in renal colic and in chronic cystitis. Dose, 10 to 20 grains (0.6 to 1.2 Gm.)
Ammonii Citras, $(NH_4)_3C_6H_5O_7+3H_2O$ Ammonium Citrate	A white powder; readily soluble in water. It is unstable in air and therefore should be kept well-stoppered. It is used as a diaphoretic, antipyretic and diuretic
Ammonii Dichromas, $(NH_4)_2Cr_2O_7$ Ammonium Dichromate	Orange crystals; soluble in water. When strongly heated it decomposes leaving a residue of chromium sesquioxide. It is used chiefly as a chemical reagent
Ammonii et Ferri Chloridum Ammonium and Iron Chloride	A reddish-yellow powder; soluble in water. It is used as an aperient and chalybeate, and should be kept well stoppered. Dose, 4 to 12 grains (0.25 to 0.7 Gm.)
Ammonii et Potassii Tartras, $NH_4KC_4H_4O_6$ Ammonium and Potassium Tartrate	A white, crystalline powder; soluble in water. It is used as a cathartic
Ammonii Formas, NH_4CHO_2 Ammonium Formate	Transparent, colorless crystals having a cooling pungent taste. It is used in chronic paralysis and palsy of sensation or motion. Dose, 5 grains (0.3 Gm.)
Ammonii Fluoridum, NH_4F Ammonium Fluoride	White crystals; soluble in cold water. It is used in the manufacture of other fluorides and as a reagent in analytical chemistry
Ammonii Iodidum, NH_4I (U. S. P. IX) Ammonium Iodide	A white, granular powder; hygroscopic and very soluble in water. On exposure to air and light it becomes yellow or yellowish brown due to the loss of ammonia and the separation of free iodine. It is used as a resolvent and alterative, similar to potassium iodide. The dose is from 3 to 5 grains (0.2 to 0.3 Gm.)
Ammonii Nitras, NH_4NO_3 Ammonium Nitrate	Colorless crystals; soluble in water. Used in pyrotechnics, explosives, fertilizers and in the manufacture of "laughing gas"
Ammonii Nitris, NH_4NO_2 Ammonium Nitrite	A clear, yellow liquid; soluble in water and decomposed by heat, yielding water and nitrogen. It is used in the laboratory preparation of nitrogen
Ammonii Sulphas, $(NH_4)_2SO_4$ Ammonium Sulphate	Colorless, transparent crystals, when pure. It is readily soluble in water. It is chiefly used as a source of ammonia and as a fertilizer
Ammonii Sulphis, $(NH_4)_2SO_3$ Ammonium Sulphite	Colorless, deliquescent crystals, having an acrid and sulphurous taste. Very soluble in water. Used in fermentative dyspepsia and in skin diseases. Dose, 5 to 20 grains (0.3 to 1.2 Gm.)
Ammonii Sulphocyanidum, NH_4CNS Ammonium Sulphocyanide	Colorless, deliquescent crystals, very soluble in water. It is chiefly used as a chemical reagent, especially in the detection of ferric iron
Ammonii Valeras (U. S. P. IX) Ammonium Valerate	Colorless, deliquescent plates, having a valerian-like odor. It is very soluble in water. It is used as a nerve tonic. The dose is from 2 to 8 grains (0.12 to 0.5 Gm.)

CHAPTER L

MAGNESIUM, CALCIUM, RADIUM, BARIUM, AND STRONTIUM

Mg; 24.32 Ca; 40.07 Ra; 226.00 Ba; 137.37 Sr; 87.63

The compounds of these metals form a natural group. They have numerous physical and chemical characteristics in common. Barium is represented in the U. S. P. by only one compound, the insoluble sulphate, used in X-ray work. The soluble salts are too toxic for use in medicine. Strontium salts were first admitted to the U. S. P. 1890, and have limited use. Magnesium was formerly classed with the alkali earths, but it is now usually separated from them, because of its closer chemical analogies to zinc. It is so closely allied to the alkali earths in its pharmaceutical and medical aspects that it is more convenient to consider it in its former relation.

Magnesium is from the Latinized name for Magnesia, a city in Asia Minor. It is widely distributed, the principal minerals being *magnesite*, a carbonate; *dolomite*, a magnesium and calcium carbonate; *kieserite*, a sulphate; *carnallite*, a double magnesium and potassium chloride. It is also combined as a silicate in *talc*, *asbestos*, *meerschaum*, *serpentine*, etc. The metal is a silver-white color, losing its luster through the oxidation of its surface, and burning with a radiant light when heated to redness, magnesium oxide being formed.

Tests for Salts of Magnesium

Solutions of magnesium salts in the presence of ammonium chloride yield no precipitate with ammonium carbonate T.S., but on the subsequent addition of sodium phosphate T.S. a white precipitate is produced which is insoluble in ammonia T.S.

MAGNESII CARBONAS. U. S. Magnesium Carbonate

[Mag. Carb.]

Magnesium Carbonate is a mixture of hydrated magnesium carbonate and magnesium hydroxide, equivalent to not less than 39.2 per cent of MgO (40.32).

Preparation—It is largely prepared from *dolomite* ($MgCO_3.CaCO_3$) by first calcining it, suspending the calcined product in water saturated with CO_2, whereupon the magnesia, being soluble in carbonated water dissolves, forming the bicarbonate ($Mg(HCO_3)_2$). The lime is now separated, the magnesium solution evaporated, and the residue heated, liberating CO_2 and water and forming magnesium carbonate.

Magnesium carbonate varies in composition somewhat according to the process used. The reaction in making a carbonate corresponding to that of the U. S. P. would be explained as follows:

$$\underset{\text{magnesium sulphate}}{5MgSO_4} + \underset{\text{sodium carbonate}}{5Na_2CO_3} + \underset{\text{water}}{H_2O} = \underset{\text{magnesium carbonate}}{4MgCO_3.Mg(OH)_2} + \underset{\text{sodium sulphate}}{5Na_2SO_4} + \underset{\text{carbon cioxide}}{CO_2}$$

The process for making light magnesium carbonate differs from the heavy in the substitution of a larger proportion of cold water for the boiling water.

This furnishes a good illustration of the rule in precipitation, that dilute solutions produce light precipitates, and concentrated solutions heavy precipitates.

Description and Physical Properties—Light, white, friable masses, or a bulky, white powder. It is odorless, and is stable in the air.

Magnesium Carbonate is practically insoluble in water, to which, however, it imparts a slightly alkaline reaction. It is insoluble in alcohol, but is dissolved by dilute acids with effervescence.

When strongly heated, it loses water and carbon dioxide, and is converted into magnesium oxide.

Tests for Identity—When Magnesium Carbonate is treated with diluted hydrochloric acid, it dissolves with effervescence and the resulting solution responds to the reactions for magnesium, page 661.

Tests for Purity—Mix 1 Gm. of Magnesium Carbonate with 50 cc. of distilled water, heat the mixture to the boiling point, and cool. Then filter, and evaporate the filtrate to dryness on a water bath. The weight of the residue does not exceed 0.01 Gm. (*soluble salts*).

Dissolve 2.5 Gm. of Magnesium Carbonate in 50 cc. of diluted hydrochloric acid and 200 cc. of distilled water: the solution is colorless. Transfer 50 cc. of this solution to a 50 cc. graduated cylinder and add 0.2 cc. of potassium ferrocyanide T.S. After mixing well, the color produced in the solution, if any, when viewed downward against a white surface is not greater than the color of a control solution prepared as follows: Dilute 0.2 cc. of ferric chloride T.S. with sufficient distilled water to make 1000 cc. Transfer 25 cc. of this solution to another 50 cc. graduated cylinder, and add 10 cc. of diluted hydrochloric acid and sufficient distilled water to make 50 cc. Then add 0.2 cc. of potassium ferrocyanide T.S. The two cylinders used in this test must be matched, be of practically colorless glass and have the same internal diameter (*iron*).

Dissolve 0.5 Gm. of Magnesium Carbonate in a slight excess of diluted hydrochloric acid (about 5 cc.), and dilute with distilled water to 25 cc.: a 10 cc. portion of this solution meets the requirements of the test for *heavy metals*, page 1519.

Dissolve 4 Gm. of Magnesium Carbonate in 50 cc. of diluted hydrochloric acid in a beaker of about 900 cc. capacity. Dilute this solution to about 400 cc. with distilled water, add 5 Gm. of ammonium chloride, heat to boiling, and add 50 cc. of ammonium oxalate T.S., followed by 5 drops of methyl orange T.S. and afterward by ammonia T.S. (previously diluted with two volumes of distilled water), added slowly in small portions, stirring constantly until the liquid has assumed a yellow color. This operation normally requires about twenty minutes. Allow the liquid to stand for four hours or overnight, collect the precipitate on a filter, wash it with hot, distilled water containing 1 per cent of ammonium oxalate solution, until the washings, after strongly acidifying with nitric acid, cease to react with silver nitrate T.S. Dissolve the precipitate by pouring 50 cc. of warm diluted hydrochloric acid in small portions over the filter, wash the filter with about 100 cc. of distilled water, collect the solution of the precipitate and washings in the same beaker, then dilute to 400 cc. with distilled water, and precipitate as before (omitting the addition of 5 Gm. of ammonium chloride). Allow the new precipitate to stand four hours or overnight, filter, and wash as before, then dry the precipitate within the filter paper and after cautious ignition in a platinum crucible heat the residue until of constant weight. The heat should be applied gently at first, the temperature should then be gradually increased, and finally the heat of a blast lamp should be applied for fifteen minutes or longer if necessary. Cool the crucible and contents in a desiccator before weighing. The weight of CaO so obtained does not exceed 0.032 Gm., corresponding to not more than 0.8 per cent (*limit of calcium oxide*).

Assay—Dissolve about 1 Gm. of Magnesium Carbonate, accurately weighed, in 30 cc. of normal sulphuric acid, and determine the residual acid by titrating with normal sodium hydroxide, using methyl orange T.S. as indicator. From the volume of the normal sulphuric acid consumed, deduct the volume of normal sulphuric acid corresponding to the per cent of calcium oxide found. The difference represents the normal sulphuric acid equivalent to the magnesium oxide present. Each cc. of normal sulphuric acid corresponds to 0.02016 Gm. of MgO or to 0.02804 Gm. of CaO.

This assay is explained on page 1457.

U. S. P. Preparations—Liquor Magnesii Citratis; Syrupus Tolu; Syrupus Zingiberis.

N. F. Preparations—Elixir Eriodictyi Aromaticum; Glyceritum Picis Pini; Liquor Aromaticus Alkalinus; Liquor Pancreatini; Liquor Phosphatum Acidus; Mistura Carminativa; Mistura Magnesiæ, Asafœtidæ et Opii; Syrupus Eriodictyi Aromaticus.

Uses—Magnesium carbonate is antacid, and in large doses cathartic. It is also employed externally as an absorbent or drying powder. The dose is from thirty to sixty grains (2 to 4 Gm.). It was at one time largely employed in making medicated waters to assist in diffusing the oils used in preparing them, but being slightly soluble it always imparts an alkaline reaction to the water, which is especially dangerous in dispensing, as aromatic waters made with it, will cause the gradual precipitation of free alkaloids like strychnine, atropine, etc., when the salt of the alkaloid is dissolved in such aromatic water. Its use in this manner is not recognized by the U. S. P.

MAGNESII OXIDUM. U. S. Magnesium Oxide

[Mag. Oxid.—Magnesia, Calcined Magnesia, Light Magnesia]

Magnesium Oxide contains, after ignition, not less than 96 per cent of MgO (40.32). Upon ignition it loses not more than 10 per cent.

Preparation—Magnesium carbonate is exposed in crucibles to a red heat, carbon dioxide and water are expelled, and magnesium oxide is left.

$$\underset{\text{magnesium carbonate}}{(MgCO_3)_4Mg(OH)_2} + \underset{\text{water}}{5H_2O} = \underset{\text{magnesium oxide}}{5MgO} + \underset{\text{carbon dioxide}}{4CO_2} + \underset{\text{water}}{6H_2O}$$

Magnesium Oxide is rendered less soluble if heated too strongly. It should always be kept in well-closed vessels; exposure to air and moisture causes the formation of carbonate and hydroxide.

Description and Physical Properties—A white, very bulky, odorless powder. On exposure to air it absorbs moisture and carbon dioxide.

Magnesium Oxide is practically insoluble in water and is insoluble in alcohol. It is dissolved by dilute acids.

Tests for Identity—A solution of Magnesium Oxide in diluted hydrochloric acid responds to the reactions for magnesium, page 661.

Tests for Purity—Boil 1 Gm. of Magnesium Oxide with 50 cc. of distilled water, cool and filter: the filtrate is not more than faintly alkaline to litmus paper, and when evaporated to dryness leaves not more than 0.02 Gm. of residue (*soluble salts*).

Boil a mixture of 0.1 Gm. of Magnesium Oxide with 5 cc. of distilled water, and after cooling pour it into 5 cc. of acetic acid: solution takes place without the evolution of more than a few isolated gas bubbles (*carbonate*).

It meets the requirements of the test for *iron* under *Magnesii Carbonas*, using 1 Gm. of Magnesium Oxide.

Dissolve 0.5 Gm. of Magnesium Oxide in a slight excess of diluted hydrochloric acid, and dilute with distilled water to 25 cc.: a 10 cc. portion of this solution meets the requirements of the test for *heavy metals*, page 1519.

Transfer to a porcelain crucible about 1 Gm. of Magnesium Oxide, weigh accurately, and expose to a low red heat (about 600° C.): it loses not more than 10 per cent of its weight (*water and other volatile substances*).

When determined by the method described under *Magnesii Carbonas*, using about 1.5 Gm. of freshly ignited Magnesium Oxide, accurately weighed, it shows not more than 2 per cent of calcium oxide.

Assay—Ignite about 0.5 Gm. of Magnesium Oxide to constant weight at a low red heat, weigh the residue accurately, dissolve it in 30 cc. of normal sulphuric acid, and determine the residual acid by titrating with normal sodium hydroxide, using methyl orange T.S. as indicator. From the volume of the normal sulphuric acid consumed, deduct the volume of normal sulphuric acid corresponding to the per cent of calcium oxide found. The difference represents the normal sulphuric acid equivalent to the magnesium oxide present. Each cc. of normal sulphuric acid corresponds to 0.02016 Gm. of MgO or to 0.02804 Gm. of CaO.

This assay is explained on page 1457.

Preserve in well-closed containers.

U. S. P. Preparations—Ferri Hydroxidum cum Magnesii Oxido; Pulvis Rhei Compositus. It is also used as a diluent and absorbent in extracts and to neutralize the resins in cascara sagrada.

N. F. Preparation—Massa Copaibæ.

Uses—Magnesium Oxide or *magnesia* is popularly used as a laxative and antacid, in doses of thirty grains (2 Gm.). In administering, the magnesia should be added to the diluent (water or milk), and not *vice versa*. If it fails to act when used as a laxative it should be followed by lemon juice or some other form of citric acid.

MAGNESII OXIDUM PONDEROSUM. U. S. Heavy Magnesium Oxide

[Mag. Oxid. Pond.—Heavy Magnesia]

Heavy Magnesium Oxide contains, after ignition, not less than 96 per cent of MgO (40.32). Upon ignition it loses not more than 10 per cent.

Heavy magnesium oxide is preferable to the ordinary magnesium oxide on account of its density. This often permits the decrease in bulk of the dose in

the ratio of nearly four to one. Magnesium oxide is rendered less bulky by trituration, and if the heavy carbonate is used for the calcination, a heavier powder is produced.

Description and Physical Properties—A white, dense, odorless and very fine powder, which meets the requirements of the tests for identity, purity, and the assay under *Magnesii Oxidum*. **Preserve** in well-closed containers.

N. F. Preparations—Fluidglyceratum Cascaræ Sagradæ Aromaticum; Pulvis Rhei et Magnesiæ Anisatus.

Uses—The uses and dose of heavy magnesia are the same as those of the light magnesia.

MAGMA MAGNESIÆ. U. S. Magnesia Magma

[**Magma Mag.**—Milk of Magnesia]

Magnesia Magma contains not less than 7 per cent of $Mg(OH)_2$ (58.34).

	Metric	Alternative
Magnesium Sulphate	**300 Gm.**	**10 oz. av.**
Sodium Hydroxide	**100 Gm.**	**3 oz. av. 148 gr.**
Distilled Water, a sufficient quantity,		
To make about	**1000 cc.**	**2 pints**

Dissolve the magnesium sulphate in sufficient distilled water to make 650 cc. [21 fl. oz.], place this in a vessel of about 5000 cc. [10 pints] capacity, and heat to boiling. Dissolve the sodium hydroxide in sufficient distilled water to make 1000 cc. [2 pints], add this slowly to the boiling solution of magnesium sulphate, and continue the boiling for thirty minutes. Transfer the mixture to a cylindrical container of not less than 5000 cc. [10 pints], capacity, and fill with hot distilled water. Allow to stand until separation has occurred, and remove the supernatant liquid. Wash repeatedly with hot distilled water until sulphates have practically been eliminated, as shown by testing the supernatant liquid with barium chloride T.S. Concentrate the mixture by evaporation until it contains not less than 7 per cent of magnesium hydroxide.

Note—One-half cc. of oil of peppermint, or a sufficient quantity of oil of anise or other suitable flavoring may be added if desired.

Distilled water is used in this preparation because the slightest trace of iron will cause discoloration. If the available water supply is free from iron, and otherwise suitable, or if it has been heated to boiling with powdered magnesium carbonate (5 Gm. [73 gr.] in each 1000 cc. [2 pints]), and then filtered, distilled water will not be necessary.

The official process does not direct the preparation of a definite volume. It is apparently the intention, as is the commercial custom, after thorough washing, to allow it to settle, then draw off the clear liquid, and market only the milky magma, no upper limit being fixed for the $Mg(OH)_2$ content.

This preparation is also made on a large scale by mixing freshly calcined magnesium oxide with distilled water in proper proportion and, after hydration, which is accompanied by heat, the product is ready for use. This process has not been adopted generally because of the difficulty of obtaining freshly calcined magnesium oxide. The Keasbey and Mattison Company offer such an article in tightly-sealed containers, but if it is exposed to the air, magnesium oxide soon loses the property of forming a gelatinous magnesium hydroxide when mixed with water.

If the cork stoppers are not protected by dipping them in melted paraffin the magma soon darkens, due to action on the tannin of the cork. The product should be protected against freezing, as this alters the colloidal gel, a more dense precipitate forming and a clear water stratum separating on top.

Description and Physical Properties—A viscous, opaque, white mixture, from which more or less water usually separates on standing; free from mustiness.

Tests for Identity—It is alkaline to litmus paper and to phenolphthalein T.S.

A solution of 2 cc. of diluted hydrochloric acid and 1 cc. of Magnesia Magma responds to the reactions for magnesium, page 661.

Tests for Purity—The addition of 2 cc. of diluted hydrochloric acid to 1 cc. of Magnesia Magma causes not more than a slight effervescence (*carbonate*), and the resulting solution is not more than slightly turbid.

Dilute 20 cc. of Magnesia Magma with distilled water to make 200 cc. and allow it to stand until the precipitate has settled. Remove 50 cc. of the clear liquid, and evaporate it to dryness on a water bath. The residue, when dried to constant weight at 150° C., does not exceed 0.005 Gm. To another 50 cc. portion of the supernatant liquid, add 1 drop of methyl orange T.S. and titrate with tenth-normal sulphuric acid: not more than 0.4 cc. is required to produce a red color (*soluble alkalies*).

Assay—Place about 5 Gm. of Magnesia Magma in a tared flask, stopper, and weigh accurately, add 25 cc. of normal sulphuric acid, and after solution is complete titrate the excess of acid with normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of normal sulphuric acid corresponds to 0.02917 Gm. of $Mg(OH)_2$.

Preserve in wide-mouthed bottles, tightly stoppered with corks which have been dipped in melted paraffin.

U. S. P. Preparation—Ferri Hydroxidum cum Magnesii Oxido.

Uses—It is used as an antacid and laxative and the addition of a flavor, as suggested above, renders it very acceptable when used as an antacid mouthwash, for which purpose it is frequently used under a dentist's orders. The usual dose as an antacid is one fluidrachm (4 cc.); as a laxative, four fluidrachms (15 cc.).

MAGNESII SULPHAS. U. S. Magnesium Sulphate

[**Mag. Sulph.**—Epsom Salt]

Magnesium Sulphate contains not less than 48.60 per cent and not more than 53.45 per cent of $MgSO_4$ (120.38), corresponding to not less than 99.5 per cent of the crystallized salt [$MgSO_4.7H_2O$ = 246.49].

Preparation—This well-known salt is prepared from a number of mineral substances, the mineral *kieserite*, of Stassfurt, yielding the largest supply. It can also be made by neutralizing sulphuric acid with magnesium oxide, hydroxide, or carbonate.

Magnesium sulphate was formerly made as a by-product in the manufacture of carbonated waters; the mineral *magnesite* being decomposed by sulphuric acid and the carbon dioxide passed into the water.

$$\underset{\text{magnesite}}{MgCO_3} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\substack{\text{magnesium}\\\text{sulphate}}}{MgSO_4} + \underset{\substack{\text{carbon}\\\text{dioxide}}}{CO_2} + \underset{\text{water}}{H_2O}$$

In England, Epsom salt is sometimes prepared from *dolomite*, the double carbonate of magnesium and calcium, by driving off the carbon dioxide by heat, converting the residue into hydroxides, and then treating these with hydrochloric acid in amount insufficient for complete neutralization. Calcium chloride is formed; this is dissolved out by washing with water, and the purified magnesium oxide is converted into sulphate by treating it with sulphuric acid.

Description and Physical Properties—Small, colorless, prismatic needles or rhombic prisms, without odor, and having a cooling, saline, and bitter taste.

One Gm. of Magnesium Sulphate is soluble in 1.3 cc. of water and in about 1.1 cc. of glycerin, at 25° C. One Gm. is soluble in about 0.2 cc. of boiling water. It is sparingly soluble in alcohol at 25° C.

When exposed to warm air, the salt loses some of its water of crystallization and is converted into a white powder. Further heating removes more water, and at a temperature somewhat above 200° C. it is rendered anhydrous.

Tests for Identity—An aqueous solution of the salt (1 in 20) responds to the reactions for magnesium, page 661, and for sulphates, page 581.

Tests for Purity—An aqueous solution of the salt (1 in 20) is neutral to litmus paper.

One Gm. of the salt shows no more *chloride* than corresponds to 0.2 cc. of fiftieth-normal hydrochloric acid, page 1556.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Dissolve about 1 Gm. of Magnesium Sulphate, accurately weighed, in 100 cc. of distilled water, gradually add to the solution, with constant stirring, an excess of sodium phosphate T.S. (about 20 cc.), allow the mixture to stand for ten minutes, then add 30 cc. of ammonia T.S. and let stand for four hours. Collect the precipitate on a filter, wash it with dilute ammonia T.S. (1 volume of ammonia T.S. to 19 volumes of distilled water) until the washings are free from sulphate. Dry, and ignite to constant weight. The weight of magnesium pyrophosphate($Mg_2P_2O_7$) multiplied by 1.081, indicates its equivalent in $MgSO_4$. Each Gm. of Magnesium Sulphate corresponds to not less than 0.4495 Gm. and not more than 0.4944 Gm. of magnesium pyrophosphate ($Mg_2P_2O_7$).

This assay is explained on page 1480.

Preserve in well-closed containers.

U. S. P. Preparation—Magma Magnesiæ.

N. F. Preparations—Infusum Sennæ Compositum; Sal Kissingense Factitium; Sal Kissingense Factitium Effervescens; Sal Magnesii Sulphatis Effervescens; Sal Vichyanum Factitium; Sal Vichyanum Factitium Effervescens.

History—This salt, which at one time sold for a shilling an ounce, was first obtained from the celebrated spring at Epsom, the English Spa, hence the common name. In continental Europe it is frequently called "*Seidlitz Salt*", because it is the principal active constituent in the Seidlitz spring of Germany. In America it has been called *Crab Orchard Salt*, because it was obtained from the waters of a spring by that name in Kentucky.

Uses—Magnesium sulphate is a valuable hydragogue cathartic, in doses of from one-half to one ounce (15 to 30 Gm.); if dissolved in iced water, its nauseous taste is not so perceptible as when water of ordinary temperature is used; it may be still further disguised by the use of orange juice. Hot concentrated, aqueous solutions of magnesium sulphate (about 1 pound per pint of water) are extensively used in the treatment of deep-seated infections, cloths being saturated and applied while hot. The action is much like that of a poultice and has the advantage of being sterile.

LIQUOR MAGNESII CITRATIS. U. S. Solution of Magnesium Citrate
[Liq. Mag. Cit.]

Solution of Magnesium Citrate contains, in each 100 cc., magnesium citrate corresponding to not less than 1.5 Gm. of MgO.

	Metric	Alternative
Magnesium Carbonate	**15.0 Gm.**	232 gr.
Citric Acid	**35.0 Gm.**	1 oz. av. 103 gr.
Syrup	**60.0 cc.**	2 fl. oz.
Purified Talc	**5.0 Gm.**	77 gr.
Oil of Lemon	**0.1 cc.**	1.5 min.
Potassium Bicarbonate	**2.5 Gm.**	39 gr.
Distilled Water, a sufficient quantity,		
To make	**350 cc.**	12 fl. oz.

Dissolve the citric acid in 150 cc. [5¼ fl. oz.] of hot distilled water in a suitable dish, and, having added the magnesium carbonate, previously mixed with 100 cc. [3½ fl. oz.] of distilled water, stir until it is dissolved. Then add the syrup, heat the mixed liquids to the boiling point, immediately introduce the oil of lemon, previously triturated with the purified talc, and filter the mixture, while hot, into a strong bottle (previously rinsed with boiling water) of suitable

capacity. Add enough boiled distilled water to make the product measure 350 cc. [12 fl. oz.]. Stopper the bottle with purified cotton, allow to cool, drop in the potassium bicarbonate, and immediately stopper the bottle securely. Lastly, shake the solution occasionally until the potassium bicarbonate is dissolved. Keep the bottle on its side in a cool place, preferably in a refrigerator.

NOTE—In this process the 2.5 Gm. [39 gr.] of potassium bicarbonate may be replaced by 2.1 Gm. [32 gr.] of sodium bicarbonate, preferably in tablet form.

Description and Physical Properties—A slightly yellow, clear, effervescent liquid, having a sweet, acidulous taste and a lemon flavor.

Tests for Purity—Add 1 cc. of glacial acetic acid and 3 cc. of an aqueous solution of potassium acetate (1 in 2) to 10 cc. of Solution of Magnesium Citrate, shake the mixture vigorously, then gently rub the sides of the test tube with a glass rod for a few minutes, and allow to stand for one hour: no white crystalline precipitate soluble in ammonia T.S. is produced (*tartaric acid*).

Dilute 2 cc. of the Solution with 8 cc. of distilled water, and add 5 drops of hydrochloric acid and 1 cc. of barium chloride T.S.: no turbidity is produced within one minute (*sulphate*).

Dilute 2 cc. of the Solution with distilled water to 45 cc., add 5 cc. of ammonium oxalate T.S. and mix well: the resulting turbidity, if any, is not greater than the turbidity in a control test made with 1 cc. of a solution prepared as follows: Dissolve 1 Gm. of calcium carbonate, previously dried to constant weight at 200° C., in 1 cc. of acetic acid and 5 cc. of distilled water. Boil for about one minute, and dilute with distilled water to 100 cc. (*calcium*).

Boil down exactly 10 cc. of the Solution to about 5 cc. to expel carbon dioxide, dilute with 15 cc. of distilled water, and titrate with half-normal sodium hydroxide, using phenolphthalein T.S. as indicator: it requires not less than 9.5 cc. of the alkali for neutralization (*minimum of acidity*). Concentrate the liquid, and transfer it completely with the aid of a little distilled water to a platinum or porcelain crucible, evaporate to dryness, and proceed as directed under the assay for alkali salts of organic acids, page 1514: not less than 28 cc. of half-normal sulphuric acid should be consumed (*minimum of total citric acid*).

Assay for Magnesium Oxide—Measure exactly 10 cc. of Solution of Magnesium Citrate, transfer to a platinum or porcelain dish, evaporate to dryness, and ignite until most of the carbonaceous matter has burned off. Add to the residue 20 cc. of diluted hydrochloric acid, heat on a water bath for fifteen minutes, filter if necessary, and wash the residue thoroughly with hot distilled water. To the combined filtrate and washings, which should measure about 100 cc. add an excess of sodium phosphate T.S. (about 20 cc.), then gradually add ammonia T.S. with constant stirring until slightly alkaline. After ten minutes add 30 cc. of ammonia T.S. and allow the mixture to stand for twelve hours. Then filter, and wash the precipitate with a mixture of 1 volume of ammonia T.S. and 19 volumes of distilled water until free from chloride. Dry, and ignite to constant weight. The weight of the magnesium pyrophosphate ($Mg_2P_2O_7$) so obtained is not less than 0.414 Gm., indicating an equivalent of not less than 1.5 Gm. of MgO in 100 cc. of the Solution.

This assay is explained on page 1481.

A few modifications in the manipulation of the official process are advisable. The 15 Gm. of bulky magnesium carbonate may be replaced by 6.23 Gm. [98 gr.] of light calcined magnesia. The syrup should be introduced into the bottle, and the filtered solution of magnesium citrate very carefully poured in without stirring up the syrup. (For this purpose a hard rubber funnel, having the neck closed but with perforations on the side so that the liquid is delivered gently on the sides of the bottle, may be advantageously used.) The potassium bicarbonate, in large crystals (or in compressed blocks of the proper weight), is dropped into the bottle—it gradually dissolves in the syrup—and the bottle at once stoppered to prevent loss of carbonic acid gas. The bottle is not disturbed until it is called for, when a careful shake mixes the solution of the bicarbonate in the bottom of the bottle with the acid liquid above, liberating the carbonic acid gas, and the solution can then always be dispensed in a sparkling condition.

FIG. 427

Patent top citrate bottle

FIG. 428

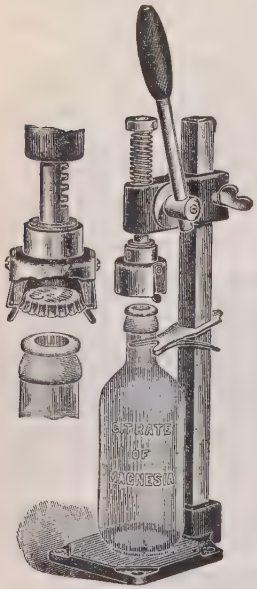
Metal cap citrate bottle

Fig. 427 and Fig. 428 show two types of "citrate bottles" now largely employed. The patent top of porcelain or glass which readily clamps in place

and which may be easily opened and closed without special tools is still the most popular style, although the metal cap, which is crimped into place by a special machine is also very popular. The chief objection to the latter is the difficulty in closing it tightly after it is once opened. The use of a metal cap requires a capping machine (see Fig. 429) costing about $5.00, but the bottles are much less expensive than those made with the "patent stopper", and the cap is easily removed and, unless it has been bent in its removal, it may even be sprung back on the bottle by pressing it against a flat surface, should the patient desire to use only a portion of its contents.

The Pharmacopœia has provided tests and an assay for this important solution and pharmacists should closely follow the official formula. For those who prepare relatively large quantities for their retail trade special facilities should be provided to expedite its manufacture. In Fig. 430 is illustrated an arrangement which is inexpensive but which lessens the amount of labor required.

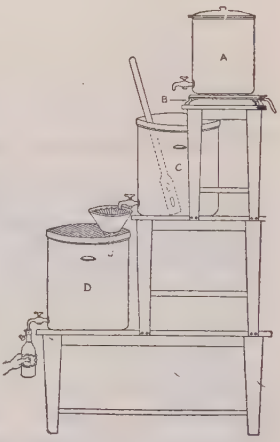
Fig. 429



Bottle capping machine

A tank for hot water, *A*, is mounted in an elevated position, on a gas-heated hot plate, *B*. The boiling water runs from this into the large earthenware crock, *C*, in which the solution is made and from this it can be run into the filter, the speed being adjusted to correspond with the rate of filtration. The tank for the filtered liquid should be fitted with a spigot, shaped to enter a "citrate bottle" to facilitate filling.

Fig. 430



Preparing solution of magnesium citrate

Great quantities of Solution of Magnesium Citrate are being manufactured in the larger centers by specialty houses; the solution is sterilized and delivered to retail customers each day, ready for sale. The official Solution contains more citric acid than is required for a normal "citrate", since the acid salt is more stable. This, however, makes the solution quite acid. If it is too acid for the patient, an additional amount of sugar or syrup will render it more palatable. The use of distilled water has been found necessary, as precipitation has frequently been traced to the use of ordinary water.

The U. S. P. process attempts by the use of heat to eliminate mold spores or other microörganisms which are likely to be present in the solution and cause confervoid growths. If the pharmacist experiences annoyance and loss from this cause, it may be overcome even more effectually by preparing the solution without any attempt at sterilization, then bottling, closing the bottles with absorbent cotton, and afterwards sterilizing them by heating in a closed vessel, containing boiling water. Any form of vessel which will hold the bottles, such as a wash boiler, may be used. The bottles should stand in water to the depth of about an inch, on a raised bottom made of wooden slats or tin and the lid of the vessel placed on loosely. The steam should heat the contents of the bottles to 100° C., and then the boiling be continued for at least thirty

minutes. The bottles may now be set aside closed only with the cotton stopper and may be kept for an extended period without danger of mold development. When a bottle is to be dispensed, the cotton is removed, the potassium bicarbonate added, and the permanent stopper at once inserted.

A white, crystalline, and odorless salt, containing not less than 98 per cent of *acid magnesium citrate*, is sold under the trade name *Citresia*. This is recognized in the 1925 N. N. R. It has a pleasant, acidulous taste, and the laxative and purgative action of solution of Magnesium Citrate, in doses of six drachms to one and one-half ounces (25 Gm. to 50 Gm.). It is manufactured by Horace North, Brooklyn, N. Y.

Uses—"*Citrate of magnesia*" or "*citrate*", as it is usually called, is one of the most agreeable saline cathartics available. It is usually given to adults in the quantity of the official formula, twelve fluidounces (350 cc.). The practice of dividing the dose, taking one-half three or four hours after the other, is often preferable.

MAGNESII CHLORIDUM. N. F. Magnesium Chloride

[**Magnes. Chlorid.**]

Magnesium Chloride contains, when dried for 24 hours over sulphuric acid, not less than 95 per cent of $MgCl_2.6H_2O$ (203.34).

Preparation—It is obtained from *carnallite*, a double potassium and magnesium chloride, by evaporating an aqueous solution to the proper concentration (45° Baumé) when magnesium chloride crystallizes, or by dissolving *magnesite*, magnesium carbonate, in hydrochloric acid. It is also a by-product in the preparation of potassium chloride from *carnallite*.

Magnesium chloride may be prepared by the action of hydrochloric acid on magnesium oxide, as follows:

$$\underset{\text{magnesium oxide}}{MgO} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{magnesium chloride}}{MgCl_2} + \underset{\text{water}}{H_2O}$$

The salt is then crystallized from solution.

Description and Physical Properties—Magnesium Chloride occurs as colorless, transparent crystals, or as white, translucent pieces; deliquescent in moist air.

One Gm. dissolves in about 0.6 cc. of water; it is readily soluble in alcohol. The aqueous solution of the salt (1 in 20) is neutral to litmus paper.

Tests for Identity—An aqueous solution of the salt, acidulated with nitric acid, yields a white precipitate upon the addition of silver nitrate T.S.

A mixture of 10 cc. of an aqueous solution of the salt (1 in 20) with 10 cc. of ammonium chloride T.S., rendered slightly alkaline with ammonia water, yields a white precipitate on the addition of sodium phosphate T.S.

Tests for Purity—One Gm. of the salt dissolves in 10 cc. of alcohol, leaving not more than .1 per cent of insoluble residue (*substances insoluble in alcohol*).

Add 1 cc. of potassium sulphate T.S. to 10 cc. of an aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid; no turbidity results (*barium*).

Ten cc. of an aqueous solution of the salt (1 in 200), acidulated with hydrochloric acid, is not reddened by potassium thiocyanate T.S. (*iron*).

Warm 5 cc. of an aqueous solution of the salt (1 in 10) with 10 cc. of sodium hydroxide T.S.; the odor of ammonia is not evolved.

A mixture of 10 cc. of an aqueous solution of the salt (1 in 20), 10 cc. of ammonium chloride T.S. and 5 cc. of ammonia water, is not rendered more than slightly turbid upon the addition of ammonium oxalate T.S. (*calcium*).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

An aqueous solution of the salt meets the requirements of the test for arsenic (see page 1512).

Assay—Dissolve about 0.5 Gm. of Magnesium Chloride previously dried to constant weight over sulphuric acid and accurately weighed, in 50 cc. of distilled water in a 200 cc. measuring flask; add 3 cc. of nitric acid, then add 50 cc. of tenth-normal silver nitrate and sufficient distilled water to make the mixture measure 200 cc. Mix thoroughly, filter through a dry filter, reject the first 20 cc. of filtrate, then collect 100 cc. of filtrate, add 2 cc. of ferric ammonium sulphate T.S. and titrate the excess of silver nitrate with tenth-normal potassium thiocyanate.

Each cc. of tenth-normal silver nitrate used, corresponds to 0.010167 Gm. of $MgCl_2.6H_2O$. Each Gm. of Magnesium Chloride corresponds to not less than 93.4 cc. of tenth-normal silver nitrate.

This assay is explained on page 1463.

N. F. Preparation—Liquor Hydrastinæ Compositus.

Uses—It is used as a mild cathartic in doses of 4 drachms (16 Gm.).

SAL MAGNESII SULPHATIS EFFERVESCENS. N. F. Effervescent Magnesium Sulphate

[Sal. Mag. Sulph. Eff.]

	Metric	Alternative
Magnesium Sulphate, unefflouresced crystals	**500 Gm.**	2 oz. av.
Sodium Bicarbonate, dried and powdered	**403 Gm.**	1 oz. av. 267 gr.
Tartaric Acid, dried and powdered	**211 Gm.**	369 gr.
Citric Acid, unefflouresced crystals	**136 Gm.**	238 gr.
To make about	**1000 Gm.**	4 oz. av.

Dry the magnesium sulphate on a water bath, until it ceases to lose weight, then, after powdering the dry salt, mix it intimately with the citric acid, which has previously been powdered, add the tartaric acid, and thoroughly incorporate the sodium bicarbonate.

From this mixture prepare an effervescent salt as directed in the General Process (see page 475).

Average dose—240 grains (16 Gm.).

Unofficial Salts and Preparations of Magnesium

Magnesii Acetas, $Mg(C_2H_3O_2)_2+4H_2O$ Magnesium Acetate	Colorless, deliquescent crystals; very soluble in water. Like the citrate it is used as a cathartic. It should be kept well stoppered. Dose, 5 to 60 grains (0.3 to 3.8 Gm.)
Magnesii Iodidum, MgI_2+8H_2O Magnesium Iodide	A white, deliquescent, crystalline powder; soluble in water but decomposing in aqueous solution. It is used as an alterative and sialagogue. Dose, 2 to 10 grains (0.12 to 0.6 Gm.)
Magnesii Lactas, $Mg_2C_3H_5O_3+3H_2O$ Magnesium Lactate	A white, crystalline powder; it has a very bitter taste. It is soluble in water, and is used as a mild laxative. Dose, 15 to 45 grains (1 to 3 Gm.)
Magnesii Salicylas, $MgC_{14}H_{10}O_6+4H_2O$ Magnesium Salicylate	A white, crystalline powder; soluble in water. It is used as an antiseptic and antirheumatic. Dose, 8 to 30 grains (0.5 to 2 Gm.)
Magnesii Silicas, $H_2Mg_2Si_3O_9+H_2O$ Magnesium Silicate	Several forms of magnesium silicate occur in nature as the minerals *asbestos*, *meerschaum*, *talc* and *serpentine*. The pure compound is a fine, white powder; insoluble in water. It is used as an absorbent, astringent, and antiseptic. Dose, 60 to 240 grains (4 to 15 Gm.)
Liquor Magnesii Sulphatis Effervescens (N. F. IV) Effervescent Solution of Magnesium Sulphate	Each 350 cc. (12 fl. oz.) bottle is to contain 25 Gm. of magnesium sulphate, 4 Gm. of citric acid, 60 cc. of syrup of citric acid, in sufficient distilled water to make 350 cc. Just before stoppering the bottle, 2.5 Gm. of potassium bicarbonate are added. This solution is a laxative, similar in use to solution of magnesium citrate.
Magnesii Sulphis, $MgSO_3+6H_2O$ Magnesium Sulphite	A white, crystalline powder; soluble in water; gradually changing to sulphate on exposure to air. It is used as a cathartic and antiseptic. Dose, 10 to 60 grains (0.6 to 4 Gm.)
Magnesii Phenolsulphonas, $Mg(C_6H_5SO_4)+7H_2O$ Magnesium Phenolsulphonate	A white, crystalline powder; soluble in water. It is a laxative and intestinal antiseptic. Dose, 15 to 30 grains (1 to 2 Gm.)
Crab Orchard Salt	A mild, saline purgative, consisting mainly of magnesium sulphate and obtained by evaporating the waters of Crab Orchard Springs, Kentucky. Dose, from 1 to 2 teaspoonfuls.

Calcium, Ca; 40.07

Calcium is from the Latin word "calx" which is now applied to calcium oxide. Calcium is a very abundant element occurring in nature as carbonate (*limestone*), sulphate (*gypsum*), phosphate, silicate, chloride, fluoride, etc. It belongs to the class of metals. When heated, it burns with a bright light. It is of a light yellow color, and is ductile like gold; it may be hammered into very thin sheets but it is not permanent in the air. It forms but one chloride. The oxide, carbonate, sulphate, phosphate, and hypophosphite are of pharmaceutical interest.

The N. N. R. description, in part as follows, provides a concise picture of the value of calcium salts in body functions. "Calcium performs important functions, especially in the deposition of calcium salts in bone, in the regulation of nervous, muscular, and glandular activity, and in the coagulation of the blood.

"Rickets and osteomalacia show defective deposition of calcium in the bone, but this seems to be the result and not the cause of the disorder.

"The administration of calcium salts has been found useful against the skin rashes of serum disease, against other urticarias, against diarrhea, etc.

"Calcium depresses the nervous functions and is, therefore, more or less efficacious against convulsions. It cannot usually be introduced safely in effective quantities, but it has been asserted that it enhances markedly the sedative effects of bromides in resistant cases of epilepsy.

"For oral administration, calcium chloride is generally employed; for hypodermic use, the less irritant lactate is preferred."

Tests for Salts of Calcium

In neutral or alkaline solutions, or in solutions of calcium salts free from mineral acid, ammonium oxalate T. S. produces a white precipitate. This precipitate is insoluble in acetic acid, but dissolves in hydrochloric acid. Calcium salts moistened with hydrochloric acid impart a yellowish-red color to a non-luminous flame.

CALX. U. S. Lime

[Calcium Oxide—QUICKLIME]

Lime, when freshly ignited to constant weight with a blast lamp, contains not less than 95 per cent of CaO (56.07). It loses not more than 10 per cent of its weight on ignition.

Preparation—Lime, or calcium oxide, is a very important alkaline earth, and is made by calcining limestone, or native calcium carbonate, in kilns with strong heat; carbon dioxide is expelled.

$$\underset{\text{calcium carbonate}}{CaCO_3} = \underset{\text{lime}}{CaO} + \underset{\text{carbon dioxide}}{CO_2}$$

Description and Physical Properties—Hard, white or grayish-white masses or granules, or a white powder. It is odorless.

One Gm. of Lime is soluble in 840 cc. of water at 25° C. and in 1740 cc. of boiling water. It is soluble in glycerin and in syrup, but is insoluble in alcohol.

Tests for Identity—When moistened with water, Lime becomes heated, and is gradually converted into a white powder (calcium hydroxide or slaked lime). When this is mixed with about 3 or 4 times its weight of water, it forms a smooth magma (milk of lime).

Water, when agitated with Lime, becomes alkaline to litmus paper.

Slake 1 Gm. of Lime with 20 cc. of distilled water and add acetic acid until the lime is dissolved: the resulting solution responds to the reactions for calcium, page 671.

Tests for Purity—Slake 1 Gm. of Lime, thoroughly mix it with 50 cc. of water, and decant the greater portion of the milky liquid: the addition of an excess of diluted hydrochloric acid to the residue does not cause more than a slight effervescence (*carbonate*).

Slake 5 Gm. of Lime, then mix it with 100 cc. of distilled water, followed by hydrochloric acid, drop by drop, with agitation until solution takes place: the resulting solution after boiling and cooling should be acid and should not deposit more than 0.05 Gm. of insoluble matter.

Ignite a portion of Lime to constant weight in a tared platinum crucible, with a blast lamp: the loss in weight does not exceed 10 per cent (*volatile substances*).

Dissolve 0.5 Gm. of Lime in 10 cc. of diluted hydrochloric acid, neutralize with ammonia T.S., completely precipitate the calcium by adding ammonium oxalate T.S., and then filter: the filtrate, on evaporation and ignition leaves not more than 0.004 Gm. of fixed residue (*magnesium, other alkali earths, or alkalies*).

Assay—Ignite about 1 Gm. of Lime to constant weight over a blast lamp, weigh accurately, dissolve in 20 cc. of diluted hydrochloric acid, cool the solution, dilute with distilled water to 100 cc., and mix well. Transfer 20 cc. of this solution to a 200 cc. volumetric flask, and proceed with the assay as directed under *Calcii Carbonas Præcipitatus*. Each cc. of tenth-normal oxalic acid corresponds to 0.002804 Gm. of CaO.

This assay is explained on page 1473.

Preserve in air-tight containers, in a dry place.

U. S. P. Preparations—Fluidextractum Cascaræ Sagradæ Aromaticum; Liquor Calcii Hydroxidi; Sulphur Præcipitatum.

N. F. Preparations—Fluidglyceratum Cascaræ Sagradæ Aromaticum; Liquor Calcis Sulphuratæ.

Uses—Externally, lime acts as an escharotic; it enters into the composition of many depilatory powders. It is used as the starting point in making official lime water.

LIQUOR CALCII HYDROXIDI. U. S. Solution of Calcium Hydroxide

[Liq. Calc. Hydrox.—Liquor Calcis U. S. P. IX, Lime Water]

Solution of Calcium Hydroxide is an aqueous solution containing, in each 100 cc., not less than 0.14 Gm. of $Ca(OH)_2$ at 25° C. The strength in calcium hydroxide varies with the temperature at which the solution is stored, being about 0.17 Gm. per 100 cc. at 15° C. and diminishing as the temperature rises.

	Metric	Alternative
Lime	**25 Gm.**	365 gr.
Water, a sufficient quantity.		

Slake the lime by the addition of about 50 cc. [1½ fl. oz.] of warm water. Transfer the mixture to a bottle having a capacity of about 4000 cc. [8 pints], and add 950 cc. [30½ fl. oz.] of water. Agitate the mixture occasionally during half an hour, allow it to settle, and then decant and reject the clear liquid. To the residue add sufficient water to make about 4000 cc. [8 pints], agitate thoroughly, stopper the bottle and set it aside in a cool place. Decant and dispense the clear liquid.

The undissolved portion should not be used for making additional quantities of Solution of Calcium Hydroxide unless the solution so prepared is found to be of full strength when assayed.

Lime water is very extensively used in pharmacy; the object of keeping it upon undissolved lime is to insure a saturated solution. Lime is but sparingly soluble in water and less soluble in hot water than in cold; when the solution is heated, a deposition of lime takes place which is redissolved on cooling. A solution of lime containing particles of undissolved lime in suspension is termed *milk of lime.*

Description and Physical Properties—A clear, colorless, odorless liquid with an alkaline taste. Specific gravity: about 1.00 at 25° C.

Test for Identity—Solution of Calcium Hydroxide is strongly alkaline to litmus paper.

It absorbs carbon dioxide from the air, a film of calcium carbonate forming on the surface of the liquid.

On being heated it becomes turbid, due to the separation of calcium hydroxide which redissolves when the liquid is cooled.

Test for Purity—The alkaline reaction of the Solution entirely disappears after it has been saturated with carbon dioxide and subsequently boiled (*alkalies and their carbonates*).

Assay—Titrate exactly 50 cc. of Solution of Calcium Hydroxide at 25° C. with tenth-normal sulphuric acid, using phenolphthalein T.S. as indicator. Each cc. of tenth-normal sulphuric acid corresponds to not less than 0.003705 Gm. of $Ca(OH)_2$.

This assay is explained on page 1455.

Preserve in well-filled, tightly-stoppered bottles.

U. S. P. Preparation—Linimentum Calcis.

N. F. Preparations—Linimentum Calaminæ; Lotio Calaminæ; Lotio Flava; Lotio Nigra; Pasta Zinci Mollis.

When lime of official quality is obtained it has been suggested that it be slaked in larger quantity than that directed by the Pharmacopœia, the magma washed free from chloride and the moist magma or milk of lime then transferred to small bottles, completely filled and kept until needed for the making of lime water. This plan avoids the necessity of freshly slaking the

lime and washing the magma for each lot of lime water. Lime of official quality is now marketed in sealed glass tubes. Unless protected from the the air, lime soon becomes unfit for use, due to the action of carbon dioxide and partial hydration from moisture in the air. To avoid such deterioration the lime water may be stored in a large bottle from which it may be drawn by means of a glass siphon. A piece of rubber tubing is attached to the outlet of the siphon and is opened or closed by a pinchcock to be used when the lime water is drawn from the container. This siphon is held in place by a rubber stopper which also carries an air tube leading to a small bottle of solution of sodium hydroxide. By this plan all air admitted to the bottle of lime water is first passed through the NaOH solution and deprived of CO_2. The preparation of lime water involves a reaction expressed by the following equation:

$$\underset{\text{lime or calcium oxide}}{CaO} + \underset{\text{water}}{H_2O} + \underset{\text{calcium hydroxide}}{Ca(OH)_2}$$

When it is exposed to the air, which almost always contains CO_2, it is quickly converted into the insoluble carbonate as follows:

$$\underset{\text{calcium hydroxide}}{Ca(OH)_2} + \underset{\text{carbon dioxide}}{CO_2} = \underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{water}}{H_2O}$$

Uses—Probably the most extensive use of lime water in medicine is in checking nausea, although its value is greatly overestimated; it contains so small a proportion of alkali that it would require upwards of a tumblerful to have any real effect. It is usually administered with milk when used for correcting its acidity, especially in infant feeding. It is employed externally to allay inflammation, and in washes of various kinds. The dose of lime water is four fluidrachms (15 cc.).

CALX CHLORINATA. U. S. Chlorinated Lime

The activity of this compound is based upon the amount of available chlorine present, and it is therefore most appropriately considered under that head (see page 568).

CALCII BROMIDUM. U. S. Calcium Bromide
[Calc. Brom.]

Calcium Bromide is a hydrated salt, containing not less than 84 per cent of $CaBr_2$ (199.91).

Preparation—Calcium bromide may be made by the simple process of adding precipitated calcium carbonate, in excess, to hydrobromic acid, filtering, evaporating the solution to dryness, and granulating the product.

$$\underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{hydrobromic acid}}{2HBr} = \underset{\text{calcium bromide}}{CaBr_2} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

It may also be made by adding milk of lime to a boiling solution of ammonium bromide until ammoniacal vapors cease to be evolved. The solution is then filtered and the salt granulated. Care should be used to protect the product from moisture.

$$\underset{\text{ammonium bromide}}{2NH_4Br} + \underset{\text{calcium hydroxide}}{Ca(OH)_2} = \underset{\text{calcium bromide}}{CaBr_2} + \underset{\text{ammonia}}{2NH_3} + \underset{\text{water}}{2H_2O}$$

Description and Physical Properties—A white, granular salt, having no odor. It is very deliquescent.

One Gm. of Calcium Bromide is soluble in 0.7 cc. of water and in 1.3 cc. of alcohol, at 25° C. One Gm. is soluble in 0.4 cc. of boiling water. It is insoluble in chloroform and in ether.

Tests for Identity—An aqueous solution of the salt (1 in 20) responds to the reactions for calcium, page 671, and for bromides, page 574.

Tests for Purity—An aqueous solution of Calcium Bromide (1 in 20) is neutral or slightly alkaline to litmus paper. Add a few drops of ferric chloride T.S. and 1 cc. of chloroform to 10 cc. of an aqueous solution of the salt (1 in 20), and shake the mixture: the chloroform does not acquire a violet tint (*iodide*).

Drop 1 cc. of diluted sulphuric acid upon about 1 Gm. of the powdered salt: no yellow color appears at once (*bromate*).

Dissolve 0.1 Gm. of the salt in 5 cc. of distilled water, add an excess of silver nitrate T.S. and a few drops of nitric acid, and filter. Wash the precipitate with distilled water, digest it for ten minutes with 5 cc. of ammonium carbonate T.S. and filter. Dilute the filtrate with enough distilled water to make 40 cc.: a 10 cc. portion of this dilution, acidulated with nitric acid and further diluted with enough water to make 50 cc. shows no more *chloride* than corresponds to 0.5 cc. of fiftieth-normal hydrochloric acid, page 1556.

A 20 cc. portion of an aqueous solution of Calcium Bromide (1 in 250) does not at once assume a blue color with potassium ferrocyanide T.S. (*iron*).

A 5 cc. portion of an aqueous solution of the salt (1 in 20), when acidulated with 1 drop of hydrochloric acid, shows no immediate turbidity with 1 cc. of barium chloride T.S. (*sulphate*).

Dissolve 1 Gm. of Calcium Bromide and 1 Gm. of sodium acetate in 5 cc. of distilled water, and render the solution slightly acid by the addition of a sufficient quantity (from 3 to 5 drops) of diluted acetic acid. After boiling and thoroughly cooling the solution, it does not become cloudy within five minutes after the addition, with agitation, of five drops of potassium dichromate T.S (*barium*).

Precipitate the calcium completely from 10 cc. of an aqueous solution of Calcium Bromide (1 in 20) by adding ammonium oxalate T.S., and filter: the filtrate on evaporation and ignition leaves not more than 0.004 Gm. of residue (*magnesium or alkalies*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Assay—Proceed as directed under the assay for bromides, page 1515, using about 0.5 Gm. of Calcium Bromide, accurately weighed in a stoppered weighing bottle. Each cc. of tenth-normal silver nitrate corresponds to 0.009996 Gm. of $CaBr_2$.

This assay is explained on page 1462.

Preserve in well-closed containers.

N. F. Preparations—Elixir Bromidorum Quinque; Syrupus Bromidorum.

Uses—Calcium bromide is used as a nerve sedative in doses of fifteen to sixty grains (1 to 4 Gm.).

CALCII CARBONAS PRÆCIPITATUS. U. S. Precipitated Calcium Carbonate

[Calc. Carb. Præc.—Precipitated Chalk]

Precipitated Calcium Carbonate, when dried to constant weight at 200° C., contains not less than 98 per cent of $CaCO_3$ (100.08).

Preparation—This salt is readily prepared by double decomposition. The following process was formerly official in the British Pharmacopœia:

Take of calcium chloride 5 oz. av.; sodium carbonate 13 oz. av.; boiling distilled water a sufficiency. Dissolve the calcium chloride and the sodium carbonate each in 2 pints [Imperial measure] of the water; mix the two solutions; and allow the precipitate to subside. Collect this on a cloth strainer, wash it with boiling distilled water until the washings cease to give a precipitate with silver nitrate, and dry the product at the temperature of 100° C.

Calcium carbonate precipitates and sodium chloride remains in solution.

$$\underset{\text{calcium chloride}}{CaCl_2} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{sodium chloride}}{2NaCl}$$

The fineness of the powder is greatly promoted by using hot, dense solutions

Description and Physical Properties—A fine, white, microcrystalline powder, without odor or taste. It is stable in the air.

Precipitated Calcium Carbonate is practically insoluble in water. The solubility is increased by the presence of ammonium salts and also by carbon dioxide. Alkali hydroxides diminish its

solubility. It is insoluble in alcohol, and is dissolved with effervescence by diluted acetic, hydrochloric, or nitric acid.

When heated to about 825° C., the salt gradually loses carbon dioxide, and a residue of calcium oxide remains.

Tests for Identity—The addition of acetic acid to Precipitated Calcium Carbonate produces effervescence, and the resulting solution after boiling to expel carbon dioxide and neutralizing with ammonia T.S. responds to the reactions for calcium, page 671.

Tests for Purity—Mix 2 Gm. of Precipitated Calcium Carbonate with 100 cc. of distilled water and add hydrochloric acid, drop by drop, with agitation until solution takes place. This solution does not impart a green or crimson color to a non-luminous flame, and a 10 cc. portion of the liquid does not respond to the test for *heavy metals*, page 1519. Filter any insoluble residue remaining, wash with water until the washings show no more chloride, and ignite: the weight of the residue does not exceed 0.004 Gm.

Dissolve 0.5 Gm. of Precipitated Calcium Carbonate in 10 cc. of diluted hydrochloric acid, neutralize with ammonia T.S., completely precipitate the calcium by adding ammonium oxalate T.S., and then filter: the filtrate on evaporation and ignition leaves not more than 0.004 Gm. of residue (*magnesium or alkalies*).

Assay—Dry about 0.3 to 0.4 Gm. of Precipitated Calcium Carbonate to constant weight at 200° C., weigh accurately, dissolve it in 10 cc. of diluted hydrochloric acid and 10 cc. of distilled water, and boil the solution to expel all carbon dioxide. Transfer this solution to a 200 cc. volumetric flask, add 100 cc. of tenth-normal oxalic acid, render it alkaline with ammonia T.S., shake the mixture well, and allow it to stand for three hours at from 60° to 70° C. or overnight at room temperature. Cool the liquid if necessary, fill the flask with distilled water to 200 cc., mix well, filter through a dry filter into a dry flask, reject the first 20 cc. of the filtrate, and proceed as follows: Acidulate 100 cc. of the filtrate (corresponding to one-half of the Precipitated Calcium Carbonate taken) with diluted sulphuric acid, then add 25 cc. more of the diluted sulphuric acid, warm the solution to about 65° C. and titrate with tenth-normal potassium permanganate. Each cc. of tenth-normal oxalic acid corresponds to 0.005004 Gm. of $CaCO_3$.

This assay is explained on page 1473.

N. F. Preparations—Elixir Calcii Lactophosphatis; Liquor Alumini Subacetatis; Liquor Phosphatum Acidus; Liquor Phosphatum Compositus; Pasta Zinci Mollis; Syrupus Calcii Iodidi; Syrupus Calcii Lactophosphatis; Unguentum Sulphuris Compositum.

Uses—This form of calcium carbonate, known popularly as *precipitated chalk*, is largely used in tooth powders and similar preparations; it must be very finely powdered or the crystalline particles would cause erosion upon the enamel of the teeth. It is less useful than prepared chalk as an ingredient in chalk mixtures for internal use, because it does not possess the adhesive properties of the latter. The dose is fifteen grains (1 Gm.).

CRETA PRÆPARATA. U. S. Prepared Chalk

[Cret. Præp.—Drop Chalk]

Prepared Chalk is a native form of calcium carbonate freed from most of its impurities by elutriation, and containing, when dried to constant weight at 200° C., not less than 97 per cent of $CaCO_3$ (100.08).

Preparation—A process formerly official is as follows:

Take of chalk a *convenient quantity*. Add a little water to the chalk, and rub it into fine powder. Place this into a large vessel nearly full of water, stir briskly, and, after a short interval, decant the supernatant liquid, while yet turbid, into another vessel. Treat the coarser particles of the chalk, remaining in the first vessel, in a similar manner, and add the turbid liquid to that previously decanted. Lastly set the liquid aside, that the powder may subside, and, having poured off the water, dry the powder.

The object of this process is to effect the separation of the gritty particles in ordinary chalk by elutriation (see page 154). It is usual to form the moist magma into cones by trochiscation (see page 155). While elutriation effects the purification of the chalk to a certain extent, it does not separate the insoluble fine particles, and hence prepared chalk is chemically not so pure as precipitated calcium carbonate.

It also differs greatly in appearance from precipitated chalk, even after it has been reduced to a fine powder. It is usually not so white as the latter, and

it adheres to the fingers when handled. This adhesiveness fits it for many purposes. *Whiting*, a less pure form of prepared chalk obtained as a by-product in the elutriation process, is used for polishing.

Description and Physical Properties—A white to grayish-white, very fine, amorphous powder, often formed into "conical drops". It is odorless and tasteless, and is stable in the air.

Tests for Identity—When heated to about 825° C., Prepared Chalk gradually loses carbon dioxide and is converted into calcium oxide.

Dissolve about 0.1 Gm. of Prepared Chalk in 5 cc. of diluted acetic acid, and filter the solution: this solution responds to the reactions for calcium, page 671.

Tests for Purity—Prepared Chalk is practically insoluble in water and is insoluble in alcohol. It is decomposed and dissolved by diluted acetic, hydrochloric, or nitric acid, with copious effervescence. When a weighed amount of Prepared Chalk is dissolved in diluted hydrochloric acid and the insoluble residue collected and ignited, it yields not more than 2 per cent of the amount of Prepared Chalk taken.

Assay—Proceed as directed under *Calcii Carbonas Præcipitatus*.

This assay is explained on page 1473.

U. S. P. Preparations—Hydrargyrum cum Creta; Mistura Cretæ; Pulvis Cretæ Compositus.

N. F. Preparations—Dentifricium; Pulvis Cretæ Aromaticus.

Uses—This is the form of chalk which is used in medicine almost exclusively as it occurs in amorphous particles which have a greater adhesive property than precipitated calcium carbonate, which is crystalline. It is antacid, and is admirably adapted for the treatment of diarrhea. Dose, fifteen grains (1 Gm.).

CALCII CHLORIDUM. U. S. Calcium Chloride
[Calc. Chlor.]

Calcium Chloride is a hydrated salt containing not less than 75 per cent of $CaCl_2$ (110.99).

Preparation—Hydrated calcium chloride is obtained as a by-product of various industrial processes, such as the manufacture of ammonia water and ammonia soda, but may be prepared by saturating hydrochloric acid with chalk or marble, and carefully evaporating to dryness, at a temperature not exceeding 200° C., until it contains about 24 per cent of water.

$$\underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{calcium chloride}}{CaCl_2} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—White, slightly translucent, hard, odorless fragments or granules. It is very deliquescent.

One Gm. of Calcium Chloride is soluble in 1.2 cc. of water, and in about 10 cc. of alcohol, at 25° C. One Gm. is soluble in 0.7 cc. of boiling water and in about 2 cc. of boiling alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 10) responds to the reactions for calcium, page 671, and for chlorides, page 567.

Tests for Purity—An aqueous solution of Calcium Chloride (1 in 20) is neutral or slightly alkaline to litmus paper.

Add ammonia water to an aqueous solution of the salt (1 in 20) until alkaline: no turbidity or precipitation occurs either before or after boiling (*iron, aluminum, or phosphates*).

Precipitate the calcium completely from 10 cc. of an aqueous solution of the salt (1 in 20) by adding ammonium oxalate T.S. and filter: the filtrate on evaporation and ignition leaves not more than 0.004 Gm. of residue (*magnesium or alkalies*).

An aqueous solution of the salt does not respond to the test for *heavy metals*, page 1519.

Assay—Proceed as directed under the assay for chlorides, page 1514, using about 0.3 Gm. of Calcium Chloride, accurately weighed in a stoppered weighing-bottle. Each cc. of tenth-normal silver nitrate corresponds to 0.00555 Gm. of $CaCl_2$.

This assay is explained on page 1463.

Preserve in well-stoppered bottles.

N. F. Preparation—Liquor Hydrastinæ Compositus.

Uses—It is used in internal hemorrhages, in certain bone diseases, nervous disorders, tuberculosis, enteritis, and wherever there is a deficiency of lime in the system. The dose is from five to fifteen grains (0.3 to 1 Gm.). It is incompatible with carbonates, phosphates, tartrates, and sulphates, since it forms

with these, insoluble calcium salts. Fused calcium chloride is used in chemical processes for dehydrating gases; this it does through its powerful affinity for water. It is also used as a dehydrating agent in desiccators.

CALCII GLYCEROPHOSPHAS. U. S. Calcium Glycerophosphate

[Calc. Glycerophos.—Calcium Glycerinophosphate]

The normal calcium salt of glycerophosphoric acid [$C_3H_5(OH)_2PO_4H_2 = 172.13$] containing, when dried to constant weight at 130° C., not less than 98 per cent of $C_3H_5(OH)_2PO_4Ca$ (210.18).

Preparation—This salt is prepared by adding glycerophosphoric acid to an excess of milk of lime or calcium carbonate, filtering out the excess of calcium salt, removing any dissolved lime by the addition of carbon dioxide, concentrating in vacuum, and precipitating the glycerophosphate by the addition of alcohol.

The following equation illustrates the reaction that takes place:

$$\underset{\text{glycerophosphoric acid}}{C_3H_5(OH)_2PO_4.H_2} + \underset{\text{calcium hydroxide}}{Ca(OH)_2} = \underset{\text{calcium glycerophosphate}}{C_3H_5(OH)_2PO_4Ca} + \underset{\text{water}}{2H_2O}$$

Description and Physical Properties—A fine, white, odorless powder. It is somewhat hygroscopic.

One Gm. of Calcium Glycerophosphate is soluble in about 50 cc. of water at 25° C. It is more soluble in water at a lower temperature; citric acid increases its solubility in water. It is insoluble in alcohol.

Tests for Identity—A saturated aqueous solution of Calcium Glycerophosphate is alkaline to litmus paper and to phenolphthalein T.S.

A cold, saturated aqueous solution of the salt upon boiling yields white, iridescent scales of anhydrous calcium glycerophosphate. When heated above 170° C., the salt is decomposed, evolving inflammable vapors, and at a red heat is converted into calcium pyrophosphate.

A saturated aqueous solution of the salt responds to the reactions for calcium, page 671, and for glycerophosphates, page 678.

With lead acetate T.S. a saturated aqueous solution of the salt yields a white curdy precipitate, which is soluble in nitric acid.

Tests for Purity—Dissolve 1 Gm. of Calcium Glycerophosphate in 10 cc. of diluted nitric acid, and add an equal volume of cold ammonium molybdate T.S.: no precipitate is formed within one hour (*phosphates*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

One Gm. of Calcium Glycerophosphate shows no more *chloride* than 1 cc. of fiftieth-normal hydrochloric acid, page 1556.

Two-tenths of 1 Gm. of Calcium Glycerophosphate shows no more *sulphate* than 1 cc. of fiftieth-normal sulphuric acid, page 1520.

Shake 1 Gm. of finely powdered Calcium Glycerophosphate with 25 cc. of dehydrated alcohol, filter the mixture, evaporate the filtrate on a water bath, and dry the residue for an hour at a temperature not exceeding 70° C.: the resulting residue weighs not more than 0.01 Gm. (*alcohol-soluble substances*).

The loss on drying a portion of the finely powdered salt to constant weight at 130° C. does not exceed 10 per cent (*water*).

Dry about 3 Gm. of Calcium Glycerophosphate to constant weight at about 130° C., weigh accurately, dissolve it in 250 cc. of distilled water, and then titrate with half-normal hydrochloric acid, using methyl orange T.S. as indicator, to a slight yet distinct pink. Each Gm. of dry Calcium Glycerophosphate requires not less than 9 cc. of half-normal hydrochloric acid (*minimum limit for glycerophosphate*).

Assay—Dry about 0.4 Gm. of Calcium Glycerophosphate to constant weight at 130° C., weigh accurately, dissolve in 20 cc. of a 5 per cent solution of acetic acid, and add 30 cc. of distilled water. Heat the mixture to boiling, and add an excess of ammonium oxalate T.S. Collect the resulting precipitate, wash, dry, and ignite to constant weight. This residue of calcium oxide corresponds to not less than 26.1 per cent of the weight of dried Calcium Glycerophosphate taken.

Dry a portion of Calcium Glycerophosphate to constant weight at 230° C. and ignite it to constant weight. The weight of calcium pyrophosphate corresponds to not less than 59.2 per cent of the weight of Calcium Glycerophosphate taken.

This assay is explained on page 1478.

Preserve in well-closed containers.

N. F. Preparations—Elixir Calcii et Sodii Glycerophosphatum; Elixir Glycerophosphatum Compositum; Elixir Terpini Hydratis et Creosoti Compositum.

Uses—It is used in doses of four to ten grains (0.25 to 0.6 Gm.) as a tonic and nervine, and where calcium salts are indicated.

Tests for Glycerophosphates

Glycerophosphates—Solutions of glycerophosphates yield no precipitate in the cold with ammonium molybdate T.S., but upon heating, an abundant yellow precipitate is formed. Moderately diluted solutions of glycerophosphates, when treated with calcium chloride T.S., remain unaffected in the cold but on boiling, a precipitate is produced which redissolves on cooling.

CALCII LACTAS. U. S. Calcium Lactate

[Calc. Lact.]

Calcium Lactate contains not less than 70 per cent and not more than 75 per cent of $Ca(C_3H_5O_3)_2$ (218.18), corresponding to not less than 98 per cent of the hydrated salt $[Ca(C_3H_5O_3)_2.5H_2O = 308.26]$.

Preparation—It may be prepared by dissolving calcium carbonate in warm diluted lactic acid, filtering while hot, and crystallizing.

$$\underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{lactic acid}}{2HC_3H_5O_3} = \underset{\text{calcium lactate}}{Ca(C_3H_5O_3)_2} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

In the manufacture of lactic acid calcium lactate is obtained as an intermediate product.

Description and Physical Properties—White, granular masses or powder. It is odorless or has a slight odor. It is somewhat efflorescent and at 120° C. becomes anhydrous.

One Gm. of Calcium Lactate is soluble in 20 cc. of water at 25° C. It is practically insoluble in alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 20) responds to the reactions for calcium, page 671, and for lactates, page 1183.

Tests for Purity—When dried to constant weight at 120° C., Calcium Lactate loses not less than 25 per cent and not more than 30 per cent of its weight.

A solution of 1 Gm. of Calcium Lactate in 20 cc. of distilled water requires not more than 0.5 cc. of tenth-normal sodium hydroxide for neutralization, using phenolphthalein T.S. as indicator.

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

Add ammonium oxalate T.S. to 20 cc. of a hot aqueous solution of Calcium Lactate (1 in 20) until no further precipitate is produced, filter the mixture after three hours, and wash the precipitate with 50 cc. of distilled water: the combined filtrate and washings leave not more than 0.01 Gm. of residue on evaporation and subsequent ignition (*magnesium or alkalies*).

Stir about 0.5 Gm. of the salt with 1 cc. of sulphuric acid: the mixture does not emit an odor of volatile fatty acids even on warming.

Assay—Dry about 2 Gm. of Calcium Lactate to constant weight at 120° C., weigh accurately in a crucible, incinerate, wash the incinerated residue into a flask with about 50 cc. of distilled water, add exactly 50 cc. of half-normal hydrochloric acid, and titrate the excess of acid with half-normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of half-normal hydrochloric acid corresponds to 0.05455 Gm. of $Ca(C_3H_5O_3)_2$.

This assay is explained on page 1459.

Preserve in well-closed containers.

Uses—It is used to control hemorrhage, and in other diseases where calcium is indicated. Dose, from five to ten grains (0.3 to 0.6 Gm.) three or four times a day.

CALCII HYPOPHOSPHIS. N. F. Calcium Hypophosphite

(U. S. P. IX)

[Calc. Hypophos.]

Calcium Hypophosphite contains, when dried to constant weight over sulphuric acid, not less than 98 per cent of $Ca(PH_2O_2)_2$ (170.18).

Caution should be observed in dispensing Calcium Hypophosphite as an explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents.

Preparation—This salt is made by boiling milk of lime and phosphorus together until the spontaneously inflammable gas, hydrogen phosphide, ceases to be evolved; it is necessary to provide for the safe escape of this gas by conducting it by a hood into a powerful draught.

$$\underset{\text{phosphorus}}{8P} + \underset{\text{calcium hydroxide}}{3Ca(OH)_2} + \underset{\text{water}}{6H_2O} = \underset{\text{calcium hypophosphite}}{3Ca(PH_2O_2)_2} + \underset{\text{hydrogen phosphide}}{2PH_3}$$

The liquid is filtered to separate the insoluble phosphate and residuary lime, then concentrated, and refiltered to separate the calcium carbonate formed by the action of the air on a little lime held in solution, and lastly evaporated till a pellicle appears; after which the salt may be allowed to crystallize by setting the liquid aside, or may be obtained in the granular form by continuing the heat, and stirring.

The heat employed in evaporating the solution should not be above 85° C. (185° F.), for fear of explosions, several accidents having occurred through carelessness in this respect, even when the evaporation was conducted with a water bath.

Description and Physical Properties—Calcium Hypophosphite occurs as colorless, transparent, monoclinic prisms, as small lustrous scales, or as a white, crystalline powder; odorless; having a nauseous and bitter taste, permanent in the air.

One Gm. of Calcium Hypophosphite is slowly soluble in 6.5 cc. of water at 25° C.; insoluble in alcohol.

Tests for Identity—When heated the salt decrepitates and begins to decompose, giving off water and evolving spontaneously inflammable hydrogen phosphide, and on complete ignition leaving a residue of calcium pyrophosphate.

When an aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, with agitation, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed. Upon the further addition of the solution of Calcium Hypophosphite the precipitate becomes gray from reduction to metallic mercury.

An aqueous solution of Calcium Hypophosphite (1 in 20) yields with ammonium oxalate T.S. a white precipitate, insoluble in acetic acid, but soluble in hydrochloric acid.

Tests for Purity—Dissolve 1 Gm. of the salt in 20 cc. of distilled water; it requires not more than 1 cc. of tenth-normal potassium hydroxide to produce a pink color, phenolphthalein T.S. being used as indicator.

When 1 Gm. of the salt is dissolved in 20 cc. of distilled water, not more than 0.005 Gm. of residue remains (*phosphate*).

Mix 5 cc. of an aqueous solution of the salt (1 in 10) in a test tube with 0.5 cc. of diluted hydrochloric acid and heat on a water bath; no offensive odor develops within thirty minutes.

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

Pour 5 cc. of an aqueous solution of the salt (1 in 25) into a beaker containing 3 cc. of nitric acid, diluted with about 10 cc. of distilled water, and evaporate it to dryness on a water bath. The residue meets the requirements of the test for arsenic (see page 1512).

Assay—Dissolve about 0.75 Gm. of Calcium Hypophosphite, previously dried to constant weight over sulphuric acid and accurately weighed, in 10 cc. of distilled water, add 10 cc. of nitric acid and evaporate to dryness on a water bath. Add 5 cc. of nitric acid to the residue, again evaporate to dryness on a water bath and dissolve the residue in sufficient distilled water to measure 100 cc. Transfer 10 cc. of this solution to a 100 cc. graduated flask, add sodium hydroxide T.S. (free from chloride) until a slight, permanent precipitate is produced; then add 50 cc. of tenth-normal silver nitrate and agitate well. Then gradually add zinc oxide (free from chloride) in small portions until the liquid is neutral to litmus. Then add distilled water to make 100 cc., agitate the mixture thoroughly, filter through a dry filter, rejecting the first 20 cc. of filtrate, collect 50 cc. of the subsequent filtrate, add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate to the production of a red color.

Each cc. of tenth-normal silver nitrate corresponds to 0.002836 Gm. of $Ca(PH_2O_2)_2$. Each Gm. of Calcium Hypophosphite, dried to constant weight, corresponds to not less than 345.5 cc. of tenth-normal silver nitrate.

This assay is explained on page 1464.

Preserve it in well-closed containers. Caution should be observed in dispensing Calcium Hypophosphite as an explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents.

N. F. Preparations—Emulsum Olei Morrhuæ cum Hypophosphitibus; Liquor Hypophosphitum Compositus; Syrupus Calcii et Sodii Hypophosphitum; Syrupus Calcii Hypophosphitis; Syrupus Hypophosphitum; Syrupus Hypophosphitum Compositus.

Uses—Calcium hypophosphite is used pharmaceutically to prepare the other hypophosphites, hypophosphorous acid, and as an ingredient in the syrup and compound syrup of hypophosphites and other preparations. Medicinally, it is used in phthisis and other wasting diseases, and in cases of defective nerve nutrition. The dose is from five to thirty grains (0.32 to 2 Gm.).

CALCII LACTOPHOSPHAS. N. F. Calcium Lactophosphate

[Calc. Lactophos.]

A mixture in variable proportions of calcium lactate, calcium acid lactate, and calcium acid phosphate, corresponding to not less than 1.5 per cent and not more than 2 per cent of (P_2O_5).

Preparation—It may be prepared by mixing 15 parts of calcium carbonate, 30 parts of lactic acid, 9.86 parts of phosphoric acid and 150 parts of distilled water, and evaporating to dryness in a warm place, avoiding the use of a water bath.

Description and Physical Properties—Calcium Lactophosphate occurs in white granules or as a white powder, without odor.

It is soluble in water, almost insoluble in alcohol.

Its aqueous solution (1 in 20) is acid to litmus.

Tests for Identity—The addition of ammonium oxalate T.S. to an aqueous solution of Calcium Lactophosphate produces a white precipitate insoluble in acetic acid but soluble in hydrochloric acid.

Add 10 cc. of diluted sulphuric acid and 5 cc. of potassium permanganate T.S. to 5 cc. of an aqueous solution of Calcium Lactophosphate (1 in 20) and gently warm the mixture; the odor of acetaldehyde is evolved.

Add silver nitrate T.S. or ammonium molybdate T.S. to separate portions of an aqueous solution of Calcium Lactophosphate (1 in 20); a yellow precipitate is produced.

Tests for Purity—Mix 0.5 Gm. of Calcium Lactophosphate with 5 cc. of sulphuric acid; not more than a slight coloration results within one minute (*readily carbonizable impurities*).

Ten cc. of an aqueous solution of Calcium Lactophosphate (1 in 100) mixed with 1 cc. of diluted hydrochloric acid, does not at once become turbid on the addition of a few drops of barium chloride T.S. (*sulphate*).

Ten cc. of an aqueous solution of Calcium Lactophosphate (1 in 100) when mixed with a few drops of nitric acid, yields not more than an opalescence on the addition of a few drops of silver nitrate T.S. (*chloride*).

An aqueous solution of Calcium Lactophosphate does not respond to the test for heavy metals (see page 1519).

Mix 0.2 Gm. of Calcium Lactophosphate with 1 Gm. of potassium nitrate, ignite the mixture cautiously, in small portions at a time until the carbonaceous matter is all or nearly all burned off, then add to the residue 20 cc. of diluted sulphuric acid and evaporate the mixture until fumes of sulphuric anhydride are evolved. The residue meets the requirements of the test for arsenic (see page 1512).

Dissolve 1 Gm. of Calcium Lactophosphate and 2 Gm. of ammonium chloride in 75 cc. of distilled water, heat the solution to boiling and add an excess of ammonium oxalate T.S. (about 20 cc.). Allow the precipitate to subside completely, then filter and supersaturate the filtrate with ammonia water; not more than a slight turbidity is produced (*magnesium*).

Assay—Dissolve about 1 Gm. of Calcium Lactophosphate, accurately weighed, in a mixture of 15 cc. of distilled water and 10 cc. of nitric acid contained in a 200 cc. beaker, and then add ammonia T.S. to a point just short of neutralization. Dilute the solution to 100 cc., heat to 60° C., add 25 cc. of ammonium molybdate T.S. and agitate well. Allow the mixture to remain at 60° for fifteen minutes, then filter through paper and wash with distilled water until the washings are neutral. Transfer the precipitate and filter back to the beaker, dissolve the precipitate in 30 cc. of half-normal sodium hydroxide, and titrate the excess of alkali with half-normal hydrochloric acid, using phenolphthalein T.S. as indicator. Each cc. of half-normal alkali corresponds to 0.001544 Gm. of P_2O_5.

This assay is explained on page 1455.

N. F. Preparations—Lactophosphatis; Syrupus Calcii Lactophosphatis; Syrupus Calcii Lactophosphatis et Ferri.

Uses—It is used as a tonic and to supply calcium to the system, usually in the form of the official syrup. The dose is five to ten grains (0.32 to 0.65 Gm.).

CALCII PHOSPHAS PRÆCIPITATUS. N. F. Precipitated Calcium Phosphate

[Calc. Phos. Præc.]

Calcium Phosphate ($Ca_3(PO_4)_2$=310.29) losing, when dried at 200° C., not more than 4 per cent of moisture.

Preparation—Take of bone, calcined to whiteness, and in fine powder, 4 oz. troy; hydrochloric acid, 8 oz. troy; ammonia water, 12 fl. oz., or a sufficient quantity; distilled water, a sufficient quantity. Macerate the bone in the acid, diluted with a pint of distilled water, until it is dissolved, and filter the solution. Add another pint of distilled water, and then, gradually, ammonia water, until the liquid acquires an alkaline reaction. Mix the precipitate obtained, while yet in the state of magma, with twice its bulk of boiling distilled water, and pour the whole upon a strainer. Wash the precipitate with boiling distilled water until the washings cease to be affected by a solution of nitrate of silver, acidulated with nitric acid. Lastly dry the precipitate with a gentle heat.

Calcium phosphate exists in calcined bone; it is soluble in hydrochloric acid, but is precipitated from its solution by ammonia water, ammonium chloride remaining in solution.

It may be prepared from calcium chloride and sodium phosphate in the presence of ammonia water at boiling temperature. The reaction is as follows:

$$3CaCl_2 + 2Na_2HPO_4 + 2NH_4OH = Ca_3(PO_4)_2 + 4NaCl + 2NH_4Cl + 2H_2O$$

calcium chloride	sodium phosphate	ammonia water	calcium phosphate	sodium chloride	ammonium chloride	water

Description and Physical Properties—Precipitated Calcium Phosphate occurs as a white, amorphous or microcrystalline, bulky powder, odorless and tasteless; permanent in the air. At an intense white heat the salt fuses without decomposition.

Almost insoluble in cold water; partly decomposed by boiling water; almost insoluble in acetic acid, except when freshly precipitated; easily dissolved by hydrochloric or nitric acid; insoluble in alcohol.

Tests for Identity—When moistened with silver nitrate T.S., either before or after ignition, the salt acquires a yellow color (distinction from *acid calcium phosphate* which, after ignition when moistened with silver nitrate T.S., remains white).

For applying tests of identity and of purity, prepare a solution by shaking 2 Gm. of Precipitated Calcium Phosphate with 20 cc. of distilled water adding nitric acid, drop by drop, until solution is effected, and then sufficient distilled water to make the liquid measure 40 cc. While making this solution, no effervescence occurs on adding the acid (*carbonate*).

To a portion of this solution add a slight excess of ammonia water, then an excess of silver nitrate T.S. and afterwards acetic acid, drop by drop, until the excess of ammonia is neutralized; the color of the precipitate changes from white to yellow.

Ammonium molybdate T.S. precipitates from the solution yellow ammonium phosphomolybdate; the reaction is accelerated by a gentle heat, not exceeding 65° C.

Tests for Purity—Add to 5 cc. of the solution, acidulated with nitric acid, 0.5 cc. of silver nitrate T.S.; not more than a slight turbidity is produced (*chloride*).

Add to five cc. of the solution, strongly acidulated with nitric acid, 1 cc. of potassium sulphate T.S.; no turbidity appears within fifteen minutes (*barium*).

An aqueous solution of Precipitated Calcium Phosphate (1 in 50), obtained by shaking the salt with distilled water, adding hydrochloric acid, drop by drop, and heating until solution is effected, does not respond to the test for heavy metals (see page 1519).

Five cc. of a solution of Precipitated Calcium Phosphate in diluted nitric acid (1 in 25), heated with 1 cc. of sulphuric acid until fumes of sulphur trioxide appear, meets the requirements of the test for arsenic (see page 1512).

Preparations—Liquor Phosphatum Acidus; Liquor Phosphatum Compositus; Pulvis Antimonialis; Syrupus Phosphatum Compositus; Syrupus Phosphatum cum Quinina et Strychnina.

Uses—Precipitated calcium phosphate, on account of its insolubility in water, was used in making medicated waters in preference to magnesium carbonate and other similar substances in the U. S. P. 1890, but has been replaced by purified talc in later revisions of the U. S. P. It is administered largely now in combination with lactic acid and phosphoric acid, for use in cases of defective nutrition, as in the official syrup and in the N. F. emulsion. The dose is from 10 to 30 grains (0.65 to 2 Gm.).

LIQUOR CALCIS SULPHURATÆ. N. F. Solution of Sulphurated Lime

[**Liq. Calc. Sulphurat.**—Solution of Oxysulphuret of Calcium, Vleminckx Solution, Vleminckx Lotion]

	Metric	Alternative
Lime	**165 Gm.**	5 oz. av. 222 gr.
Sublimed Sulphur	**250 Gm.**	8 oz. av. 151 gr.
Water, a sufficient quantity,		
To make about	**1000 cc.**	2 pints

Slake the lime, mix it with the sulphur and add the mixture gradually to 1750 cc. [3½ pints] of boiling water. Boil this mixture, with frequent agitation, until it is reduced to 1000 cc. [2 pints], and maintain this volume, one hour while boiling, by the addition of water from time to time. Cool and strain the mixture and having allowed the solution to become clear by standing in a stoppered bottle, decant the clear brownish liquid, and preserve it in completely filled and well-stoppered bottles.

Solution of Sulphurated Lime is a clear, brownish red liquid with a slight hydrogen sulphide-like odor and an alkaline reaction.

Add to 5 cc. of the Solution an excess of diluted hydrochloric acid: the color changes to a pale yellow, a white precipitate of sulphur appears, and hydrogen sulphide is evolved with effervescence.

Boil the liquid obtained in the foregoing test, filter, and add a slight excess of ammonia T.S., followed by a slight excess of acetic acid: the subsequent addition of 1 cc. of ammonium oxalate T.S. produces a white precipitate.

Uses—Used externally in the treatment of itch, scabies and other skin diseases; for application it is usually diluted with an equal volume or more of water.

LIQUOR HYPOPHOSPHITUM COMPOSITUS. N. F. Compound Solution of Hypophosphites

[Liq. Hypophos. Co.]

	Metric	Alternative
Calcium Hypophosphite	8.500 Gm.	124 gr.
Potassium Hypophosphite	8.500 Gm.	124 gr.
Sodium Hypophosphite	2.200 Gm.	34 gr.
Ferric Hypophosphite	4.400 Gm.	64 gr.
Manganese Hypophosphite	2.200 Gm.	32 gr.
Quinine	2.000 Gm.	29 gr.
Strychnine	0.065 Gm.	1 gr.
Potassium Citrate	8.500 Gm.	124 gr.
Hypophosphorous Acid	7.000 cc.	108 min.
Orange Flower Water	35.000 cc.	1 fl. oz. 58 min.
Glycerin	350.000 cc.	11 fl. oz. 96 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the calcium, sodium and potassium hypophosphites in 300 cc. [9½ fl. oz.] of distilled water. Dissolve the remaining salts in 250 cc. [8 fl. oz.] of distilled water with the aid of heat and add the hypophosphorous acid in which the quinine and strychnine have previously been dissolved. Mix the two solutions, add the orange flower water and glycerin, and sufficient distilled water to make the product measure 1000 cc. [2 pints]; allow the mixture to stand 12 hours and filter.

Compound Solution of Hypophosphites is a clear, colorless liquid, almost odorless, and with a sweetish, acidulous, and bitter taste, and a slightly acid reaction.

Acidulate 5 cc. of the Solution with acetic acid and add 1 cc. of ammonium oxalate T.S.: a white precipitate is produced. A clean platinum wire dipped in the Solution and then held in a non-luminous flame, shows the characteristic flame of sodium.

When this flame is observed through a blue glass, the potassium flame is recognized.

Acidulate 5 cc. of the Solution with hydrochloric acid and add a few drops of potassium ferrocyanide T.S.: a blue color is observed.

Render 25 cc. of the Solution alkaline with ammonia T.S. and shake out with 10 cc. of ether. Evaporate the ether and apply the thalleioquin test to the residue. It shows the presence of quinine. The liquid which has been extracted with ether is subsequently shaken cut with 10 cc. of chloroform. Evaporate the chloroform, add 0.5 cc. of sulphuric acid to the dry residue and drop in a fragment of a crystal of potassium dichromate. A fugitive purple color is produced, showing the presence of strychnine.

Add to 5 cc. of the Solution, one half cc. of silver nitrate T.S.: a white precipitate is produced, which turns brown and eventually black.

Evaporate 1 cc. of Compound Solution of Hypophosphites almost to dryness and ignite carefully. Dissolve the ash in 10 cc. of distilled water, filter, add 1 Gm. of ammonium persulphate, boil until solution is effected and add 1 cc. of silver nitrate T.S.: a purple color results, indicating the presence of manganese.

Uses—The N. F. solutions of hypophosphites contain no sugar and therefore may be used when sugar is contraindicated. Its use is similar to other hypophosphites in doses of 1 fluidrachm (4 cc.).

LIQUOR PHOSPHATUM ACIDUS. N. F. Acid Solution of Phosphates

[Liq. Phos. Acid.—Solution of Acid Phosphates]

	Metric	Alternative
Precipitated Calcium Carbonate	50 Gm.	1 oz. av. 293 gr.
Magnesium Carbonate	5 Gm.	73 gr.
Phosphoric Acid	120 cc.	3 fl. oz. 403 min.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Mix the phosphoric acid with 700 cc. [22½ fl. oz.] of distilled water and dissolve the carbonates in this mixture. Then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Acid Solution of Phosphates is a clear, colorless, odorless liquid, with an acid taste and a strongly acid reaction.

Add to 5 cc. of the Solution an excess of ammonia T.S.: a thick, gelatinous, white precipitate is produced.

Uses—It is used as a tonic and alterative, usually added to nutritive drinks. The dose is 1 fluidrachm (4 cc.).

LIQUOR PHOSPHATUM COMPOSITUS. N. F. Compound Solution of Phosphates

[Liq. Phos. Co.]

	Metric	Alternative
Precipitated Calcium Carbonate	70 Gm.	2 oz. av. 147 gr.
Soluble Ferric Phosphate	35 Gm.	1 oz. av. 74 gr.
Ammonium Phosphate	35 Gm.	1 oz. av. 74 gr.
Sodium Citrate	35 Gm.	1 oz. av. 74 gr.
Citric Acid	120 Gm.	4 oz. av. 2 gr.
Phosphoric Acid	106 cc.	3 fl. oz. 188 gr.
Glycerin	375 cc.	12 fl. oz.
Orange Flower Water	125 cc.	4 fl. oz.
Distilled Water, a sufficient quantity, To make	1000 cc.	2 pints

Dissolve the citric acid and phosphoric acid in 100 cc. [3 fl. oz. 96 min.] of distilled water and gradually add the precipitated calcium carbonate. When the latter is dissolved and effervescence has ceased, add the orange flower water and glycerin, and mix well. Dissolve the ferric phosphate, ammonium phosphate and sodium citrate in 100 cc. [3 fl. oz. 96 min.] of hot distilled water, cool and add to the solution previously prepared. Then add sufficient distilled water to make the product measure 1000 cc. [2 pints], and filter.

Compound Solution of Phosphates is a clear, pale yellow liquid, with an orange flower-like odor, an acid taste and a strongly acid reaction. Add to 5 cc. of the Solution an excess of ammonia T.S.: a thick, gelatinous, pale yellow precipitate is produced.

This preparation was introduced to provide a relatively permanent solution of the phosphates for the extemporaneous preparation of the N. F. syrups which rapidly discolor, due to the caramelization of the sugar by the free acid.

N. F. Preparations—Syrupus Phosphatum Compositus; Syrupus Phosphatum cum Quinina et Strychnina.

Unofficial Salts of Calcium

Calcii Benzoas, $Ca(C_7H_5O_2)_2.3H_2O$ Calcium Benzoate	Soluble white powder or crystals; made by the action of benzoic acid on calcium hydroxide. It is used in preparing certain aromatic ketones and has been employed in medicine as an alterative and antiseptic. Dose, 10 to 30 grains (0.6 to 2 Gm.)
Calcium Chloride Urea, N. N. R. $CaCl_2.4(NH_2)_2CO$ Afenil	Colorless crystals, very soluble in water. Has the same action as calcium chloride. Used intravenously. Dose, 10 cc. of 10 per cent solution by injection. Manufactured by Knoll and Co.
Calcii Hydroxidum, $Ca(OH)_2$ Calcium Hydroxide	A white, dry powder. It is very slightly soluble in water. It is made by the action of water on calcium oxide. Calcium hydroxide is used on a large scale in the manufacture of mortar, cements, calcium salts, and is the active constituent of lime water
Calcii Iodas, $Ca(IO_3)_2.6H_2O$ Calcium Iodate	A white, crystalline powder; slightly soluble in water. It is used as an intestinal antiseptic. Dose, from 3 to 5 grains (0.2 to 0.32 Gm.)
Calcii Iodidum, CaI_2 Calcium Iodide	A yellowish-white powder; gradually decomposed by absorbing moisture and carbon dioxide from the air. It is deliquescent and very soluble in water
Calcii Phenolsulphonas, $Ca(C_6H_5SO_4)_2.H_2O$ Calcium Phenolsulphonate	A white crystalline powder; soluble in water. It is used in medicine as an intestinal antiseptic and astringent. Dose, 5 to 15 grains (0.32 to 1 Gm.)
Calcii Salicylas, $Ca(C_7H_5O_3)_2.2H_2O$ Calcium Salicylate	A white crystalline powder, having an alkaline reaction. It is very slightly soluble in water but readily soluble in carbonated water. It is used in gastroenteritis and the summer diarrhea of children. Dose, 8 to 15 grains (0.5 to 1 Gm.)
Calcii Sulphas, $CaSO_4.2H_2O$ Calcium Sulphate	Commonly called *gypsum*, as it occurs in nature. A white powder, insoluble in water. Plaster of Paris is made from this salt by driving off three-fourths of its water of crystallization. Gypsum is also used as a glaze in paper manufacture and as a polishing powder
Calcii Sulphas Exsiccatus, $CaSO_4.\frac{1}{2}H_2O$ Exsiccated Calcium Sulphate (Plaster of Paris)	A fine, white powder; very slightly soluble in water. When mixed with half its weight of water it forms a smooth paste which rapidly hardens. It is used in decorative and stucco work and in making *plaster of Paris bandages*
Calcii Sulphidum, CaS Calcium Sulphide	Light-gray cubes; slightly soluble in water; dissolved by acids with the evolution of hydrogen sulphide. This compound is used in depilatories and in luminous paint
Calcii Sulphidum Crudum Crude Calcium Sulphide, U. S. P. IX (Calx Sulphurata, Sulphurated Lime)	A pale gray or yellowish powder having a faint odor of hydrogen sulphide. It gradually decomposes on exposure to moist air. It is very slightly soluble in cold water. Sulphurated lime is used as a depilatory and internally for acne, and other skin diseases. It has also been suggested as an antidote to bichloride of mercury. The dose is ½ to 1 grain (0.03 to 0.06 Gm.)

Unofficial Salts of Calcium—*Continued*

Calcii Sulphis, $CaSO_3$ Calcium Sulphite	A white powder, slightly soluble in water but readily soluble in water containing sulphur dioxide. It is used as a disinfectant, an antichlor, and a preservative. Its dose, as an antiseptic, is from 1 to 5 grains (0.06 to 0.32 Gm.)
Calcii Sulphydras, $CaH_2S_2.6H_2O$ Calcium Sulphydrate	Colorless, transparent crystals that decompose in air. It should be kept in well-closed containers. It is soluble in water and is used as a depilatory
Calcii Thiosulphas, $CaS_2O_3.6H_2O$ Calcium Thiosulphate	White crystals that are readily soluble in water. This salt is the commercial source of "hypo" or sodium thiosulphate, since, when treated, in solution, with sodium carbonate it yields the insoluble calcium carbonate and a solution of sodium thiosulphate. In medicine it is used as an internal antiseptic. Dose, 3 to 10 grains (0.2 to 0.65 Gm.)

RADIUM AND ITS DISINTEGRATION PRODUCTS AND COMPOUNDS

Radium is from the Latin "radius", meaning "ray" and indicative of the active emanations, characteristic of this marvelous element. It belongs to the barium group, and has an atomic weight of 226.0. It is a bright white metal, melting at about 700° C.

It was discovered in 1898 by Pierre and Madame Curie, from the concentrates of some of the Austrian uranium mines after the extraction of the uranium from the ore. The principal radium-containing ores are *carnotite* and *pitchblende*. It is possible that radium is a disintegration product of uranium, which is the element possessing the highest atomic weight known to chemistry. Radium has been the key to some of the mysteries of physical chemistry and the composition of the atom.

It exists in very minute amounts in the ores from which it is extracted, only a small fraction of a grain of radium being present in each ton of the ore. This accounts for its extremely high cost, which is approximately $100,000 a gram. There has been extracted and purified, up to the present time, a total of about 200 grams of radium. The insoluble carbonate and sulphate of radium, and the soluble bromide and chloride are the salts most frequently used. Radium and its compounds are used for their radioactivity, which has been defined as "the property of spontaneously emitting radiations, part of which are capable of passing through plates of metal and other substances opaque to ordinary light, and which have the power of discharging electrified bodies". All of the radioactive elements undergo spontaneous disintegration. During this disintegration certain rays are emitted which are known as alpha, beta and gamma rays. The *alpha rays* are material particles of atomic size, carrying a positive electric charge. After losing this charge the particles become atoms of helium. This transformation, which has been substantiated by much experimental evidence, is a true example of the transformation of one element into another. The *beta rays* are subatomic in size, are not material but consist of electrons, and are identical with the cathode rays of an X-ray tube. The *gamma rays* are like light rays of short wave length. Radioactivity is therefore due to an atomic explosion, the particles and rays being emitted with a speed almost as great as that of light, which travels 186,000 miles a second.

The energy that is thus represented is tremendous. It is stated that the interatomic energy of a gram of radium, if it could be harnessed, would yield power enough to drive a huge ocean liner across the Atlantic Ocean.

In the transformations of radium a series of products is formed. The first of these is the gas *niton*, with a density of over one hundred times that of the element hydrogen. In less than four days, half of this emanation disintegrates

with the formation of *Radium A*, and the emission of alpha rays. Radium A is identical with *polonium*. By the successive loss of alpha and beta rays other disintegration products are produced. Gamma rays usually accompany the emission of a beta particle. The *Radium C* group yields the most penetrating rays and those which are most useful of the therapeutic properties of radium. The following table from the N. N. R. of 1925 shows a complete list of the disintegration products of radium. It is estimated that the natural disintegration of radium is taking place at such a rate that in 1700 years half of any given quantity will have changed.

Radium and Its Disintegration Products

Substance	Chemical Nature	Atomic Weight	Valence	Half Value Periods	Rays
Radium	Metal	226	2	1,780 yrs.	Alpha
Radium emanation	Inert gas	222	0	3.85 days	Alpha
Radium A	Solid non-metal identical with polonium	218	6	3.0 min.	Alpha
Radium B	Identical with lead	214	4	26.7 min.	Beta, Gamma
Radium C_1	Identical with bismuth	214	5	19.5 min.	Alpha, Beta, Gamma
Radium C_2	Identical with thallium	210	3	1.4 min.	Beta, Gamma
Radium C	Identical with polonium	214	6	10^{-6} sec.	Alpha
Radium D	Identical with lead	210	4	15.8 yrs.	Beta, Gamma
Radium E	Identical with bismuth	210	5	4.85 days	Beta, Gamma
Radium F	Polonium	210	6	136 days	Alpha

Radium and its products are valued in mathematical terms of radioactivity expressed in units of distinctive character created for this purpose. The ionization or dissociation produced in certain gases by the influence of radioactivity is used as a basis of determining activity.

The units commonly employed are as follows:

1. *Milligrams* and *micrograms* (a microgram is 0.001 mgm.).

2. *Curies, millicuries* and *microcuries.* The curie is the quantity of emanation represented by 1 Gm. of radium, in equilibrium with its disintegration products (a millicurie is 0.001 curie, a microcurie is 0.000001 curie).

3. *Mache units.* A mache unit is the equivalent of 1/2700 of one microcurie of radium emanation. The use of this latter unit is being discouraged.

Purchasers and users of radium salts may have their radioactive value determined upon application to the U. S. Bureau of Standards.

Radium emanation has been termed "radon" in scientific literature. It may be collected and purified and kept in sealed glass tubes which are then kept in a metal container until needed for use. The emanation is sometimes dissolved in water for use.

Radium therapy requires the knowledge of skilled specialists. Pharmacists are sometimes called upon to supply radium salts or radium emanation devices.

For detailed descriptions of these forms, see N. N. R. 1925.

Barium, Ba.; 137.37

Barium takes its name from a Greek word meaning "heavy". This element furnishes but one official salt, the sulphate, although several others are found among the reagents—the chloride, the nitrate, and also the hydroxide. Barium dioxide was formerly designated in the official process for making solution of hydrogen dioxide, but since the U. S. P. no longer gives a method for preparing this solution the dioxide is not given official recognition, though it is used in enormous quantities in the production of hydrogen dioxide and is now manufactured in the United States. Barium occurs abundantly as *heavy spar*, a sulphate, and as *witherite*, a carbonate. It is a malleable metal, having a yellowish-white luster, decomposing water, and gradually oxidizing in the air.

Tests for Salts of Barium

Barium—Solutions of barium salts yield a white precipitate with diluted sulphuric acid. This precipitate is insoluble in hydrochloric or nitric acid. Barium salts impart a green color to a non-luminous flame.

BARII SULPHAS. U. S. Barium Sulphate

Barium Sulphate [$BaSO_4 = 233.43$], freed from soluble barium salts.

The Pharmacopœia adds the following special note to emphasize to both the physician and the pharmacist the danger from mistakes when prescribing this salt.

Caution—In prescribing Barium Sulphate the title should never be abbreviated, to avoid confusion with the poisonous barium sulphide or sulphite.

Other salts of barium, especially the sulphide are employed for legitimate purposes and are frequently sold by the manufacturer or wholesale druggist, but they are so rarely prescribed by the physician that it is a safe rule never to dispense any other salt than the *sulphate* even should the doctor write for "Bar. Sulph."

Preparation—While the mineral *heavy spar* or *barytes* consists of crude barium sulphate this is usually ground to powder and strongly heated in contact with charcoal or some other carbonaceous substance, which removes the oxygen as carbonic oxide and converts the sulphate into sulphide, as indicated by the following equation:

$$\underset{\text{barium sulphate}}{BaSO_4} + \underset{\text{carbon}}{C_4} = \underset{\text{carbon monoxide}}{4CO} + \underset{\text{barium sulphide}}{BaS}$$

In preparing the purified sulphate the sulphide, which contains $Ba(SH)_2$ and $Ba(OH)_2$, is mixed with water and treated with dilute sulphuric acid, when the extremely insoluble barium sulphate separates and is collected, purified, and dried. The equation is as follows:

$$\underset{\text{barium hydroxide}}{Ba(OH)_2} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{barium sulphate}}{BaSO_4} + \underset{\text{water}}{2H_2O}$$

It may also be prepared by precipitating a solution of barium chloride by the addition of sodium sulphate, as indicated in the following equation:

$$\underset{\text{barium chloride}}{BaCl_2} + \underset{\text{sodium sulphate}}{Na_2SO_4} = \underset{\text{barium sulphate}}{BaSO_4} + \underset{\text{sodium chloride}}{2NaCl}$$

Commercial grades of the precipitated barium sulphate, under the names *permanent white* or *blanc fixé*, are extensively used as a paint pigment, fre-

quently replacing white lead, chiefly because it does not darken with sulphides but also because it is less expensive.

Description and Physical Properties—A fine, white, odorless, tasteless and bulky powder, free from grittiness.

Barium Sulphate is insoluble in water, in organic solvents, and in aqueous solutions of acids and alkalies.

Tests for Identity—Mix 0.5 Gm. of Barium Sulphate with 2 Gm. each of anhydrous sodium carbonate and anhydrous potassium carbonate, heat the mixture in a crucible until fusion is complete, treat the resulting fused mass with hot water, and filter. Acidulate a portion of the filtrate with hydrochloric acid, and add 1 cc. of barium chloride T.S.: a white precipitate forms.

Dissolve in acetic acid a portion of the well-washed precipitate, obtained in the preceding test: the solution responds to the reactions for barium, page 686.

Tests for Purity—Boil 10 Gm. of Barium Sulphate with a mixture of 10 cc. of diluted hydrochloric acid and 90 cc. of distilled water for ten minutes, and add sufficient distilled water to restore the original volume. During boiling there should be no evolution of hydrogen sulphide, recognizable by the darkening of lead acetate paper exposed to the vapor (*sulphide*). Cool the mixture, and filter through paper which has been previously washed with a solution of 10 cc. of diluted hydrochloric acid and 90 cc. of distilled water, returning the first portions if necessary until a perfectly clear filtrate is obtained. Evaporate 50 cc. of the filtrate to dryness on a water bath, add two drops of hydrochloric acid and 10 cc. of hot distilled water. Filter through acid-washed paper, wash with 10 cc. of hot distilled water, and evaporate the combined filtrate and washings to dryness in a tared dish on a water bath. The residue, when dried to constant weight at from 100° to 110° C., should not be more than 0.3 per cent (*limit of acid-soluble substances*). Treat this residue with 10 cc. of distilled water, filter the solution through a filter previously washed with a mixture of 10 cc. of diluted hydrochloric acid and 90 cc. of distilled water, and add 0.5 cc. of diluted sulphuric acid: no turbidity should develop within one-half hour (*soluble barium salts*).

Boil 1 Gm. of Barium Sulphate with a mixture of 3 cc. of nitric acid and 5 cc. of distilled water during five minutes. Filter, and add to the warm filtrate an equal volume of ammonium molybdate T.S.: no yellow precipitate is formed (*phosphate*).

Digest 1 Gm. of Barium Sulphate with 20 cc. of distilled water during five minutes: the latter remains neutral to litmus paper (*free acid or alkali*).

Boil 5 Gm. of Barium Sulphate with 50 cc. of diluted acetic acid, and filter while hot: the filtrate meets the requirements of the test for *heavy metals*, page 1519.

Triturate 2 Gm. of Barium Sulphate with 5 cc. of concentrated hydrochloric acid, and add 10 cc. of a freshly made, saturated solution of stannous chloride: no dark coloration occurs within one-half hour (*arsenic*).

Uses—Barium sulphate is used in roentgenography for the purpose of making the intestinal tract opaque to the X-ray so that it may be photographed. As the amount required is large (two to eight ounces, and as soluble salts of barium are extremely poisonous, it is highly important to be sure that the sulphate dispensed is of U. S. P. quality. Very rigid tests are provided for the exclusion of soluble barium salts.

The N. N. R. describes the method of administration as follows:

For the Roentgen-Ray Examination of the Stomach—The evening before the examination, the patient receives 1 fluidounce of castor oil. In the morning an ordinary portion of wheat-meal porridge, with which 2 ounces of barium sulphate has been well mixed, together with a little sugar and cream, is administered by mouth. The patient is then directed to abstain from further food. The examination is made six hours later.

For the Roentgen-Ray Examination of the Colon—An enema consisting of 16 ounces of mucilage of acacia, 3 pounds of condensed milk, and 8 ounces of barium sulphate is warmed to body temperature and injected into the rectum from a height of from 3 to 6 feet (90 to 170 cm.). The examination is made with a fluoroscope while the injection is passing into the rectum.

Unofficial Salts of Barium

Barii Acetas, $Ba(C_2H_3O_2)_2.H_2O$ Barium Acetate	A poisonous, white, crystalline powder; soluble in water. It is chiefly used as a chemical reagent
Barii Benzoas, $Ba(C_7H_5O_2)_2.2H_2O$ Barium Benzoate	Small, colorless, laminar crystals; soluble in water. It is used as a heart stimulant, and is very poisonous
Barii Bromidum, $BaBr_2.2H_2O$ Barium Bromide	Poisonous, colorless crystals; soluble in water. It is used as a reagent and in the manufacture of other bromides

Unofficial Salts of Barium—*Continued*

Barii Carbonas, $BaCO_3$ Barium Carbonate	An insoluble, white powder, readily decomposed by acids with the evolution of carbon dioxide. It is made by precipitation and occurs as a native mineral called *witherite*. Barium Carbonate is used in the preparation of other barium compounds. It is used as a rat poison
Barii Chloridum, $BaCl_2.2H_2O$ Barium Chloride (See U. S. P. Test Solution)	Colorless, flat crystals; poisonous, and readily soluble in water. Barium chloride is used as a chemical reagent, in boiler compounds, in the leather industry, in rat and vermin poisons, and in medicine as a cardiac tonic and alterative. The dose is from ½ to 1½ grains (0.03 to 0.1 Gm.)
Barii Chromas, $BaCrO_4$ Barium Chromate	A heavy, yellow, crystalline powder; insoluble in water. It is poisonous. It is called yellow ultramarine and is used as a yellow paint pigment, and in Swedish matches
Barii Dioxidum, BaO_2 Barium Dioxide	A white or grayish-white powder. It is decomposed by water, forming the hydrated barium dioxide. It is poisonous. Barium dioxide is largely used in preparing medicinal peroxide of hydrogen; also in the manufacture of oxygen by the "Brin process", and as a bleaching agent
Barii Hydroxidum, $Ba(OH)_2.8H_2O$ Barium Hydroxide (See U. S. P. Test Solution)	A poisonous, white powder; soluble in water forming a solution known as baryta water. Barium hydroxide absorbs carbon dioxide from the air, hence it should be kept well stoppered. It is used as a reagent, in the manufacture of barium salts and in refining vegetable and animal oils
Barii Iodidum, $BaI_2.2H_2O$ Barium Iodide	Poisonous, colorless crystals that decompose and redden on exposure to air. It is readily soluble in water, and is used as an alterative. The dose is from one tenth to one half grain (0.006 to 0.03 Gm.)
Barii Nitras, $Ba(NO_3)_2$ Barium Nitrate (See U. S. P. Test Solution)	Lustrous, white, poisonous crystals or a white powder, soluble in water. It is chiefly used in pyrotechnics, as *green fire*, in green railroad torches and in marine signals
Barii Sulphidum, BaS Barium Sulphide	A yellowish-green or gray powder; soluble in water and dissolved by hydrochloric acid with the evolution of hydrogen sulphide. It is poisonous. Barium sulphide is used as a depilatory, in the manufacture of other barium compounds, and for generating pure hydrogen sulphide for analytical purposes

Strontium, Sr; 87.63

Strontium is named after Strontian, a village in Scotland where *strontianite* was first found. It enters into one official salt. It occurs in nature chiefly as sulphate and carbonate. It is a yellow metal, sp. gr. 2.5; malleable, but somewhat harder than lead. Its use in medicine is due to Laborde's demonstration in 1890 that its salts are not poisonous in ordinary doses, but, in certain cases, beneficial.

Tests for Salts of Strontium

An incompatibility frequently encountered in connection with the dispensing of soluble strontium salts occurs when a soluble carbonate is present, as in aromatic spirit of ammonia, which causes the precipitation of strontium carbonate, or when a soluble citrate is present, as in solution of potassium or sodium citrate which causes the precipitation of strontium citrate. Such a prescription must be dispensed with a "shake label".

Strontium compounds moistened with hydrochloric acid impart a crimson color to a non-luminous flame. Calcium sulphate T.S. produces a white precipitate with solutions of strontium salts.

STRONTII SALICYLAS. U. S. Strontium Salicylate

[Stront. Salicyl.]

Strontium Salicylate, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of $Sr(C_7H_5O_3)_2.2H_2O$ (397.81).

Preparation—It may be made by decomposing strontium carbonate with a strong, hot solution of salicylic acid, filtering, and crystallizing.

$$\underset{\text{strontium carbonate}}{SrCO_3} + \underset{\text{salicylic acid}}{2HC_7H_5O_3} = \underset{\text{strontium salicylate}}{Sr(C_7H_5O_3)_2} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

Description and Physical Properties—A white, odorless, crystalline powder, having a somewhat sweet, saline taste.

One Gm. of Strontium Salicylate is soluble in 19 cc. of water and in 61 cc. of alcohol, at 25° C. One Gm. is soluble in 3.7 cc. of boiling water and in 14 cc. of boiling alcohol.

Tests for Identity—When heated, the salt is decomposed, giving off inflammable vapors and an odor of phenol, and finally leaving a residue of strontium carbonate and carbon.

An aqueous solution of the salt (1 in 20) responds to the reactions for strontium, page 688, and for salicylates, page 826.

Test for Purity—An aqueous solution of the salt (1 in 30) is colorless.

Add 1 cc. of diluted sulphuric acid to 10 cc. of an aqueous solution of Strontium Salicylate (1 in 50), and filter: the filtrate meets the requirements of the test for *heavy metals*, page 1519.

Agitate 2 Gm. of Strontium Salicylate with 10 cc. of diluted acetic acid, heat the mixture, cool, and filter: the filtrate upon the addition of 5 drops of potassium dichromate T.S. does not become cloudy within three minutes (*barium*).

Assay—Place about 2 Gm. of Strontium Salicylate, previously dried to constant weight over sulphuric acid and accurately weighed, in a tared platinum crucible, and thoroughly carbonize it at a temperature not exceeding red heat. Dissolve the residue in 30 cc. of half-normal hydrochloric acid, and submit it to residual titration with normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of half-normal hydrochloric acid corresponds to 0.09945 Gm. of $Sr.(C_7H_5O_3)_2.2H_2O$.

This assay is explained on page 1456.

Preserve in well-closed containers, protected from heat and light.

Uses—Strontium salicylate is used for rheumatism in place of sodium salicylate in doses of ten to fifteen grains (0.65 to 1 Gm.). Its uses are similar to those of the sodium salt.

Unofficial Salts of Strontium

Strontii Bromidum, $SrBr_2.6H_2O$, U. S. P. IX Strontium Bromide	Colorless, transparent crystals; very soluble in water. It is hygroscopic in moist air but effloresces when exposed to dry air. It is used in epilepsy and other nervous diseases. The dose is from 15 to 30 grains (1 to 2 Gm.)
Strontii Carbonas, $SrCO_3$, N. F. IV Strontium Carbonate	This salt occurs in nature as the mineral *strontianite*. It may be prepared by precipitating any soluble salt of strontium with sodium carbonate. It is a white powder; insoluble in water. It is used in pyrotechnics, in the manufacture of iridescent glass, and in producing other salts of stronium. It has been used in the preparation of the compound elixir of formates
Strontii Chloridum, $SrCl_2$ Strontium Chloride	White, crystalline needles having a sharp, bitter taste. It is readily soluble in water and is used in the manufacture of strontium carbonate and in producing red fire
Strontii Hydroxidum, $Sr(OH)_2$ Strontium Hydroxide	Colorless, deliquescent crystals; slightly soluble in water. It is used in the manufacture of other strontium compounds, but chiefly in the sugar industry, to separate crystallizable sugar from molasses
Strontii Iodidum, $SrI_2.6H_2O$, U. S. P. IX Strontium Iodide	A white, deliquescent granular powder that becomes yellow on exposure to air and light. It is very soluble in water. Strontium Iodide is sometimes used instead of potassium iodide, as it is believed to be less irritating to the intestinal tract, or less depressing to the general nutrition. The dose is from 5 to 20 grains
Strontii Lactas, $Sr(C_3H_5O_3)_2.3H_2O$ Strontium Lactate	A white granular powder; soluble in water and having a slightly bitter taste. It is used as a tonic, diuretic, anthelmintic, and in the treatment of nephritis. The dose is from 5 to 30 grains (0.3 to 2 Gm.)
Strontii Nitras, $Sr(NO_3)_2$ Strontium Nitrate	A soluble white powder. It is used in pyrotechnics, especially in the production of *red fire*, marine signals, and railroad flares
Strontii Oxidum, SrO Strontium Oxide	A grayish-white, porous, caustic mass. It is soluble in water with the evolution of heat, forming strontium hydroxide.
Strontii Sulphas, $SrSO_4$ Strontium Sulphate	A white, crystalline powder; very slightly soluble in water. This compound occurs in nature as the mineral *celestite*. It is chiefly used in pyrotechnics

CHAPTER LI

ZINC, ALUMINUM, THORIUM, CERIUM, AND CADMIUM

Zn; 65.37. Al; 27.0. Th; 232.15. Ce; 140.25. Cd; 112.40

THESE metals are grouped together on account of the similarity in some of their physical properties, rather than because of the chemical analogies existing between them.

Metallic zinc (Zn = 65.37) of not less than 99 per cent purity was official in the U. S. P. IX for preparing solution of zinc chloride. The process was not retained in the U. S. P. X and zinc was also omitted. A zinc of special purity for the arsenic test, will be found among the reagents (see Chapter XCII). Zinc is sometimes used in preparing hydrogen.

Zinc, Zn; 65.37

Tests for Zinc Salts

In alkaline solutions, zinc salts yield a white precipitate with hydrogen sulphide. This precipitate is insoluble in acetic acid but is dissolved by diluted hydrochloric acid. Ammonium sulphide produces a similar precipitate in neutral or alkaline solutions. Zinc salts in solution yield with potassium ferrocyanide T.S. a white precipitate which is insoluble in diluted hydrochloric acid.

History—*Zinc* from "zinken", a word used by Paracelsus who regarded the element as a semi-metal. Although the alloy of zinc and copper, called brass, was known to the Romans, the metal zinc does not appear to have been separated and described until the sixteenth century. Its identity was a mystery for several centuries. Paracelsus thought it was a form of copper, others thought it was altered mercury, tin, or bismuth.

Preparation—Zinc is obtained by roasting *smithsonite*, impure zinc carbonate, with charcoal, in powder, and collecting the zinc by distillation, the vapors being conducted into water, where the zinc is condensed. It is also obtained in large quantities from *zinc blende*, which is a zinc sulphide. The ore containing the sulphide is first concentrated by a flotation process. The sulphide is then converted into oxide by roasting.

$$\underset{\text{zinc sulphide}}{ZnS} + 3O = \underset{\text{zinc oxide}}{ZnO} + \underset{\text{sulphur dioxide}}{SO_2}$$
(oxygen)

The oxide is then reduced to metal by heating with carbon.

$$\underset{\text{zinc oxide}}{ZnO} + \underset{\text{carbon}}{C} = \underset{\text{zinc}}{Zn} + \underset{\text{carbon monoxide}}{CO}$$

In the roasting process for treating this ore, the sulphur dioxide which is produced is converted into sulphuric acid.

Zinc is bivalent, and combines with oxygen, chlorine, and phosphorus, forming zinc oxide, chloride, and phosphide, and with numerous acids to form salts. A very pure grade of zinc is now made by electrolysis. The U. S. P. IX description and tests for zinc were as follows:

Description and Tests—Zinc is a bluish-white metal, showing a crystalline fracture. In thin sheets, or in irregular, granulated pieces, or molded into thin pencils, or in powder. It has a specific gravity ranging from 6.9, when it is cast, to 7.2 after it is rolled.

It is dissolved by diluted sulphuric or hydrochloric acid with the evolution of hydrogen, usually leaving some insoluble residue.

Impurities and Tests for Impurities—*Sulphur*—Add 1 Gm. of Zinc to 25 cc. of diluted sulphuric acid; the liberated hydrogen does not have a disagreeable odor, nor does it color a strip of paper moistened with lead acetate T.S.

Arsenic, Antimony, and Phosphorus—With silver nitrate T.S. the filtered solution is colorless, and yields a white, gelatinous precipitate with potassium ferrocyanide T.S. and a white precipitate with ammonium sulphide T.S.

Assay—Dissolve about 1 Gm. of Zinc, accurately weighed, in a slight excess of hydrochloric acid and add sufficient distilled water to make 100 cc. Dilute 10 cc. of the clear solution with distilled water to make 100 cc., render it slightly alkaline with ammonia water and subsequently treat it as directed in the assay for *Zinci Acetas* (page 691), for the determination of zinc oxide. Each Gm. of Zinc corresponds to not less than 1.232 Gm. of ZnO.

Zinc may also be assayed by the Electrolytic method.

ZINCI ACETAS. U. S. Zinc Acetate

[Zinc. Acet.]

Zinc Acetate contains not less than 83.16 per cent and not more than 87.32 per cent of $Zn(C_2H_3O_2)_2$ (183.44), corresponding to not less than 99.5 per cent of the crystallized salt $[Zn(C_2H_3O_2)_2.2H_2O = 219.47]$.

Preparation—This salt may be made by adding 2 parts of zinc oxide to 8½ parts of acetic acid, and 5 parts of distilled water; then digesting the mixture for half an hour, heating to the boiling point, filtering while hot, crystallizing, draining the crystals in a funnel, and drying them on bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother liquor to one-half, slightly acidulating with acetic acid, and crystallizing.

The reaction is expressed by the following equation:

$$\underset{\text{zinc oxide}}{ZnO} + \underset{\text{acetic acid}}{2HC_2H_3O_2} = \underset{\text{zinc acetate}}{Zn(C_2H_3O_2)_2} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Soft, white, six-sided, monoclinic plates, having a pearly luster, a faintly acetous odor, and, in dilute solutions, an astringent, metallic taste. When exposed to air, the salt gradually effloresces and loses some of its acid.

One Gm. of Zinc Acetate is soluble in 2.3 cc. of water and in 30 cc. of alcohol, at 25° C. One Gm. is soluble in 1.6 cc. of boiling water and in about 1 cc. of boiling alcohol.

When heated, Zinc Acetate is partially fused, losing water and acetic acid. At a higher temperature it is decomposed, with the evolution of inflammable and empyreumatic vapors, and leaves a residue consisting chiefly of zinc oxide.

Tests for Identity—An aqueous solution of the salt responds to the reactions for zinc, page 690, and for acetates, page 800.

Tests for Purity—An aqueous solution of the salt is neutral or slightly acid to litmus paper.

A 10 cc. portion of an aqueous solution of the salt (1 in 50) to which 1 cc. of hydrochloric acid has been added, meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

Assay—Dissolve about 1 Gm. of Zinc Acetate, accurately weighed, in 100 cc. of distilled water, render the solution slightly alkaline with ammonia T.S., and warm to 80° C. Completely precipitate the zinc as zinc sulphide by the addition of ammonium sulphide T.S. and warm the liquid on a water bath until the precipitate settles. Collect the latter on a filter, wash it with distilled water containing a few drops of ammonium sulphide T.S. then dissolve it in hot, dilute nitric acid (1 in 3), evaporate the solution to dryness in a tared dish, ignite the residue, and weigh it as zinc oxide. The weight of zinc oxide obtained, multiplied by 2.254, indicates its equivalent in $Zn(C_2H_3O_2)_2$. Each Gm. of Zinc Acetate corresponds to not less than 0.369 Gm. and not more than 0.387 Gm. of ZnO.

This assay is explained on page 1478.

Zinc Acetate may also be assayed by the electrolytic method, page 1515.

Preserve in well-closed containers.

Uses—Zinc acetate is used locally for its astringent effect, in eye washes, injections, etc. If used internally, the dose is two grains (0.125 Gm.).

ZINCI CHLORIDUM. U. S. Zinc Chloride
[Zinc. Chlor.]

Zinc Chloride contains not less than 95 per cent of $ZnCl_2$ (136.29).

Preparation—Zinc chloride is easily prepared by digesting metallic zinc in hydrochloric acid and evaporating the solution to dryness;

$$\underset{\text{zinc}}{2Zn} + \underset{\substack{\text{hydrochloric}\\\text{acid}}}{4HCl} = \underset{\substack{\text{zinc}\\\text{chloride}}}{2ZnCl_2} + \underset{\text{hydrogen}}{4H}$$

or, preferably, by evaporating the official solution of zinc chloride.

It may also be prepared by decomposing either zinc oxide or zinc carbonate with the appropriate amount of hydrochloric acid.

Description and Physical Properties—A white, or nearly white, odorless, granular powder, or in porcelain-like masses, or molded into pencils. It is very deliquescent.

One Gm. of Zinc Chloride is soluble in 0.25 cc. of water and in about 1.3 cc. of alcohol, at 25° C. It is soluble in 2 parts of glycerin.

When heated to about 260° C., Zinc Chloride fuses to a clear liquid. At a higher temperature (about 730° C.), it is partly volatilized in dense, white fumes, and partly decomposed, leaving a residue of zinc oxide.

An aqueous solution of the salt (1 in 10) is acid to litmus paper.

Tests for Identity—An aqueous solution of the salt responds to the reactions for zinc, page 690, and for chlorides, page 567.

Tests for Purity—Mix an aqueous solution of Zinc Chloride (1 in 20) with an equal volume of alcohol: a single drop of hydrochloric acid is sufficient to render 10 cc. of the mixture perfectly clear (*oxychloride*).

Completely precipitate the zinc from a solution of 1 Gm. of the salt in 50 cc. of distilled water by means of ammonium sulphide T.S., filter, evaporate the filtrate, and ignite gently: the weight of the residue does not exceed 0.004 Gm.

A 10 cc. portion of an aqueous solution of the salt (1 in 50), to which 1 cc. of diluted hydrochloric acid has been added, meets the requirements of the test for *heavy metals*, page 1519.

Add ammonium carbonate T.S. in small portions, to an aqueous solution of Zinc Chloride (1 in 20): the precipitate produced is white, and redissolves completely in an excess of the reagent.

Add sufficient sodium hydroxide T.S. to 5 cc. of an aqueous solution of the salt (1 in 10) to redissolve the precipitate which first forms, and then warm the solution: the odor of ammonia is not perceptible (*ammonium salts*).

One Gm. of Zinc Chloride shows no more *sulphate* than corresponds to 0.3 cc. of fiftieth-normal sulphuric acid, page 1520.

Assay—Proceed as directed under the assay for chlorides, page 1514, using about 0.3 Gm. of Zinc Chloride, accurately weighed in a stoppered weighing bottle. Each cc. of tenth-normal silver nitrate corresponds to 0.006815 Gm. of $ZnCl_2$.

Zinc Chloride may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1463.

Preserve in small, glass-stoppered bottles.

Uses—Zinc chloride in dilute solution is used as an antiseptic and astringent (see Liquor Zinci Chloridi, below). Mixed with flour and water, it is used as an escharotic.

LIQUOR ZINCI CHLORIDI. U. S. Solution of Zinc Chloride
[Liq. Zinc. Chlor.]

Solution of Zinc Chloride is an aqueous solution containing not less than 48.5 per cent and not more than 52 per cent of $ZnCl_2$ (136.29).

The following method for its preparation was official in the U. S. P. IX:

	Metric	Alternative
Zinc, granulated	**240 Gm.**	6 oz. av. 84 gr.
Hydrochloric Acid	**840 Gm.**	21 oz. av. 293 gr.
Nitric Acid	**12 Gm.**	135 gr.
Precipitated Zinc Carbonate	**12 Gm.**	135 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 Gm.**	1 pint

Add the hydrochloric acid gradually to the zinc and 250 cc. [4 fl. oz.] of distilled water contained in a glass or porcelain vessel, and allow the mixture to stand until the reaction ceases and the acid is saturated. Then pour off the liquid, add the nitric acid and heat the mixture at a temperature not exceeding 115° C. until a portion, when removed and cooled, solidifies. Allow it to cool, and dissolve the solidified mass in sufficient distilled water to make the product weigh 1000 Gm. [or measure, 1 pint]. Then add the precipitated zinc carbonate, agitate the mixture occasionally during twenty-four hours, and set it aside until it has become clear by subsidence. Separate the clear solution by decantation or by means of a siphon, and preserve it in tightly stoppered bottles.

When zinc is treated with hydrochloric acid, hydrogen is evolved and zinc chloride is produced according to the equation given on page 692.

Zinc is almost invariably contaminated with iron, and more or less ferrous chloride is present in the first solution. Nitric acid is added, and the solution is evaporated to dryness. The iron salt is thus oxidized, and it is then precipitated by the addition of zinc carbonate, the insoluble ferric hydroxide and carbonate, with any excess of zinc carbonate, being filtered out.

Description and Physical Properties—A clear, colorless or slightly yellow, odorless, caustic liquid. It is strongly acid to litmus paper.

Specific gravity: about 1.548 at 25° C.

Tests for Identity and Purity—Solution of Zinc Chloride responds to the reactions for zinc, page 690, and for chlorides, page 567, and meets the requirements of the tests for purity for an aqueous solution of the salt under *Zinci Chloridum*, when taken in proportionate amount.

Assay—Place in a tared flask about 0.5 cc. of Solution of Zinc Chloride, weigh accurately, and proceed as directed under the assay for chlorides, page 1514. Each cc. of tenth-normal silver nitrate corresponds to 0.006815 Gm. of $ZnCl_2$.

This assay is explained on page 1463.

Uses—This solution, sometimes called *Burnett's disinfecting fluid*, is used principally as an antiseptic and astringent. Among its advantages, absence of odor is one of the most prominent.

ZINCI OXIDUM. U. S. Zinc Oxide
[Zinc. Oxid.]

Zinc Oxide, when freshly ignited, contains not less than 99 per cent of ZnO (81.37).

Preparation—Zinc oxide may be prepared by exposing precipitated zinc carbonate, in a shallow vessel, to a low red heat until the water and carbon dioxide are wholly expelled.

$$\underset{\text{zinc carbonate}}{2ZnCO_3.3Zn(OH)_2} = \underset{\substack{\text{zinc}\\\text{oxide}}}{5ZnO} + \underset{\substack{\text{carbon}\\\text{dioxide}}}{2CO_2} + \underset{\text{water}}{3H_2O}$$

Commercial zinc oxide is made on the large scale by roasting *calamine* and coal, ground together, in a furnace of peculiar construction, and separating the impurities by blowing the mixed vapors up a large tower, allowing the heavier particles to subside in the tower, and then by a powerful draught blowing the zinc oxide into a room containing muslin bags, where the oxide is deposited. It is also prepared by heating metallic zinc in earthenware retorts until the zinc vapor ignites in contact with the air. The resulting oxide is then conducted into large chambers, where it is deposited.

$$\underset{\text{zinc}}{2Zn} + \underset{\text{oxygen}}{O_2} = \underset{\text{zinc oxide}}{2ZnO}$$

This kind of zinc oxide will not usually conform to the official tests; it is generally very white and filled with hard lumps, which are difficult to reduce to powder. The official powder has a marked cream tint, and can be mixed with ointment so that a smooth preparation is easily made without trituration. (See Unguentum Zinci Oxidi.)

Description and Physical Properties—A very fine, odorless, amorphous, white or yellowish-white powder, free from gritty particles. It gradually absorbs carbon dioxide from the air.

Zinc Oxide is insoluble in water and in alcohol. It dissolves in dilute acids, in ammonia T.S., and in ammonium carbonate T.S.

Tests for Identity—When strongly heated, it assumes a yellow color which disappears on cooling.

A solution of Zinc Oxide in a slight excess of diluted hydrochloric acid responds to the reactions for zinc, page 690.

Tests for Purity—Mix 1 Gm. of Zinc Oxide in a flask with 10 cc. of boiling, distilled water and add 2 drops of phenolphthalein T.S.: not more than 1 cc. of tenth-normal hydrochloric acid is required to discharge any red color that may be produced (*alkali*).

Mix 2 Gm. of Zinc Oxide with 10 cc. of distilled water, add 30 cc. of diluted sulphuric acid, and heat on a water bath with constant stirring: no effervescence occurs (*carbonate*), and the resulting solution is clear and colorless. Five cc. portions of the cooled solution yield white precipitates with potassium ferrocyanide T.S. or with sodium sulphide T.S. (*iron and many other metals*).

Add 2 Gm. of Zinc Oxide to 20 cc. of distilled water, and after stirring well, add 5 cc. of glacial acetic acid, and warm upon a water bath until solution is effected: the addition of 5 drops of potassium chromate T.S. produces no turbidity or precipitate (*lead*).

Assay—Digest about 1.5 Gm. of freshly ignited Zinc Oxide, accurately weighed, with 50 cc. of normal sulphuric acid until solution is complete. Then titrate the excess of sulphuric acid with normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of normal sulphuric acid corresponds to 0.04069 Gm. of ZnO.

This assay is explained on page 1457.

Zinc Oxide may also be assayed by the electrolytic method, page 1515.

U. S. P. Preparation—Unguentum Zinci Oxidi.

N. F. Preparations—Glycerogelatinum Zinci Durum; Glycerogelatinum Zinci Molle; Linimentum Calaminæ; Lotio Calaminæ; Mulla Zinci; Pasta Resorcinolis Fortior; Pasta Resorcinolis Mitis; Pasta Zinci; Pasta Zinci Mollis; Pasta Zinci Sulphurata; Unguentum Picis Compositum; Unguentum Resorcinolis Compositum.

History—The oxide of zinc was called by many curious names during its early history. *Pompholyx, nihil album, lana philosophica* and *flores zinci* are the principal examples of these.

Uses—Zinc oxide is chiefly used externally as a desiccant, and protective to inflamed surfaces; it may be dusted on the part or used in the form of an ointment. It is occasionally given internally in diarrhea.

ZINCI STEARAS. U. S. Zinc Stearate

[Zinc. Stear.]

Zinc Stearate is a compound of zinc with stearic acid and variable proportions of palmitic acid, corresponding to not less than 13 per cent and not more than 15.5 per cent of ZnO.

Preparation—Dissolve 10.1 Gm. of monohydrated sodium carbonate in 1000 cc. of distilled water, add 46.4 Gm. of stearic acid, heat the mixture until the reaction is complete, add 1000 cc. of hot distilled water and adjust the temperature to 50° C. Then dissolve 17.9 Gm. of zinc acetate in 1250 cc. of warm distilled water, adjust the temperature of the solution to 50° C. and pour this solution into the sodium stearate solution just prepared, stirring constantly. Collect the precipitate on a strainer, wash thoroughly, and dry.

Description and Physical Properties—A fine, white, bulky powder, free from grittiness, and having a faint characteristic odor.

Zinc Stearate is insoluble in water, alcohol, and ether.

When heated, the salt fuses. At a higher temperature it is decomposed, giving off inflammable vapors and the odor of burning fat, and finally leaving a residue consisting chiefly of zinc oxide.

Tests for Identity—Heat 1 Gm. of Zinc Stearate with a mixture of 25 cc. of distilled water and 5 cc. of hydrochloric acid: stearic acid is liberated and floats as an oily layer on the surface of the liquid, and the aqueous layer responds to the reactions for zinc, page 690.

Tests for Purity—The salt is neutral to moistened litmus paper.

Boil 1 Gm. of Zinc Stearate with 25 cc. of distilled water and 5 cc. of hydrochloric acid, filter while hot, and wash the filter with 25 cc. of hot distilled water. Render the filtrate alkaline with ammonia T.S., warm to 80° C., and add ammonium sulphide T.S. in excess. Filter, evaporate the filtrate to dryness, and ignite the residue. Dissolve this residue in 10 cc. of hot distilled water, filter, again evaporate, ignite, and weigh. Not more than 1 per cent of residue remains (*alkalies or alkali earths*).

The insoluble residue of fatty acids obtained in the preceding test when well washed and dried over sulphuric acid, melts at a temperature not below 56° C.

Assay—Boil about 1 Gm. of Zinc Stearate, accurately weighed, with 50 cc. of tenth-normal sulphuric acid for ten minutes, cool, and filter. Wash the filter and flask thoroughly with distilled water and titrate the excess of sulphuric acid with tenth-normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of tenth-normal sulphuric acid corresponds to 0.004069 Gm. of ZnO.

This assay is explained on page 1458.

N. F. Preparation—Unguentum Zinci Stearatis.

Uses—Zinc stearate is used in the official ointment of zinc stearate, and as a dusting powder in dermatologic practice, for its desiccating and protective effect. Poisoning has been reported in cases of infants in which the powder has been carelessly and freely applied so that inhalation of the substance has resulted. Its use as a "baby powder" is therefore being generally discontinued, and, when used, a form of container having a self-closing aperture has been adopted by most manufacturers.

ZINCI SULPHAS. U. S. Zinc Sulphate
[Zinc. Sulph.]

Zinc Sulphate contains not less than 55.86 per cent and not more than 58.63 per cent of $ZnSO_4$ (161.43), corresponding to not less than 99.5 per cent of the crystallized salt [$ZnSO_4.7H_2O = 287.54$].

Preparation—Zinc sulphate is made by acting on metallic zinc or zinc oxide, in excess, with diluted sulphuric acid, hydrogen being evolved. The resulting solution is freed from the contamination of iron by first passing chlorine into it, when ferric chloride is produced. Upon the addition of zinc carbonate, decomposition takes place, ferric hydroxide separates as an insoluble precipitate, which is removed by filtration, and a small quantity of zinc chloride is formed, which, being very soluble, remains in the mother liquor after the crystallization of the sulphate.

$$\underset{\text{zinc}}{2Zn} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{2H_2SO_4} = \underset{\substack{\text{zinc}\\\text{sulphate}}}{2ZnSO_4} + \underset{\text{hydrogen}}{4H}$$

The salt may also be made by the action of sulphuric acid on zinc oxide according to the equation:

$$\underset{\substack{\text{zinc}\\\text{oxide}}}{ZnO} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\substack{\text{zinc}\\\text{sulphate}}}{ZnSO_4} + \underset{\text{water}}{H_2O}$$

Zinc sulphate is also prepared by roasting zinc sulphide in a limited supply of oxygen and extracting the sulphate with water.

Description and Physical Properties—Colorless, transparent, rhombic crystals, or a granular, crystalline powder, without odor, and having an astringent, metallic taste. It is efflorescent in dry air.

One Gm. of Zinc Sulphate is soluble in 0.6 cc. of water and in 2.5 cc. of glycerin, at 25° C. It is insoluble in alcohol.

When rapidly heated, Zinc Sulphate melts. When strongly ignited, it is partly decomposed, losing both water and sulphuric acid.

Its aqueous solution (1 in 10) is acid to litmus paper.

Tests for Identity—An aqueous solution of the salt responds to the reactions for zinc, page 690, and for sulphates, page 581.

Tests for Purity—A 10 cc. portion of an aqueous solution of Zinc Sulphate (1 in 50), acidulated with 1 cc. of diluted hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of the salt meets the requirements of the test for *arsenic*, page 1512.

An aqueous solution of Zinc Sulphate (1 in 20) is not colored pink by methyl orange T.S. (*free acid*).

One Gm. of Zinc Sulphate shows no more *chloride* than corresponds to 0.3 cc. of fiftieth-normal hydrochloric acid, page 1520.

Dissolve 1 Gm. of Zinc Sulphate in 50 cc. of distilled water, precipitate the zinc completely by means of ammonium sulphide T.S., filter, evaporate the filtrate to dryness, and ignite: the weight of the residue does not exceed 0.5 per cent (*alkalies or alkali earths*).

Assay—Proceed as directed under *Zinci Acetas*, using 1 Gm. of Zinc Sulphate. The weight of zinc oxide obtained, multiplied by 1.984, indicates its equivalent in $ZnSO_4$. Each Gm. of Zinc Sulphate corresponds to not less than 0.2815 Gm. and not more than 0.2955 Gm. of ZnO.

This assay is explained on page 1479.

Zinc Sulphate may also be assayed by the electrolytic method, page 1515.

Preserve in well-closed containers.

N. F. Preparations—Lotio Alba; Mistura Adstringens; Pulvis Antisepticus.

Uses—Zinc sulphate is the most important of the zinc salts. It is used medicinally as a prompt and certain emetic in doses of ten to thirty grains (0.6 to 2 Gm.); as a tonic and astringent, one to two grains (0.065 to 0.13 Gm.). It is also used locally for its astringent action.

Average dose—15 grains (1 Gm.).

ZINCI PHENOLSULPHONAS. N. F. Zinc Phenolsulphonate

(U. S. P. IX)

[**Zinc. Phenolsulph.**—ZINC SULPHOCARBOLATE]

Zinc Phenolsulphonate contains not less than 73.7 per cent and not more than 77.4 per cent of anhydrous zinc phenolsulphonate, corresponding to not less than 99.5 per cent of the crystallized salt $(C_6H_5O.SO_3)_2Zn.8_2O = 555.76$).

Preparation—This salt is made by mixing solutions of barium phenolsulphonate and zinc sulphate; barium sulphate is precipitated, the solution is evaporated, and the crystals which separate are washed and dried. The reaction is explained by the following equation:

$$\underset{\text{barium phenolsulphonate}}{Ba(C_6H_4OHSO_3)_2} + \underset{\text{zinc sulphate}}{ZnSO_4} = \underset{\text{zinc phenolsulphonate}}{Zn(C_6H_4OHSO_3)_2} + \underset{\text{barium sulphate}}{BaSO_4}$$

Description and Physical Properties—Zinc Phenolsulphonate occurs as colorless, transparent, rhombic prisms or tabular crystals, or in granular form; odorless, and having an astringent, metallic taste. When exposed to the air the salt effloresces, and upon exposure to light, and air may become slightly pink.

One Gm. of Zinc Phenolsulphonate dissolves in 1.6 cc. of water, and in 1.8 cc. of alcohol at 25° C.; also in 0.4 cc. of boiling water.

Tests for Identity—Its aqueous solution (1 in 10) is acid to litmus.

When heated to 125° C., the salt loses all of its water of crystallization. At a higher temperature, it chars, emitting inflammable vapors having the odor of phenol, and finally leaves an incombustible residue.

An aqueous solution of the salt (1 in 20) yields a white, gelatinous precipitate with potassium ferrocyanide T.S., and a white precipitate with ammonium sulphide T.S.

Ammonium carbonate T.S., when added in small portions to an aqueous solution of the salt (1 in 20) produces a white precipitate which redissolves completely upon the addition of an excess of the reagent.

A dilute solution of the salt (1 in 100) is colored pale violet by ferric chloride T.S.

Tests for Purity—The addition of a few drops of barium chloride T.S. to 10 cc. of an aqueous solution of the salt (1 in 20), previously acidulated with three drops of hydrochloric acid, produces not more than a slight turbidity (*sulphate*).

Ten cc. of an aqueous solution of the salt (1 in 50) to which 1 cc. of diluted hydrochloric acid has been added, does not respond to the test for heavy metals (see page 1519).

An aqueous solution of the salt meets the requirements of the test for arsenic (see page 1512).

Assay—Dissolve about 1 Gm. of Zinc Phenolsulphonate, accurately weighed, in 100 cc. of distilled water, render the solution slightly alkaline with ammonia water and warm it to 80° C. Completely precipitate the zinc as zinc sulphide by the addition of ammonium sulphide T.S. and warm the liquid on a water bath until the precipitate settles. Collect the precipitate on a filter, wash it with distilled water containing a few drops of ammonium sulphide T.S., then dissolve it in hot dilute nitric acid (1 in 3), evaporate the solution in a tared porcelain or platinum dish, ignite the residue and weigh it as zinc oxide. The amount of zinc oxide obtained multiplied by 5.059 indicates its equivalent in $Zn(C_6H_5SO_4)_2$.

This assay is explained on page 1479.

Zinc Phenolsulphonate may also be assayed by the electrolytic method (see U. S. P. X).

Preserve it in small, well-closed containers.

N. F. Preparation—Liquor Iodi et Zinci Phenolsulphonatis.

Uses—Zinc phenolsulphonate is used as an antiseptic astringent and stimulant. When used internally, it may be given in doses of two grains (0.13 Gm.).

CALAMINA PRÆPARATA. N. F. Prepared Calamine

[Calamin. Præp.—Lapis Calaminaris]

Prepared Calamine is Zinc Oxide containing a small amount of ferric oxide. It contains, after ignition, not less than 98 per cent ZnO (81.37).

Preparation—The native zinc oxide is calcined in covered earthen crucibles, then powdered and freed from gritty particles by elutriation. The pinkish color is due to the presence of iron. The name *calamine* is applied more frequently by mineralogists to a native form of zinc silicate, which being insoluble is not suitable for use in this preparation. The true *calamine*, which is the impure oxide, is easily distinguished from the silicate by adding diluted hydrochloric acid which almost completely dissolves the former, but has no effect upon the latter. *Artificial calamine* has been found on the market prepared by mixing zinc carbonate, zinc oxide, and ferric oxide, or by coloring talc or other insoluble substances with ferric hydroxide.

Description and Physical Properties—Prepared Calamine is a pink powder passing through a No. 100 sieve.

It is insoluble in water but dissolves in mineral acids, leaving a small amount of insoluble residue.

Tests for Identity and Purity—A filtered solution of Prepared Calamine in diluted hydrochloric acid yields the reactions of zinc.

Digest 1 Gm. of Prepared Calamine with 20 cc. of warm water, filter and add 2 drops of phenolphthalein T.S. If a red color is produced, not more than 0.2 cc. of tenth-normal sulphuric acid is required to discharge it (*alkaline substances*).

0.2 Gm. of Prepared Calamine dissolved in 5 cc. of diluted sulphuric acid meets the requirements of the test for arsenic (see page 1512).

Dissolve 1 Gm. of Prepared Calamine in 25 cc. of diluted hydrochloric acid, filter, and add to the filtrate ammonia water until the precipitate first formed is redissolved, then add 5 cc. more ammonia water. To 10 cc. of this solution add 2 cc. of ammonium oxalate T.S. Not more than a slight turbidity is produced (*calcium*). To another 10 cc. portion add 2 cc. of sodium phosphate T.S. Not more than a slight turbidity is produced (*calcium* or *magnesium*.)

To 1 Gm. of Prepared Calamine add 15 cc. of water, stir well, then add 3 cc. of glacial acetic acid, warm on the water bath until dissolved and filter. On adding five drops of potassium chromate T.S. to the filtrate no turbidity is produced (*lead*).

Assay—Ignite about 1.5 Gm. of Prepared Calamine, cool, weigh accurately and dissolve it by warming with 50 cc. of normal sulphuric acid. Filter, wash the residue and filter with hot distilled water until the washings are no longer acid to litmus paper, then titrate the combined cooled filtrate and washings with normal sodium hydroxide, using methyl orange as indicator. Each cc. of normal sulphuric acid corresponds to 0.04069 Gm. of ZnO.

This assay is explained on page 1458.

N. F. Preparations—Linimentum Calaminæ; Lotio Calaminæ; Lotio Calaminæ Composita; Unguentum Calaminæ.

Uses—Its uses are similar to those for zinc oxide, being employed chiefly in protective ointments and lotions. It is often prescribed by dermatologists to give color to lotions or ointments.

Unofficial Salts of Zinc

Zinci Bromidum, $ZnBr_2$ Zinc Bromide	A white, hygroscopic crystalline powder; soluble in water. It is used in medicine as an antiepileptic. The dose is 1 to 2 grains (0.06 to 0.13 Gm.)
Zinci Carbonas Praecipitatus, U. S. P. IX Precipitated Zinc Carbonate	An impalpable white powder; insoluble in water but dissolved by dilute acids, with effervescence. It is used in skin diseases, principally in ointments, and is often used to replace the impure carbonate, termed *calamine*, which is now official in the N. F. (see page 697), but as an important quality of the latter is its pink color, the substitution is not usually satisfactory. It is sometimes dusted upon inflamed surfaces as an astringent and absorbent
Zinci Cyanidum, $Zn(CN)_2$ Zinc Cyanide	A poisonous, white powder; insoluble in water. It is used in medicine as an alterative, antiseptic, and anthelmintic. The dose is from $\frac{1}{10}$ to 1 grain (0.006 to 0.06 Gm.)
Zinci Dioxidum, ZnO_2 Zinc Dioxide, Zinc Peroxide	A white powder; insoluble in water and decomposed by acids. It is used as a bactericide and in medicine as a dressing for wounds
Zinci et Potassii Cyanidum, K_2ZnCN_4 Zinc and Potassium Cyanide	White crystals; soluble in water and having the medicinal properties of hydrocyanic acid. The dose is $\frac{1}{10}$ to 1 grain (0.006 to 0.06 Gm.)
Zinci Ferrocyanidum, $Zn_2FeCN_6.2H_2O$ Zinc Ferrocyanide	A white powder; insoluble in water. It is used as an alterative and antiseptic. The dose is ½ to 2 grains (0.03 to 0.13 Gm.)
Zinci Iodidum, ZnI_2 Zinc Iodide	A hygroscopic, white, crystalline powder; very soluble in water. It is used in medicine as an alterative and antiseptic. The dose is 1 to 2 grains (0.06 to 0.13 Gm.)
Zinci Lactas, $Zn(C_3H_5O_3)_2.3H_2O$ Zinc Lactate	White crystals, slightly soluble in water. It is used as an antiepileptic. The dose is ½ to 1 grain (0.03 to 0.06 Gm.)

Unofficial Salts of Zinc—*Continued*

Zinci Permanganas, $Zn(MnO_4)_2.6H_2O$ Zinc Permanganate N. N. R.	Violet brown, or almost black, hygroscopic crystals; very soluble in water. It is used in medicine as an antiseptic and astringent, and is used in urethritis as an injection or douche in 1 to 4000 solution. This salt is more fully described in the New and Nonofficial Remedies of 1925
Zinci Phosphidum, Zn_3P_2 Zinc Phosphide	A dark gray, gritty powder having a faint odor of phosphorus. It is insoluble in water but is dissolved by acids with the evolution of hydrogen phosphide. It is used as a stimulant to the nervous system. The dose is $\frac{1}{60}$ to $\frac{1}{2}$ grain (0.001 to 0.03 Gm.)
Zinci Salicylas, $Zn(C_7H_5O_3)_2.3H_2O$ Zinc Salicylate	White crystalline needles, soluble in water. It is used externally as a dusting powder and internally in place of zinc oxide. The dose is $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.)
Zinci Sulphanilas, N. N. R. $Zn(C_6H_4(NH_2)SO_3)_2.H_2O$ Zinc Sulphanilate, Soloid Nizin	Water-soluble tablets used in aqueous solution as an astringent and antiseptic. These tablets are prepared by Burroughs Wellcome and Company, and are described in the New and Nonofficial Remedies of 1925
Zinci Sulphidum, ZnS Zinc Sulphide	A yellowish-white powder, insoluble in water. It is used as a pigment in paints; with zinc oxide it constitutes *mineral white* and with barium sulphate, *lithopone*
Zinci Valeras, $Zn(C_5H_9O_2)_2.2H_2O$, U. S. P. IX Zinc Valerate	White pearly scales or a white powder, having the odor of valeric acid. It is readily soluble in water but, on exposure to air, it loses valeric acid and becomes less soluble. Zinc valerate is used in nervous diseases. The dose is from 1 to 3 grains (0.06 to 0.2 Gm.)
Oleatum Zinci Oleate of Zinc	A white, greasy, granular powder; soluble in alcohol and in ether, but insoluble in water. It is chiefly used externally as an antiseptic and astringent

Aluminum, Al; 27.0

Aluminum is from the Latin word "alumen", signifying alum. The metal is found largely in combination with silicic acid, in the rocks and clays forming a great portion of the earth's surface. Some of the precious stones and valuable minerals are compounds of aluminum; the ruby and sapphire, corundum, and emery, are crystallized forms of aluminum oxide. *Kaolin*, *clay*, and *fuller's earth* are well-known forms of native materials chiefly composed of aluminum silicates. Vast quantities of aluminum are chemically combined in the double silicates of aluminum and an alkali metal in the form of *feldspar* and *mica*. Aluminum is of a silver-white color. The metal, owing to improvements in its smelting, is much cheaper than it was formerly, and is extensively used in making ornamental and useful articles and, when suitably alloyed, forms light metals of great strength which are being used in engines and other large machines. Owing to its very low specific gravity (2.64 to 2.70), it is used for grain weights, because they are much larger, and thus more easily handled, than those made from brass (see page 50). Aluminum forms but one class of compounds used in medicine; it is trivalent. The oxides and sulphates unite with those of the alkali metals and form doublesalts, called alums.

Tests for Salts of Aluminum

Solutions of aluminum salts yield with ammonia T.S. a white precipitate which is insoluble in a moderate excess of ammonium hydroxide. Sodium hydroxide T.S. or sodium sulphide T.S. produces a similar precipitate which dissolves in an excess of either of these reagents.

ALUMEN. U. S. Alum

[Alum.]

Alum contains not less than 99.5 per cent of $AlNH_4(SO_4)_2.12H_2O$ (453.35) or $AlK(SO_4)_2.12H_2O$ (474.41). The label of the container must indicate whether the salt is Ammonium Alum or Potassium Alum.

Preparation—This valuable salt is made from alum clay, which is chiefly aluminum silicate, but contains iron pyrites, which on calcination furnishes the

sulphuric acid to combine with the alumina of the clay to form aluminum sulphate. It is also prepared on a large scale from aluminum hydroxide, a by-product in the cryolite process for making sodium carbonate. Potassium or ammonium sulphate or chloride is then added, when the double salt $AlK(SO_4)_2$ or $AlNH_4(SO_4)_2$ is produced. Both salts crystallize with twelve molecules of water. Ammonium alum, $AlNH_4(SO_4)_2$, is generally found in the market, because of its greater cheapness. Soda alum has been prepared, but cannot be crystallized in stable form. In the anhydrous form soda alum is the acidic element in the so-called "alum baking powders". It is known to the trade as "S. A. S." (sodium aluminum sulphate).

Description and Physical Properties—Large, colorless crystals, crystalline fragments, or a white powder. Alum is odorless, and has a sweetish, strongly astringent taste.

One Gm. of Ammonium Alum is soluble in 5.2 cc. of water at 25° C. and in 0.3 cc. of boiling water.

One Gm. of Potassium Alum is soluble in 7.2 cc. of water at 25° C. and in 0.3 cc. of boiling water.

Alum is insoluble in alcohol but is freely soluble in glycerin.

When heated, Alum fuses, and at about 200° C. loses all of its water of crystallization. When strongly heated, it loses sulphuric anhydride, becoming incompletely soluble in water.

Tests for Identity—Sodium hydroxide T.S. added to an aqueous solution of Ammonium Alum (1 in 20) at first causes a precipitate, which completely dissolves in an excess of the reagent, ammonia being evolved.

Potassium Alum imparts a violet color to a non-luminous flame.

The addition of 10 cc. of sodium bitartrate T.S. to 5 cc. of a saturated aqueous solution of Potassium Alum produces within thirty minutes a white, crystalline precipitate.

Sodium hydroxide T.S. added to an aqueous solution of Potassium Alum (1 in 20) at first causes a precipitate, which completely dissolves in an excess of the reagent, but no ammonia is evolved.

Unless otherwise indicated Ammonium Alum and Potassium Alum conform to the following tests:

An aqueous solution of Alum (1 in 20) is acid to litmus paper.

An aqueous solution of Alum (1 in 20) responds to the reactions for aluminum, page 698, and for sulphates, page 581.

Tests for Purity—An aqueous solution of Alum meets the requirements of the test for *heavy metals*, page 1519.

An aqueous solution of Alum meets the requirements of the test for *arsenic*, page 1512.

Add 5 drops of potassium ferrocyanide T.S. to 20 cc. of an aqueous solution of Alum (1 in 150): no blue color is produced immediately (*iron*).

Completely precipitate the aluminum from a boiling solution of 1 Gm. of Ammonium Alum in 100 cc. of distilled water by the addition of a slight excess of ammonia water, and filter: not more than 0.5 per cent of residue remains on evaporating the filtrate to dryness and igniting (*alkali and earths*).

Assay—Dissolve about 1 Gm. of Alum, accurately weighed, and about 1 Gm. of ammonium chloride in 250 cc. of distilled water. Heat the solution to boiling, and add a slight excess of ammonia T.S. to precipitate aluminum hydroxide. Collect the precipitate on a filter, wash thoroughly with hot distilled water, dry, ignite strongly, and weigh. The weight of the aluminum oxide so obtained, multiplied by 8.889, indicates its equivalent in $AlNH_4(SO_4)_2.12H_2O$ and when multiplied by 9.302 indicates its equivalent in $AlK(SO_4)_2.12H_2O$. Each Gm. of aluminum oxide corresponds to 8.874 Gm. of $AlNH_4(SO_4)_2.12H_2O$ and to 9.286 Gm. of $AlK(SO_4)_2.12H_2O$.

This assay is explained on page 1477.

U. S. P. Preparation—Alumen Exsiccatum.

N. F. Preparation—Liquor Cocci.

History—Alum was a mystery to the ancient chemists and pharmacists. They were acquainted with its properties but could not fathom its composition. It was called alumen by Pliny and *stypteria* by Dioscorides. It was extensively used in early times as a mordant in dyeing.

Uses—Alum is a powerful astringent because of its precipitation of albumin. It is slightly antiseptic. When powdered, it is used as an emetic in croup, in doses of a teaspoonful. It is sometimes used as a local styptic, and is frequently employed in making astringent lotions and injections. The dose as an astringent is from five to twenty grains (0.32 to 1.3 Gm.).

ALUMEN EXSICCATUM. U. S. Exsiccated Alum

[Alumn. Exsic.—Alumen Ustum, Dried Alum, Burnt Alum]

Exsiccated Alum, when recently dried to constant weight at 200° C., contains not less than 96.5 per cent of $AlNH_4(SO_4)_2$ (237.16) or of $AlK(SO_4)_2$ (258.22). The label of the container must indicate whether it is made from Ammonium Alum or Potassium Alum.

Alum, in small pieces	**100 Gm.**	20 oz. av.
To make about	**55 Gm.**	11 oz. av.

Place a thin layer of alum in a tared, shallow, porcelain dish, and heat it cautiously on a sand bath until liquefied. Continue the application of heat at a temperature not exceeding 200° C., and stir constantly until aqueous vapors cease to evolve and a dry, white, porous mass is obtained. When cold, reduce the product to a fine powder.

This preparation represents alum nearly deprived of its water of crystallization; the latter exists in alum in the large proportion of about 45 per cent, thus constituting almost half of its weight. Great care must be observed in the regulation of the heat during the exsiccation, as temperatures above 200° C. produce insoluble compounds of alum, chiefly aluminum oxysulphate.

Description and Physical Properties—A white, odorless powder. It has a sweetish, astringent taste, and absorbs moisture on exposure to air.

One Gm. of Exsiccated Alum is very slowly and usually incompletely soluble in about 20 cc. of water at 25° C. One Gm. is soluble in about 1.5 cc. of boiling water. It is insoluble in alcohol.

Tests for Identity—Exsiccated Alum responds to the reactions, respectively, for Ammonium Alum or Potassium Alum described under *Alumen*.

Tests for Purity—Add 2 Gm. of Exsiccated Alum to 40 cc. of distilled water, and allow it to stand with occasional agitation for twenty-four hours. Collect the insoluble residue on previously dried, counterbalanced filter papers, or a Gooch crucible, wash with 50 cc. of distilled water, and finally dry to constant weight at 100° C.: the residue weighs not more than 0.05 Gm.

Dry about 1 Gm. of Exsiccated Alum to constant weight at 200° C. in an air bath: the loss does not exceed 10 per cent.

An aqueous solution of Exsiccated Alum meets the requirements for *arsenic*, *heavy metals*, *iron*, and Exsiccated Ammonium Alum meets the test for limit of *alkali and earths*, under *Alumen*, allowance being made for the difference in strength.

Assay—Dry about 0.5 Gm. of Exsiccated Alum to constant weight at 200° C., weigh accurately, and dissolve in 100 cc. of distilled water. Filter, if necessary, thoroughly wash the insoluble residue with distilled water, dilute the filtrate and washings to about 250 cc. with distilled water, and add 1 Gm. of ammonium chloride. Proceed with the assay as directed under *Alumen*, beginning with the words "Heat the solution", second line of the assay. The weight of the aluminum oxide so obtained, multiplied by 4.650, indicates its equivalent in $AlNH_4(SO_4)_2$, and multiplied by 5.063 indicates its equivalent in $AlK(SO_4)_2$. Each Gm. of aluminum oxide corresponds to 4.643 Gm. of $AlNH_4(SO_4)_2$ and to 5.055 Gm. of $AlK(SO_4)_2$.

This assay is explained on page 1478.

Preserve in well-closed containers and do not dispense if it contains more than 10 per cent of moisture.,

Uses—It is used as an escharotic and is more powerful than alum not only because it is more concentrated but it also absorbs water from the tissues on account of being very hygroscopic.

ALUMINI CHLORIDUM. N. F. Aluminum Chloride

[Alum. Chlor.]

Aluminum chloride contains $AlCl_3.6H_2O$ (241.58) corresponding to not less than 20.5 per cent of aluminum oxide (Al_2O_3).

Preparation—Aluminum chloride may be prepared by heating aluminum in a current of chlorine, or by dissolving freshly precipitated aluminum hydroxide in hydrochloric acid and evaporating off the water, as follows:

$$\underset{\text{aluminum hydroxide}}{Al(OH)_3} + \underset{\text{hydrochloric acid}}{3HCl} = \underset{\text{aluminum chloride}}{AlCl_3} + \underset{\text{water}}{3H_2O}$$

Description and Physical Properties—Aluminum Chloride occurs as a white, or yellowish-white deliquescent, crystalline powder; nearly odorless; taste sweetish and very astringent.

One gram dissolves in about 0.5 cc. of water and in about 4 cc. of alcohol at 25° C., also soluble in glycerin.

Tests for Identity—An aqueous solution of the salt (1 in 10) is clear, and is acid to litmus. Separate portions of an aqueous solution of the salt (1 in 10) yield with silver nitrate T.S. a white curdy precipitate insoluble in nitric acid, with ammonia water a white gelatinous precipitate almost insoluble in an excess of ammonia water, and with sodium hydroxide T.S. a white gelatinous precipitate completely soluble in an excess of the reagent.

Tests for Purity—Ten cc. of an aqueous solution of the salt (1 in 100) after the addition of 0.2 cc. of barium chloride T.S., does not become cloudy within one minute (*sulphate*).

The addition of 0.3 cc. of potassium ferrocyanide T.S. to 20 cc. of an aqueous solution of the salt (1 in 50) does not produce a blue coloration within one minute (*iron*).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

An aqueous solution of the salt meets the requirements of the test for arsenic (see page 1512).

Assay—Dissolve about 0.5 Gm. of the salt, previously dried over sulphuric acid and accurately weighed, in 100 cc. of distilled water, add 1 Gm. of ammonium chloride and then precipitate the aluminum hydroxide by the addition of a slight excess of ammonia water to the boiling solution. Collect the precipitate on a filter, wash it with distilled water, dry, ignite thoroughly and weigh. The weight of the aluminum oxide so obtained is not less than 20.5 per cent of the weight of the Aluminum Chloride taken for the assay.

This assay is explained on page 1478.

Preserve it in well-closed containers.

N. F. Preparation—Liquor Hydrastinæ Compositus.

Uses—Used in solution or pills in doses of two to five grains (0.13 to 0.32 Gm.). Because of the deliquescence of the salt, if made into pills they should be massed with Canada turpentine and powdered althæa. It is an astringent and antiseptic. The solution sold as *chloralum* is said to be a 20 per cent aqueous solution of aluminum chloride. Many proprietary preparations, sold as *perspiration preventatives* or as *deodorants*, are solutions of aluminum chloride, some being as high as 30 per cent in strength.

ALUMINI SULPHAS. N. F. Aluminum Sulphate

[Alum. Sulph.]

Aluminum sulphate contains not less than 99.5 per cent of $Al_2(SO_4)_3.18H_2O$ (666.47).

Preparation—Aluminum sulphate may be prepared from alum as follows: Take of alum and sodium carbonate, each 4 oz. troy; sulphuric acid, 1 oz. troy, 150 gr.; distilled water, a sufficient quantity. Dissolve the salts separately, each in 6 fluidounces of boiling water, and pour the solution of the alum gradually into that of the sodium carbonate; then digest with a gentle heat until the evolution of carbon dioxide ceases. Collect upon a filter the precipitate formed, and wash it with water, until the washings are no longer affected by barium chloride T.S. Next, with the aid of heat, dissolve the precipitate in the sulphuric acid, previously diluted with half a pint of water, and, having filtered the solution, evaporate it until a pellicle begins to form. Then remove it to a water bath, and continue the evaporation, with constant stirring, until a dry salt remains. Lastly, preserve this in a well-stoppered bottle.

Another method may be used: freshly precipitated hydroxide may be dissolved in diluted sulphuric acid, the solution evaporated, and the salt granulated.

Description and Physical Properties—Aluminum Sulphate occurs as a white, crystalline powder, shining plates, or crystalline fragments; without odor, having a sweetish and afterwards an astringent taste; permanent in the air.

One Gm. dissolves in 1 cc. of water at 25° C.; it is more soluble in boiling water, but insoluble in alcohol.

Tests for Identity—When gradually heated to about 200° C., it loses its water of crystallization (about 45.7 per cent of its weight).

An aqueous solution of the salt (1 in 20) is acid to litmus.

Separate portions of an aqueous solution of the salt (1 in 20) yield with barium chloride T.S. a white precipitate insoluble in hydrochloric acid, and with sodium hydroxide T.S. a white gelatinous precipitate which is soluble in an excess of the alkali, but which is again separated on the addition of a sufficient amount of ammonium chloride T.S.

Tests for Purity—Gently heat 1 Gm. of Aluminum Sulphate with 10 cc. of sodium hydroxide T.S.; the liquid does not evolve the odor of ammonia.

A filtered aqueous solution of the salt (1 in 10) does not become more than faintly opalescent within five minutes after the addition of an equal volume of tenth-normal sodium thiosulphate (*free acid*).

The addition of 5 drops of potassium ferrocyanide T.S. to 20 cc. of an aqueous solution of the salt (1 in 150) does not produce at once a blue coloration (*iron*).

An aqueous solution of the salt does not respond to the test for heavy metals (see page 1519).

An aqueous solution of the salt meets the requirements of the test for arsenic (see page 1512).

Assay—Dissolve about 0.5 Gm. of Aluminum Sulphate, accurately weighed, in 100 cc. of distilled water, add 1 Gm. of ammonium chloride and then precipitate the aluminum hydroxide by the addition of a slight excess of ammonia water to the boiling solution. Collect the precipitate on a filter, wash it with distilled water, dry, ignite thoroughly and weigh. The weight of the aluminum oxide so obtained is not less than 15.23 per cent of the weight of the Aluminum Sulphate taken for the assay, corresponding to not less than 99.5 per cent of $Al_2(SO_4)_3.18H_2O$.

This assay is explained on page 1478.

N. F. Preparations—Liquor Alumini Acetatis, Liquor Alumini Subacetatis.

Uses—Aluminum sulphate is a powerful astringent acting much like alum.

PUMEX. N. F. Pumice

A substance of volcanic origin, consisting chiefly of complex silicates of aluminum, potassium, and sodium.

Description and Physical Properties—Pumice occurs as very light, hard, rough, porous gray masses, or as a gritty, gray-colored powder. It is permanent in the air, odorless and tasteless. The dry masses usually float on water.

Tests for Purity—Boil 10 Gm. of Pumice with 50 cc. of distilled water for one-half hour, adding distilled water from time to time to maintain approximately the original volume and then filter; the filtrate is neutral to litmus and one-half of this filtrate, when evaporated and the residue dried to constant weight at 110° C., yields not more than 0.01 Gm. of residue (*soluble substances*). The remaining half of the filtrate, after slightly acidulating with hydrochloric acid, does not yield a blue color with potassium ferrocyanide T.S. (*iron*).

Boil 1 Gm. of Pumice with 25 cc. of diluted hydrochloric acid for one-half hour, adding distilled water from time to time to maintain approximately the original volume, and then filter the liquid; the filtrate yields upon evaporating to dryness, igniting and quickly weighing, not more than 0.05 Gm. of residue.

N. F. Preparations—Elixir Eriodictyi Aromaticum; Mistura Chloralis et Potassii Bromidi Composita; Tinctura Guaiaci Composita.

Uses—Pumice is used as a filtering and distributing medium in several N. F. Preparations. Because of its grittiness, powdered pumice is also used in certain soaps and cleaning powders.

LIQUOR ALUMINI ACETATIS. N. F. Solution of Aluminum Acetate

[Liq. Alumin. Acet.—Liquor Burowii, Burow's Solution]

An aqueous solution containing not less than 4.5 Gm. and not more than 5.5 Gm. of neutral aluminum acetate ($Al(C_2H_3O_2)_3 = 204.10$) in each 100 cc.

	Metric	Alternative
Lead Acetate	**150 Gm.**	5 oz. av. 3 gr.
Aluminum Sulphate	**85 Gm.**	2 oz. av. 366 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve each salt separately in 450 cc. [14 fl. oz. 192 min.] of water and mix the cold solutions by pouring the lead acetate solution in a thin stream, with constant stirring, into the aluminum sulphate solution. Set the mixture aside in a cold place (about 10° C.) for twenty-four hours, stirring it occasionally, and then siphon off the clear liquid. Transfer the magma to a strainer of fine texture, press it and add sufficient water through the magma to make the filtered mixed liquids measure 1000 cc. [2 pints].

Dispense only the clear solution.

Note—This Solution should not be confused with Liquor Alumini Acetatis N. F. III, which is a stronger preparation, now recognized under the name of Liquor Alumini Subacetatis.

Solution of Aluminum Acetate is a clear, colorless liquid with a faint acetic odor, a sweetish astringent taste, and an acid reaction. In addition to aluminum acetate it contains a small but variable proportion of dissolved lead sulphate.

Warm 5 cc. of the Solution with 1 cc. of sulphuric acid and 1 cc. of alcohol; ethyl acetate is produced, which is recognized by its odor.

To 5 cc. of Solution of Aluminum Acetate, diluted with 25 cc. of water, add 0.5 Gm. of ammonium chloride and a slight excess of ammonia water: a gelatinous precipitate of aluminum hydroxide is produced.

To 5 cc. of the Solution add 5 cc. of hydrogen sulphide T.S.: a dark coloration but no precipitate is produced.

Assay—Dissolve 1 Gm. of ammonium chloride in 5 cc. of the Solution, accurately measured, and add enough distilled water to measure 250 cc. Precipitate the aluminum by the addition of a

slight excess of ammonia water to the boiling solution, collect the precipitate on a filter, wash it thoroughly with hot distilled water, ignite it strongly, and weigh the residue. The weight of the residue multiplied by 3.994 represents its equivalent in $Al(C_2H_3O_2)_3$. Each cc. of Solution of Aluminum Acetate corresponds to not less than 0.01126 Gm. nor more than 0.01376 Gm. of aluminum oxide (Al_2O_3).

This assay is explained on page 1478.

Uses—This solution derives its synonym from the fact that Dr. August Burow, of the University of Köenigsberg in 1857, prescribed a similar solution. In the original solution, alum replaced aluminum sulphate but the latter is preferable, being more certain to precipitate all of the lead. It is usually diluted with water, is used as a non-toxic antiseptic dressing, also as an astringent and antiseptic mouth wash and gargle.

LIQUOR ALUMINI SUBACETATIS. N. F. Solution of Aluminum Subacetate

[Liq. Alumin. Subacet.]

An aqueous solution, containing not less than 7.5 Gm. and not more than 8.5 Gm. of basic aluminum acetate ($Al(C_2H_3O_2)_2OH = 162.08$) in each 100 cc.

	Metric	Alternative
Aluminum Sulphate	**160 Gm.**	5 oz. av. 149 gr.
Acetic Acid	**160 cc.**	5 fl. oz. 58 min.
Precipitated Calcium Carbonate	**70 Gm.**	2 oz. av. 147 gr.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the aluminum sulphate in 600 cc. [19 fl. oz.] of water, filter the solution, and gradually add the precipitated calcium carbonate, in several portions, with constant stirring. Then slowly add the acetic acid and set the mixture aside for several days, stirring occasionally. Siphon off the clear liquid, transfer the magma to a strainer, press it and pass sufficient water through the magma to make the filtered, mixed liquids measure 1000 cc. [2 pints].

Solution of Aluminum Subacetate is a clear, colorless or faintly yellow liquid, having an acetous odor. It gradually becomes turbid on continued standing, due to separation of a more basic salt. It is acid to litmus paper.

Ammonia water produces a white gelatinous precipitate, soluble in an excess of hydrochloric acid.

Barium chloride T.S. produces a white precipitate, insoluble in an excess of hydrochloric acid.

Assay—Add 5 cc. of the Solution, accurately measured, 1 Gm. of ammonium chloride and enough distilled water to measure 250 cc. Precipitate the aluminum by the addition of a slight excess of ammonia water to the boiling solution. Collect the precipitate on a filter, wash it thoroughly with hot distilled water, ignite it strongly and weigh the residue. The weight of the residue multiplied by 3.172 represents its equivalent in $Al(C_2H_3O_2)_2OH$. Each cc. of Solution of Aluminum Subacetate corresponds to not less than 0.02363 Gm. and not more than 0.02836 Gm. of aluminum oxide (Al_2O_3).

This assay is explained on page 1478.

Uses—It is used as an antiseptic and astringent wash.

Unofficial Salts of Aluminum

Alumini Acetas, $Al(C_2H_3O_2)_3$ Aluminum Acetate	A white, crystalline powder; soluble in water. It is chiefly used as a mordant, also as a disinfectant by embalmers. It is also used, internally, for diarrhea and dysentery. Dose, 5 to 10 grains (0.3 to 0.6 Gm.)
Alumini Bromidum, $AlBr_3$ Aluminum Bromide	White to yellowish deliquescent crystals; soluble in water. It is chiefly used in making synthetic organic compounds
Alumini Hydroxidum, $Al(OH)_3$ U. S. P. IX Aluminum Hydroxide	A white, bulky, amorphous powder; insoluble in water. It is largely used as a mordant for dyeing, in the manufacture of colors and lakes, also as a filtering medium. In medicine it is used as a desiccant powder, and as an absorbent and antacid. The dose is from 2 to 5 grains (0.13 to 0.3 Gm.)
Alumini Iodidum, AlI_3 Aluminum Iodide	Brown crystalline pieces; readily soluble in water. It is used as an antiseptic and in organic synthesis
Alumini Naphtholsulphonas, $Al_2(C_{10}H_5OH(SO_3)_2)_3$ Aluminum Betanaphthol-Disulphonate, Alumnol	A fine white powder; soluble in water. It is used as a surgical antiseptic, generally in solution. Alumnol is more fully described in the New and Nonofficial Remedies of 1925
Alumini Nitras, $Al(NO_3)_3.9H_2O$ Aluminum Nitrate	Colorless, deliquescent crystals; very soluble in water. This salt is chiefly used in the textile and leather industries
Alumini Oxidum, Al_2O_3 Aluminum Oxide	This compound occurs native in the minerals, corundum, emery, ruby, and sapphire. Ordinarily it is a white bulky powder; insoluble in water. It is used in preparing metallic aluminum, as an abrasive and in the manufacture of refractory crucibles and tubes
Alumini Phosphas, $AlPO_4$ Aluminum Phosphate	A white, crystalline powder; insoluble in water. It is chiefly used in ceramics and as a cement in admixture with plaster of Paris and water glass

THORIUM AND ITS COMPOUNDS

Thorium is from the mineral *thoria* in which it is found and which, in turn, was named after the Scandinavian god, Thor. It belongs to the group of what are known as *rare earth elements* which include cerium, lanthanum, didymium, etc. The atomic weight of the element is 232.15. Its specific gravity is about eleven, and its melting point about 1700° C. It occurs in the minerals, *thorite, thorianite, orangite,* and *monazite.* Its oxide is one of the important constituents of incandescent gas mantles.

It is a radio-active element (see Radium, page 684), yielding a number of degradation products, the most important of which is *mesothorium.*

It forms two oxides, ThO_2 and Th_2O_7; a chloride, $ThCl_4$; and a nitrate, $Th(NO_3)_4$ which crystallizes in several hydrated forms.

The soluble thorium salts resemble alum in their irritant and astringent properties. Hypodermically they usually cause local sloughing, and intravenously produce death by coagulation of the blood. The double salts are practically nontoxic even intravenously and are excreted by the kidneys.

In consequence of their radio-activity the thorium salts have been recommended for local application in malignant growths, and the thorium emanation has been used in pulmonary diseases. The salts that have appeared upon the market are *thorium nitrate,* $Th(NO_3)_4 4H_2O$, in white, crystalline granules or lumps, very soluble in water or alcohol, and *thorium-sodium citrate* which is available in solution form in two strengths, the weaker containing the equivalent of 10 Gm. of thorium nitrate in 100 cc. of solution, and the stronger containing the equivalent of 15 Gm. of thorium nitrate in 100 cc. of solution. These solutions are used in the diagnosis of diseases of the renal pelvis and urinary bladder, as the double salt after absorption is opaque to the passage of the Roentgen rays. These solutions are called *thorium solution for cystography* and *thorium solution for pyelography,* respectively (See N. N. R. 1925).

Actinium is also a disintegration product of thorium.

Cerium, Ce; 140.25

Cerium is a metal occurring in *cerite, gadolinite, monazite,* etc.; it is of a chocolate-brown color in masses, and has been obtained by the electrolysis of the chloride; it takes fire more easily than magnesium; at ordinary temperatures it oxidizes in a moist atmosphere. Two oxides of cerium are known, Ce_2O_3, *cerous oxide,* and CeO_2, *ceric oxide.*

The commercial supplies are obtained as a by-product of the manufacture of the well-known incandescent gas mantles which consist of oxides of *thorium, lanthanum, didymium,* and *cerium.*

There are no salts of cerium official, although the oxalate is used and was official in the U. S. P. IX.

When cerium is scratched with a hard steel edge, it emits brilliant sparks and for this reason it is used in sparking or friction alloys for gas lighters, cigar lighters, etc.

History—Named from the minor planet Ceres which was discovered at about the same time.

Tests for Cerium Compounds

If sodium hypochlorite is added to a solution of a colorless cerous salt, a red precipitate separates; this dissolves in warm hydrochloric acid, and evolves chlorine.

Unofficial Salts of Cerium

Cerii Oxidum, CrO_2 Ceric Oxide	A pale yellow, heavy powder; insoluble in water. It is used in ceramics and is present in the incandescent gas mantles
Cerii Chloridum, $Ce_2Cl_6.14H_2O$ Cerium Chloride	Reddish-white crystals; very soluble in water. It is used in the preparation of other cerium compounds, as in incandescent lighting
Cerii Nitras, $Ce(NO_3)_3.6H_2O$ Cerium Nitrate	Reddish-white crystals; very soluble in water. It is used with thorium nitrate in the manufacture of incandescent gas mantles
Cerii Oxalas, U. S. P. IX Cerium Oxalate	A mixture of the oxalates of cerium, didymium, lanthanum and other associated elements. A fine, white, or slightly pink powder; insoluble in water. It is used in irritated states of the stomach, especially when there is nausea or vomiting. Its action is probably that of a mechanical protection. The dose is from 1 to 10 grains (0.06 to 0.6 Gm.)
Cerii Sulphas, $Ce(SO_4)_2.4H_2O$ Cerium Sulphate	Reddish-yellow crystals; soluble in water. It is used in photography and also in the determination of nitrous acid

Cadmium, Cd; 112.40

Cadmium is from the Greek word "kadmia", meaning calamine, an ore of zinc, with which it is associated. Although it enters into no official preparations, it is used to some extent in medicine, and hence merits a notice here. It is a white metal, resembling tin, but somewhat heavier and more tenacious. Like that metal, it crackles when bent. Its specific gravity is 8.6 and the metal melts at 320° C. (608° F.) and boils at 770° C. (1418° F.). It is little affected by the air, but when heated combines with an atom of oxygen, forming a reddish-brown or orange-colored oxide, CdO. It combines with chlorine, iodine, bromine, and sulphur.

Tests for Cadmium Salts

Neutral, alkaline, or moderately acid solutions of cadmium salts yield a yellow precipitate with hydrogen sulphide. This precipitate is insoluble in alkali hydroxides, in alkali sulphides, and in cold dilute acids, but it is soluble in cold, moderately dilute nitric acid, in hot dilute hydrochloric acid, or in hot moderately dilute sulphuric acid.

Cadmium sulphide differs from the sulphides of arsenic and antimony in that it is insoluble in solutions of the alkali sulphides.

Unofficial Salts of Cadmium

Cadmii Bromidum, $CdBr_2$ Cadmium Bromide	A yellowish, crystalline powder; soluble in water. It is mainly used in photography
Cadmii Chloridum, $CdCl_2$ Cadmium Chloride	Small, white crystals; soluble in water. It is used in photography, dyeing, and calico printing; also as a reagent and in the preparation of cadmium sulphide
Cadmii Iodidum, CdI_2 Cadmium Iodide	Colorless, flaky crystals; soluble in water. It is used in photography and externally as a resolvent and antiseptic, generally mixed with lard
Cadmii Oxidum, CdO Cadmium Oxide	This compound is closely related to zinc oxide, but has a dark brown color
Cadmii Sulphidum, CdS Cadmium Sulphide	A light-yellow powder; insoluble in water. It is used as a yellow paint pigment, in pyrotechnics, and in coloring soaps. It is also used with ultramarine blue to produce a green pigment
Cadmii Sulphas, $CdSO_4.4H_2O$ Cadmium Sulphate	Colorless crystals; soluble in water. It is used as an astringent and antiseptic, and has been employed in eye washes to replace zinc sulphate. Cadmium sulphate is also used in producing normal cadmium electric cells

CHAPTER LII

MANGANESE, IRON, CHROMIUM, AND URANIUM

Mn; 54.93. Fe; 55.84. Cr; 52.0 U; 238.2

THESE four metals form a group exhibiting some chemical and physical analogies. They unite with oxygen, producing basic oxides.

Manganese, Mn; 54.93

Manganese is a corruption of the word "magnesia" since manganese dioxide was once called "magnesia nigra". It is found as a mineral quite extensively in the state of black oxide, as *pyrolusite*, *braunite*, and *hausmannite*. The carbonate also is sometimes found. The metal is very hard and brittle, is gray and lustrous in appearance, has a specific gravity from 7.2 to 7.8 and melts at 1260° C.; when powdered, it decomposes water readily. A very pure product is obtained by the Goldschmidt method, whereby manganese dioxide is reduced with finely divided metallic aluminum at high temperatures. With oxygen it forms five—possibly seven—compounds. The *monoxide*, or *manganous oxide*, MnO, is of a light green color, and is the oxide present in or corresponding to manganous salts. The *sesquioxide*, Mn_2O_3, is black or dark brown, when in the hydrated state; the magnetic oxide, or *manganous-manganic oxide*, Mn_3O_4, is the native hausmannite and is brown-black in color; the dioxide, MnO_2, is black; and the permanganic oxide, Mn_2O_7, is, when in the free state, a very unstable dark reddish-brown liquid. The monoxide is a stable base, the sesquioxide feebly basic, and the dioxide when acted upon by acids yields manganous salts, while oxygen is evolved. The highest oxide is acid-forming, yielding permanganic acid, $HMnO_4$, the salts of which are known as permanganates. There are also manganates corresponding to an acid of the formula, H_2MnO_4.

Tests for Manganese Compounds

When in solution, manganous compounds yield a salmon-colored precipitate with ammonium sulphide T.S. This precipitate is dissolved by acetic acid.

A very delicate test for the detection of manganese is the so-called Crum's test. This involves the formation of the purplish pink permanganic acid by evaporation of the manganese compound with nitric acid and a trace of red lead and by subsequent dilution with water.

Permanganates—Solutions of permanganates acidulated with sulphuric acid are decolorized by hydrogen dioxide T.S., sodium bisulphite T.S., or oxalic acid T.S.

POTASSII PERMANGANAS. U. S. Potassium Permanganate

[Pot. Permang.]

This is the most important official compound of manganese. It is considered under the potassium compounds (page 612).

MANGANI CITRAS SOLUBILIS. N. F. Soluble Manganese Citrate

[Mangan. Cit. Sol.—MANGANESE AND SODIUM CITRATE]

Manganous citrate rendered soluble by the presence of sodium citrate. It corresponds, when dried to constant weight at 120° C., to not less than 48 per cent and not more than 52 per cent of $Mn_3(C_6H_5O_7)_2$(542.93).

Manganese citrate is prepared by the action of citric acid on manganese hydroxide. It is then rendered soluble by the aid of sodium citrate.

Description and Physical Properties—Soluble Manganese Citrate occurs as a yellowish or pinkish-white powder, or as translucent scales; odorless, and having a slightly bitter and astringent taste. It is permanent in the air.

One Gm. dissolves slowly in about 4 cc. of water; slightly more soluble in boiling water, nearly insoluble in alcohol.

Tests for Identity—An aqueous solution of Soluble Manganese Citrate (1 in 20) is slightly acid or slightly alkaline to litmus, but does not redden phenolphthalein T.S.

When strongly heated, it chars and finally leaves a residue which effervesces with acids and imparts an intensely yellow color to a non-luminous flame.

An aqueous solution of Soluble Manganese Citrate (1 in 20) rendered alkaline with ammonia water, yields a salmon-colored precipitate on warming with ammonium sulphide T.S.

Ten cc. of an aqueous solution of Soluble Manganese Citrate (1 in 20), slightly acidulated with acetic acid and mixed with 2 cc. of calcium chloride T.S., remains clear while cold, but yields a white, crystalline precipitate when heated to boiling.

Tests for Purity—Separate portions of 10 cc. each of an aqueous solution of Soluble Manganese Citrate (1 in 100), when acidulated with hydrochloric acid, are not more than slightly reddened by potassium thiocyanate T.S. (*iron*); nor rendered turbid at once by barium chloride T.S. (*sulphate*); nor show more than an opalescence with silver nitrate T.S. when acidulated with nitric acid (*chloride*).

Mix about 0.5 Gm. of Soluble Manganese Citrate with 5 cc. of sulphuric acid in a porcelain dish previously rinsed with sulphuric acid, protect the mixture from dust and heat it for fifteen minutes on a water bath; no color darker than yellow develops (*tartrates or other readily carbonizable substances*).

An aqueous solution of Soluble Manganese Citrate does not respond to the test for heavy metals (see page 1519).

Assay—Dissolve about 0.5 Gm. of Soluble Manganese Citrate, previously dried to constant weight at 120° C. and accurately weighed, in 100 cc. of distilled water, add 50 cc. of solution of hydrogen dioxide, and 10 cc. of ammonia water, and boil the mixture for several minutes. Collect the precipitate on a filter, wash it thoroughly with hot distilled water, dry and ignite to constant weight. The weight of the manganous-manganic oxide (Mn_3O_4) so obtained is not less than 20.23 per cent or more than 21.92 per cent of the weight of the salt taken, corresponding to not less than 48 per cent or more than 52 per cent of $(Mn_3C_6H_5O_7)_2$.

Each Gm. of manganous-manganic oxide is equivalent to 2.3728 Gm. of $Mn_3(C_6H_5O_7)_2$.
This assay is explained on page 1481.

N. F. Preparation—Liquor Ferri Peptonati et Mangani.

Uses—It is used as a tonic, especially in anemia in doses of three to five grains (0.2 to 0.3 Gm.).

MANGANI GLYCEROPHOSPHAS SOLUBILIS. N. F. Soluble Manganese Glycerophosphate

[**Mangan. Glycerophos. Sol.**—Soluble Manganous Glycerinophosphate]

Manganous Glycerophosphate rendered soluble by the aid of citric acid. It contains not less than 70 per cent nor more than 75 per cent of $MnC_3H_7PO_6$(225.04).

Description and Physical Properties—Soluble Manganese Glycerophosphate occurs as a yellowish or pinkish white powder, odorless, and having an acid taste.

One gram dissolves in 4 cc. of water at 25° C. The aqueous solution is strongly acid to litmus and becomes turbid on heating. Alcohol dissolves the citric acid, leaving a residue which is nearly insoluble in water.

Tests for Identity—Add an excess of ammonium sulphide T.S. to an aqueous solution of Soluble Manganese Glycerophosphate; on standing, it yields a salmon-colored precipitate soluble in acetic acid.

No yellow turbidity is produced immediately on mixing 5 cc. of an aqueous solution (1 in 20) with 10 cc. of ammonium molybdate T.S. (*phosphate*), but on prolonged standing, or on heating, a yellow precipitate is formed.

Heat a powdered mixture of about 0.1 Gm. of Soluble Manganese Glycerophosphate and about 0.5 Gm. of potassium bisulphate; pungent vapors of acrolein are evolved.

Tests for Purity—Separate portions of 10 cc. each of an aqueous solution of Soluble Manganese Glycerophosphate (1 in 20) are not rendered more than slightly turbid by barium chloride T.S. when mixed with a few drops of hydrochloric acid (*sulphate*); nor by silver nitrate T.S., after acidulation with nitric acid (*chloride*).

Add a few drops of hydrochloric acid and 1 cc. of chlorine T.S. to 10 cc. of an aqueous solution of Soluble Manganese Glycerophosphate (1 in 200) and boil; no reddish color is produced in the liquid by potassium thiocyanate T.S. after cooling (*iron*).

An aqueous solution of Soluble Manganese Glycerophosphate does not respond to the test for heavy metals (see page 1519).

Assay—Dissolve about 0.5 Gm. of Soluble Manganese Glycerophosphate, accurately weighed in 100 cc. of distilled water, add 10 cc. of ammonia water and 5 cc. of ammonium sulphide T.S., and boil the mixture until the precipitate formed has become greenish. Allow the precipitate to settle, then transfer it to a filter, wash with hot distilled water containing a few drops of ammonium sulphide T.S., dry the filter and contents and incinerate them in an open crucible, first at a low temperature and then at a strong red heat, until the weight is constant. The residue of manganese-

manganic oxide (Mn_3O_4) so obtained is not less than 23.7 per cent or more than 25.4 per cent of the weight taken, corresponding to not less than 70 per cent or more than 75 per cent of $MnC_3H_7PO_6$.

Each Gm. of manganous-manganic oxide is equivalent to 2.95 Gm. of $MnC_3H_7PO_6$.

This assay is explained on page 1481.

N. F. Preparation—Elixir Glycerophosphatum Compositum.

Uses—It is used as a nervine and blood tonic in doses of three to five grains (0.2 to 0.32 Gm.).

MANGANI HYPOPHOSPHIS. N. F. Manganese Hypophosphite

[Mangan. Hypophos.]

Manganese Hypophosphite contains not less than 97 per cent of $Mn(PH_2O_2)_2.H_2O$ (203.06).

Preparation—It may be prepared by dissolving manganese carbonate in hypophosphorous acid, in molecular proportion and crystallizing from the hot aqueous solution or by boiling together solutions of barium hypophosphite and manganese sulphate, filtering out the barium sulphate, evaporating the filtrate and crystallizing.

The equation for the above reaction is expressed as follows:

$$\underset{\text{manganous carbonate}}{MnCO_3} + \underset{\text{hypophosphorous acid}}{2HPH_2O_2} = \underset{\text{manganous hypophosphite}}{Mn(PH_2O_2)_2} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Manganese Hypophosphite is a pink, granular or crystalline powder; odorless and nearly tasteless; permanent in the air.

It is freely soluble in water; insoluble in alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 20) is neutral or acid to litmus and yields with ammonium sulphide T.S. a salmon-colored precipitate of manganese sulphide, soluble in acetic acid.

When strongly heated in a dry test tube, the salt evolves spontaneously inflammable hydrogen phosphide and finally leaves a residue of manganous pyrophosphate.

When an aqueous solution of the salt (1 in 20) acidulated with hydrochloric acid, is added, drop by drop, with agitation, to an excess of mercuric chloride T.S. a white precipitate of mercurous chloride is formed, and, upon the further addition of the solution of Manganese Hypophosphite, the precipitate becomes gray from reduction to metallic mercury.

Tests for Purity—Add about 0.5 Gm. of the salt to 5 cc. of acetic acid; no effervescence is produced (*carbonate*).

Boil 0.25 Gm. of the salt with 10 cc. of sodium hydroxide T.S.: a white precipitate is formed which gradually acquires a brown color on exposure to the air. The filtrate from this mixture, after being slightly acidulated with hydrochloric acid, boiled for one minute, and then rendered alkaline with ammonia water, yields no precipitate upon the addition of magnesia mixture T.S. (*phosphate*).

Dissolve 1 Gm. of the salt in 20 cc. of diluted hydrochloric acid with the aid of heat, and then add 1 cc. of barium chloride T.S.; not more than a slight turbidity is produced (*sulphate*).

Dissolve 0.5 Gm. of Manganese Hypophosphite in 10 cc. of hot distilled water, add 10 cc. of solution of hydrogen dioxide and 10 cc. of sodium hydroxide T.S., boil for one minute, then render slightly acid with acetic acid and again warm. Now cool, filter, and add 1 cc. of ammonium oxalate T.S. to 10 cc. of the filtrate; no turbidity is produced within five minutes (*calcium*).

Pour 5 cc. of an aqueous solution of the salt (1 in 30) into an evaporating dish containing 3 cc. of nitric acid diluted with about 10 cc. of distilled water, and evaporate to dryness on a water bath; the residue meets the requirements of the test for *arsenic* (see page 1512).

Assay—Dissolve about 1 Gm. of Manganese Hypophosphite, accurately weighed, in 30 cc. of boiling distilled water in a 250 cc. measuring flask. Add 25 cc. of solution of hydrogen dioxide and 15 cc. of sodium hydroxide T.S. and heat for ten minutes on a water bath with frequent agitation. Cool, add distilled water to make the volume exactly 250 cc., mix well and filter through a dry filter. Evaporate 25 cc. of the clear filtrate to dryness with 10 cc. of nitric acid, dissolve the residue in 10 cc. of nitric acid and again evaporate to dryness; then dissolve the residue in 10 cc. of distilled water, transfer it to a 100 cc. flask with the aid of a few cc. of distilled water, add a drop of phenolphthalein T.S. and sufficient sodium hydroxide T.S. (free from chloride) to produce a pink color, then add 50 cc. of tenth-normal silver nitrate and agitate the mixture well. Now gradually add zinc oxide (free from chloride) in small portions, agitating vigorously after each addition until the liquid is neutral to litmus. Then add distilled water to make 100 cc., agitate the mixture thoroughly, filter through a dry filter, collect 50 cc. of the filtrate, add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate to the production of a permanent red color.

Each cc. of tenth-normal silver nitrate used corresponds to 0.003384 Gm. of $Mn(PH_2O_2)_2.H_2O$. Each Gm. of Manganese Hypophosphite corresponds to not less than 286.6 cc. of tenth-normal silver nitrate.

This assay is explained on page 1464.

Preserve it in well-closed containers.

N. F. Preparations—Liquor Hypophosphitum Compositus; Syrupus Hypophosphitum Compositus.

Uses—Used as a tonic and alterative in doses of three to five grains (0.2 to 0.32 Gm.). Usually in the form of the compound Syrup of Hypophosphites.

Unofficial Salts of Manganese

Mangani Arsenas, $MnHAsO_4$ Manganese Arsenate	A reddish-white powder; slightly soluble in water. It is used as an alterative and tonic in doses of from $\frac{1}{30}$ to $\frac{1}{6}$ grain (0.002 to 0.01 Gm.)
Mangani Carbonas, $MnCO_3$ Manganese Carbonate	A rose-colored, crystalline powder; insoluble in water. It is used in the manufacture of other manganous compounds and in medicine as a tonic; dose, 5 to 15 grains (0.3 to 1 Gm.)
Mangani Chloridum, $MnCl_2$ Manganous Chloride	Deliquescent, rose-colored crystals; soluble in water. It is used in dyeing, removing color from glass, and in regenerating manganese dioxide. It is also used in solution as a mouth wash and gargle for syphilitic ulcers
Mangani Citras, $MnHC_6H_5O_7$ Manganese Citrate	A white powder; soluble in water. It is used in medicine as a tonic and astringent
Mangani Oxalas, $2MnC_2O_4.5H_2O$ Manganese Oxalate	A white, crystalline powder; slightly soluble in water. It is used as a varnish drier and in the manufacture of metallic manganese
Mangani Sulphas, $MnSO_4$ (N. F. IV)	Rose-colored, translucent, prisms, soluble in water. It is used as a cholagogue and tonic in doses of 3 to 20 grains
Mangani Tartras, $MnC_4H_4O_6$ Manganese Tartrate	A white powder; very slightly soluble in water. It is made by precipitation from solutions of manganous chloride and neutral potassium tartrate

Iron, Fe; 55.84

Iron is from words of several languages pertaining to anything strong, hard or unyielding. It is the most useful and abundant of the metals, is widely diffused in nature, and is found not only in the mineral kingdom, but in animal and vegetable products as well.

Iron is a hard, malleable, ductile, and tenacious metal, of a grayish-white color and fibrous texture, a slightly styptic taste, having a sensible odor when rubbed. Its specific gravity is 7.8. It is combustible, and, when heated to whiteness, burns in atmospheric air, and with brilliant scintillations in oxygen. At a red heat its surface is converted into black oxide, and at common temperatures, by the combined agency of air and moisture, it becomes covered with a reddish matter, called *rust*, which is hydrated ferric oxide. All commercial forms of iron contain carbon partly in the free state and partly in the form of carbide. *Wrought iron* contains the lowest amount of carbon, *cast iron* the highest amount, and *steel* an intermediate proportion of carbon. Iron combines with all the non-metallic elements except hydrogen and nitrogen, and with most of the metals. It forms three well-known oxides.

Ferrous oxide (FeO) is an unstable oxide of iron of little importance. Ferric oxide (Fe_2O_3) is the most important oxide of iron. It occurs in nature as hematite and can be made by heating ferric hydroxide. Ferroso-ferric oxide (Fe_3O_4) is the magnetic oxide of iron that occurs in nature as magnetite. The black scale that forms when iron is heated in air or steam is of this composition.

The following discussion of this use of iron in medicine is from the N. N. R. (1925), and is worthy of the consideration of the pharmacy student:

Iron and Iron Compounds

Iron is used (1) in the form of metallic or elementary iron (reduced iron, U. S. P.); (2) in the ferrous or unoxidized form (ferrous carbonate); (3) in the trivalent or oxidized form, the ferric compounds (tincture of ferric chloride); and (4) complex compounds of iron (scale salts of iron).

Complex iron compounds are those whose solutions do not respond to the ordinary tests for ferrous or ferric ions because in them the iron is part of a radicle. Complex compounds of iron do not have the astringent taste of simple iron solutions. Their permanency differs widely; while some are converted to simple ionic iron by action of dilute acids (soluble ferric phosphate, syrup of citro-iodide of iron, etc.), others resist treatment with strong acids or with alkalies. The complex iron compounds occurring naturally in animal

and vegetable tissues (which are often termed food irons) belong generally to the more resistant class, while the complex iron compounds produced artificially are as a rule decomposed rather readily. There is, however, no sharp line of distinction between the natural complex iron compounds and the artificially produced ones, nor is there any good evidence that they differ in therapeutic action. Salts of iron which give the iron test directly are classed as inorganic iron, whatever their acid radicles may be; true iron albuminate and iron peptonate are inorganic iron compounds.

Solutions of ferric iron are used externally as styptics. Ferric solutions may be used for their astringent effects, internally, and as a gargle. The principal use of iron, however, is in the treatment of anemia and chlorosis. For this purpose, the ferrous salts are usually preferred to the ferric salts, as they are not so caustic and hence are less likely to disturb the stomach.

Tests for Iron Salts

Ferrous or ferric compounds in solution yield a black precipitate with ammonium sulphide T.S. This precipitate is dissolved by cold, diluted hydrochloric acid with the evolution of hydrogen sulphide.

Ferric salts in solution yield a dark blue precipitate with potassium ferrocyanide T.S. With an excess of sodium hydroxide T.S. a reddish-brown precipitate is formed. Solutions of ferric salts produce with potassium thiocyanate T.S. a deep red color which is not destroyed by diluted mineral acids.

Ferrous salts in solution yield a dark blue precipitate with potassium ferricyanide T.S. This precipitate is insoluble in diluted hydrochloric acid, but is decomposed by sodium hydroxide T.S. Solutions of ferrous salts yield with sodium hydroxide T.S. a white precipitate, the color rapidly changing to green.

FERRUM. U. S. Iron

[Ferr.]

Metallic iron [Fe = 55.84] in the form of fine, bright wire.

Iron, when employed in pharmaceutical operations, should be of the purest kind; hence the pharmacopœias generally direct it, when wanted in small masses, to be in the form of *iron wire*, which is necessarily made from the purest iron, because it is the softest and most ductile, and readily cut into pieces. Such wire is very flexible and without elasticity.

The wire clippings and the ends of card teeth obtained from the manufacturers of cotton carding machines are frequently used for making iron preparations. They are very convenient and it may be incidentally mentioned that they are sometimes used as a substitute for sand in sand baths. Iron scraps and waste from steel pen factories are also used to make preparations of iron.

U. S. P. Preparation—Syrupus Ferri Iodidi.
N. F. Preparation—Syrupus Calcii Iodidi.

FERRUM REDUCTUM. U. S. Reduced Iron

[**Ferr. Reduct.**—Ferrum Redactum, Iron by Hydrogen, Quevenne's Iron]

Reduced Iron is obtained by the action of hydrogen upon ferric oxide and contains not less than 90 per cent of metallic iron [Fe = 55.84].

Preparation—Reduced iron is prepared by treating ferric oxide (Fe_2O_3) with hydrogen in a heated reduction tube, until the reduction is complete

(see Remington's Practice of Pharmacy, Sixth edition, page 862, for full details).

The reaction for its production is illustrated by the following equation:

$$\underset{\text{ferric oxide}}{Fe_2O_3} + \underset{\text{hydrogen}}{6H} = \underset{\text{iron}}{2Fe} + \underset{\text{water}}{3H_2O}$$

Imitations of "reduced iron" have been offered for import in recent years. One of these differs from the official product by being crystalline and by not being so fine a powder. This has not been admitted for entry since it did not comply with the U. S. P. specifications. It has evidently been prepared by electric deposition or by some mechanical process. One product is termed *alcoholized iron* in which the word alcohol has its original Arabic meaning of "finely divided".

The value of Reduced Iron is largely dependent upon its physical characteristics, hence the new tests, requiring it to pass through a No. 100 sieve and be amorphous when viewed under a microscope. A test has also been added requiring "glowing" when the substance is heated in a crucible and thrown into the air.

Description and Physical Properties—An odorless, grayish-black, lusterless powder, all of which must pass through a No. 100 sieve. When viewed under a lens having a magnifying power of one hundred diameters, Reduced Iron appears as an amorphous powder, free from crystalline particles. It is stable in dry air.

Reduced Iron is insoluble in water and in alcohol.

Tests for Identity—Heat about 1 Gm. of Reduced Iron in a porcelain crucible with a small Bunsen flame until it assumes a bluish-black color without glowing. Then quickly pour it from the crucible: the particles of iron will glow brightly as they fall through the air.

Tests for Purity—Shake 1 Gm. of Reduced Iron with 5 cc. of distilled water, and filter: the filtrate does not change the color of litmus paper.

Treat 1 Gm. of Reduced Iron with 20 cc. of diluted sulphuric acid and when the reaction subsides, heat gently until no more gas is evolved. Filter, wash the residue with distilled water until the washings cease to react for sulphate, dry at 110° C. to constant weight, and weigh. The weight of the residue should not exceed 0.010 Gm.

One Gm. of Reduced Iron mixed with 20 cc. of diluted sulphuric acid in a flask causes the evolution of nearly odorless hydrogen gas, which does not affect paper moistened with lead acetate T.S. within two minutes (*sulphide*).

Add 20 cc. of diluted sulphuric acid to 0.5 Gm. of Reduced Iron contained in a small, covered beaker, and after the reaction has subsided somewhat, warm the liquid on a water bath until the reaction ceases. Pass the solution through a small filter to collect any undissolved residue, rinse the beaker with distilled water, add the rinsings to the filter, and then wash the residue with distilled water until free from acid reaction. Transfer the residue to the beaker by rinsing it back, and after adding about 0.25 Gm. of potassium chlorate and 5 cc. of hydrochloric acid, slowly evaporate the solution to dryness on a water bath. Dissolve the residue in sufficient distilled water to measure 50 cc., add 5 cc. of this solution to 5 cc. of a saturated solution of sulphurous acid, and heat the liquid on a water bath for fifteen minutes, or until all traces of sulphurous acid have been removed: the resulting solution meets the requirements of the test for *arsenic*, page 1512.

Assay—Triturate thoroughly about 1 Gm. of Reduced Iron, weigh accurately, place it in a 100 cc. flask, and add 10 Gm. of finely powdered corrosive mercuric chloride and 50 cc. of boiling distilled water. Boil the mixture for five minutes, shaking it frequently, then fill the flask to the 100 cc. mark with distilled water, recently boiled and cooled, and cool the mixture to room temperature. Again fill the flask to the mark with distilled water, stopper, agitate the contents well, and allow to stand for a few minutes. Now filter the contents of the flask, and immediately titrate 20 cc. of the filtrate to which has been added 20 cc. of diluted sulphuric acid, with tenth-normal potassium permanganate until a permanent pink color is produced. Each cc. of tenth-normal potassium permanganate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1474.

Preserve in well-closed containers.

N. F. Preparations—Extractum Ferri Pomatum; Pilulæ Ferri Iodidi; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Fortiores; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Mites.

History—Reduced iron was first produced by Theodore Quevenne, head pharmacist of the Paris Charity Hospital about 1850.

Uses—Powder of iron, or reduced iron, is one of the best of the chalybeate tonics. It is generally given in pill form, in doses of one to six grains (0.065 to 0.38 Gm.). It has been used for the preparation of syrup of ferrous iodide, replacing the iron wire and hastening the reaction. An excellent form of administering it is in combination with chocolate in the form of lozenges.

Average dose—1 grain (0.06 Gm.).

FERRI CARBONAS SACCHARATUS. U. S. Saccharated Ferrous Carbonate [Ferr. Carb. Sacch.]

Saccharated Ferrous Carbonate contains not less than 15 per cent of $FeCO_3$ (115.85).

	Metric	Alternative
Ferrous Sulphate	**50 Gm.**	5 oz. av.
Sodium Bicarbonate	**35 Gm.**	3½ oz. av.
Lactose	**10 Gm.**	1 oz. av.
Sucrose, in fine powder,		
Diluted Sulphuric Acid,		
Distilled Water, each, a sufficient quantity,		
To make	**100 Gm.**	10 oz. av.

Dissolve 8.5 Gm. [372 gr.] of sucrose in 200 cc. [20 fl. oz.] of hot distilled water, and then dissolve the ferrous sulphate in that solution. Add from three to five drops of diluted sulphuric acid, and filter. Dissolve the sodium bicarbonate in 500 cc. [3 pints] of distilled water at a temperature not exceeding 50° C., and filter. To the solution of sodium bicarbonate contained in a flask having a capacity of about 1000 cc. [6 pints] gradually add the solution of ferrous sulphate, and mix thoroughly by rotating the flask. Fill the flask with boiling distilled water, cork it loosely, and set the mixture aside. When the precipitate has subsided, draw off the clear supernatant liquid by means of a siphon, fill the flask again with hot distilled water, and shake it. Again draw off the liquid, and repeat the washing with hot distilled water in the same manner until the decanted liquid gives merely a slight cloudiness with barium chloride T.S. Drain the precipitate, transfer it to a porcelain dish containing 61.5 Gm. [6 oz. av. 66 gr.] of sucrose and 10 Gm. [1 oz. av.] of lactose, and mix intimately. Evaporate the mixture to dryness on a water bath, reduce it to a powder, weigh, and mix intimately with it, if necessary, enough well-dried sucrose to make the product weigh 100 Gm. [10 oz. av.]. To minimize oxidation make this preparation in the shortest possible time.

In this preparation ferrous carbonate is formed, sodium sulphate remaining in solution. Sodium bicarbonate is preferred because the evolution of carbonic acid during the decomposition measurably prevents oxidation; it would have been an improvement to use syrup in the solutions to protect them still further.

The object of boiling the water for washing the precipitate is to expel the air, so that the ferrous carbonate may escape its oxidizing action; the evaporation of the mixture should be conducted as rapidly as possible, for the same reason.

$$\underset{\text{ferrous sulphate}}{FeSO_4} + \underset{\text{sodium bicarbonate}}{2NaHCO_3} = \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{ferrous carbonate}}{FeCO_3} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

Description and Physical Properties—A greenish-brown, odorless powder, which gradually becomes oxidized by contact with air.

Saccharated Ferrous Carbonate is only partially soluble in water.

Tests for Identity—When treated with hydrochloric acid, it dissolves with copious evolution of carbon dioxide, a clear, greenish-yellow liquid resulting.

Dissolve 1 Gm. of Saccharated Ferrous Carbonate in 5 cc. of hydrochloric acid, and dilute the solution with distilled water until it measures 100 cc.: this solution responds to the reactions for ferrous salts, page 710.

Tests for Purity—A 10 cc. portion of the solution prepared as above, when diluted with distilled water to 50 cc. shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1520.

Assay—Dissolve about 2 Gm. of Saccharated Ferrous Carbonate, accurately weighed, in 15 cc. of diluted sulphuric acid, and dilute the solution with distilled water to about 100 cc. Titrate immediately with tenth-normal potassium dichromate, potassium ferricyanide T.S. being used as indicator. Each cc. of tenth-normal potassium dichromate corresponds to 0.01159 Gm. of $FeCO_3$.

This assay is explained on page 1472.

Preserve in small, well-stoppered bottles, exposed to light.

Uses—Saccharated ferrous carbonate is used as a hematinic, in doses of four grains (0.25 Gm.).

MASSA FERRI CARBONATIS. U. S. Mass of Ferrous Carbonate

[**Mass. Ferr. Carb.**—Vallet's Mass]

Mass of Ferrous Carbonate contains not less than 35 per cent of $FeCO_3$. (115.85). (See page 487 for the formula.)

Assay—Dissolve about 1 Gm. of Mass of Ferrous Carbonate, accurately weighed, in 15 cc. of diluted sulphuric acid, dilute the solution with distilled water to about 100 cc., and immediately titrate with tenth-normal potassium dichromate, potassium ferricyanide T.S. being used as indicator. Each cc. of tenth-normal potassium dichromate corresponds to 0.01159 Gm. of $FeCO_3$.

This assay is explained on page 1472.

This preparation consists of ferrous carbonate preserved from oxidation by contact with syrup and honey. The reaction is expressed as follows:

$$\underset{\text{ferrous sulphate}}{FeSO_4} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{ferrous carbonate}}{FeCO_3} + \underset{\text{sodium sulphate}}{Na_2SO_4}$$

Uses—Mass of ferrous carbonate is widely known as *Vallet's Mass;* it is a valuable chalybeate tonic, and is administered in pill form, in doses of four grains (0.25 Gm.). Ferrous carbonate is also official in the U. S. P. under the title *Pilulæ Ferri Carbonatis*, see Chapter 487. A powdered Vallet's Mass is also obtainable.

A mixture of dried ferrous sulphate and potassium or sodium carbonate in glycerin is a commercial product. Under these conditions there is no reaction and to avoid surface oxidation a small amount of liquid petrolatum is added, which floats on the surface and makes an air-tight seal. This mixture is to be well shaken, then added to water, before administering, when the reaction occurs and freshly precipitated ferrous carbonate is made available.

A formula for a *liquid ferrous carbonate*, or *nascent ferrous carbonate*, of this character, was suggested by M. I. Wilbert, as given below. Advantage is taken of the solvent properties of glycerin to inhibit the reaction and it must be well diluted with water before administration.

Granulated Ferrous Sulphate	3.2 cc.
Distilled Water	1.5 cc.
Potassium Carbonate	1.6 Gm.
Glycerin, to make	100 cc.

Dissolve the ferrous sulphate in the water, add 50 cc. of Glycerin and then the potassium carbonate, dissolved in the remainder of the glycerin. Each 5 cc. of this liquid is the equivalent of an official pill of ferrous carbonate.

FERRI CHLORIDUM. U. S. Ferric Chloride

[Ferr. Chlor.—Iron Perchloride, Sesquichloride of Iron]

Ferric Chloride contains $FeCl_3$ (162.22), in a hydrated form, corresponding to not less than 20 per cent of Fe (55.84).

Preparation—The Pharmacopœia no longer includes a process but the U. S. P. VIII gave the following:

	Metric	Alternative
Solution of Ferric Chloride	**100 Gm.**	10 oz. av.
To make	**40 Gm.**	4 oz. av.

Evaporate the solution of ferric chloride on a water bath until it weighs 40 Gm. [4 oz. av.]; then set it aside in a glass-covered vessel until it forms a crystalline mass. Lastly, break the salt into pieces, and keep it in glass-stoppered bottles, protected from light.

Description and Physical Properties—Orange-yellow, or brown-yellow, crystalline pieces. It is odorless, or has a faint odor of hydrochloric acid, and a strongly styptic taste. It is very deliquescent.

One Gm. of Ferric Chloride is soluble in 0.2 cc. of water at 25° C. It is freely soluble in alcohol, and is soluble in glycerin and in ether.

At about 35.5° C. the salt fuses to a reddish-brown liquid. When strongly heated, it is decomposed, leaving a residue of ferric oxide.

Tests for Identity—Ferric Chloride responds to the reactions for ferric iron, page 710, and for chlorides, page 567.

Tests for Purity—An aqueous solution of Ferric Chloride, made by dissolving 10 Gm. of the salt in 15 cc. of distilled water, complies with the tests for purity under *Liquor Ferri Chloridi*, omitting the test for hydrochloric acid.

Assay—Dissolve about 1 Gm. of Ferric Chloride, accurately weighed in a stoppered weighing-bottle, in 25 cc. of distilled water, transfer to a glass-stoppered flask or bottle, add 3 cc. of hydrochloric acid and 4 Gm. of potassium iodide, stopper the container securely, and allow the mixture to stand for thirty minutes at a temperature of 40° C. Cool this solution, then dilute it with 100 cc. of distilled water, and titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1466.

Preserve in well-closed glass containers protected from light.

Uses—Ferric chloride is used externally as an astringent and styptic, and internally as a chalybeate tonic, in doses of one to five grains (0.065 to 0.32 Gm.).

LIQUOR FERRI CHLORIDI. U. S. Solution of Ferric Chloride

[Liq. Ferr. Chlor.—Solution of Iron Perchloride]

Solution of Ferric Chloride contains ferric chloride [$FeCl_3 = 162.22$], corresponding to not less than 10 per cent and not more than 11 per cent of Fe.

The Pharmacopœia no longer contains a process of manufacture but the U. S. P. IX formula was as follows:

	Metric	Alternative
Iron, in the form of fine, bright wire and cut into small pieces	**125 Gm.**	2 oz. av. 325 gr.
Hydrochloric Acid	**680 Gm.**	12 fl. oz. 3 fl. dr.
Nitric Acid,		
Distilled Water, each, a sufficient quantity,		
To make	**1000 Gm.**	1 pint

Introduce the iron wire into a flask having a capacity of about 2000 cc. [3 pints], pour upon it a mixture of 420 Gm. [or measure 7 fl. oz. 7 fl. dr.] of hydrochloric acid and 250 cc. [5½ fl. oz.] of distilled water and heat the mixture on a water bath for not less than one hour and fifteen minutes, or until effervescence ceases; then boil the liquid, filter it through paper, and, having rinsed the flask and iron wire with a little hot distilled water, pass the rinsings through the filter. To the filtered liquid add 220 Gm. [or measure 4 fl. oz.] of

hydrochloric acid, then add the mixture slowly and gradually in a stream to 65 Gm. [or measure 468 min.] of nitric acid contained in a tared, capacious porcelain vessel, and warm gently. If the solution has acquired a black color, continue the addition of nitric acid, drop by drop, until red fumes are no longer evolved and the solution assumes a clear, reddish-brown color. After effervescence ceases, heat on a sand bath, stirring occasionally until the liquid is free from nitric acid, as indicated by the test given below. During the heating add distilled water from time to time to maintain about the original volume. Finally add the remaining 40 Gm. [or measure 6 fl. oz.] of hydrochloric acid and enough distilled water to make the Solution weigh 1000 Gm. [or measure 1 pint].

In the first step of the process, ferrous chloride is produced; thus:

$$\underset{\text{iron}}{Fe_2} + \underset{\text{hydrochloric acid}}{4HCl} = \underset{\text{ferrous chloride}}{(FeCl_2)_2} + \underset{\text{hydrogen}}{4H}$$

Ferrous chloride is converted into ferric chloride by the addition of nitric and hydrochloric acids; thus:

$$\underset{\text{ferrous chloride}}{6FeCl_2} + \underset{\text{hydrochloric acid}}{6HCl} + \underset{\text{nitric acid}}{2HNO_3} = \underset{\text{ferric chloride}}{6FeCl_3} + \underset{\text{nitrogen dioxide}}{N_2O_2} + \underset{\text{water}}{4H_2O}$$

If this solution, when finished, has a black color, it is due to incomplete oxidation, and the remedy is to heat it to boiling in a capacious dish, adding a few drops of nitric acid until the color changes to a clear ruby-red and effervescence ceases. If a brown precipitate is deposited upon dilution or standing, deficiency of hydrochloric acid is indicated, and the solution must be heated, and a few drops of the acid added until the precipitate is dissolved; but a large excess of hydrochloric acid must be avoided or the solution will prove unsatisfactory in the preparation of tincture of ferric citro-chloride of the N. F. (see page 389), producing a reddish instead of a green colored solution. The U. S. P. has included a test to limit the amount of free acid.

Description and Physical Properties—A yellowish-brown liquid, having a faint odor of hydrochloric acid and an acid reaction.

It is miscible in all proportions with alcohol.

Specific gravity: from 1.29 to 1.32 at 25° C.

Tests for Identity—An aqueous dilution of the Solution (1 in 10) responds to the reactions for ferric iron, page 710, and for chlorides, page 567.

Tests for Purity—Weigh about 4 cc. of the Solution, dilute to 100 cc. with distilled water, and precipitate the iron completely by adding an excess of ammonia T.S., and filter: the filtrate is colorless. One-half of the filtrate does not yield a precipitate with hydrogen sulphide T.S. (*zinc, lead, or copper*).

The residue obtained upon evaporation and ignition of the remaining half of the filtrate does not exceed 0.1 per cent (*salts of the fixed alkalies*).

Mix 1 cc. of the Solution with 10 cc. of ferrous sulphate T.S. and superimpose the mixture upon 5 cc. of sulphuric acid contained in a test tube: the line of contact does not assume a brown or reddish-brown color (*nitrate*).

Add a few drops of freshly prepared potassium ferricyanide T.S. to an aqueous dilution of the Solution (about 1 in 20): a brown color is produced which does not at once turn green or greenish-blue (*ferrous salts*).

Add 10 cc. of distilled water and 50 cc. of tenth-normal silver nitrate to about 0.5 Gm. of Solution of Ferric Chloride, accurately weighed, shake vigorously, then add 2 cc. of nitric acid and sufficient distilled water to measure exactly 100 cc., and mix well. Pass the mixture through a filter not previously moistened (rejecting the first 10 cc. portion), and determine the excess of silver nitrate in 50 cc. of the filtrate by titration with tenth-normal potassium thiocyanate. The percentage of chlorine found is not less than 3 per cent and not more than 5 per cent in excess of that required to combine as ferric chloride with the iron present. The percentage of iron (see assay below) multiplied by 1.9, gives the percentage of chlorine combined as ferric chloride (*free hydrochloric acid*). Each cc. of tenth-normal silver nitrate corresponds to 0.003546 Gm. of Cl.

Assay—Transfer about 2 Gm. of Solution of Ferric Chloride to a tared flask, stopper, weigh accurately, add 5 cc. of hydrochloric acid, 25 cc. of distilled water and about 3 Gm. of potassium iodide. Securely stopper the flask, and allow the mixture to stand for thirty minutes at a temper-

ature of 40° C. Cool the liquid, dilute it with 100 cc. of distilled water, and then titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1467.

Preserve in glass-stoppered bottles, protected from light.

U. S. P. Preparation—Tinctura Ferri Chloridi.

N. F. Preparations—Ferri Oxidum Saccharatum; Gossypium Stypticum; Tinctura Ferri Chloridi Ætherea; Tinctura Ferri Citrochloridi.

Uses—This solution is occasionally used as a hemostatic; its principal use, however, is to form, by dilution with alcohol, the well-known tincture of ferric chloride. The dose is from one to two minims (0.06 to 0.12 cc.).

TINCTURA FERRI CHLORIDI. U. S. Tincture of Ferric Chloride

A hydro-alcoholic solution containing about 13 per cent of ferric chloride [$FeCl_3 = 162.22$], corresponding to not less than 4.48 per cent of Fe.

This tincture is made by diluting 350 cc. of solution of ferric chloride with sufficient alcohol to make 1000 cc. The details of the process will be found on page 373. If a brownish-red precipitate of ferric oxychloride takes place upon diluting the solution of ferric chloride, it shows that the solution has not been properly made, and is deficient in free hydrochloric acid.

Description and Physical Properties—A bright, amber-colored liquid, having a slightly ethereal odor, a very astringent, styptic taste, and an acid reaction.

Specific gravity: about 1.00 at 25° C.

Tests for Identity—The Tincture responds to the reactions for ferric iron, page 710, and for chlorides, page 567.

After the Tincture has been exposed for some time to daylight, it yields a greenish or greenish-blue color with potassium ferricyanide T.S. (presence of some *ferrous salt*, due to reduction).

Tests for Purity—Mix 3 cc. of the Tincture with 10 cc. of ferrous sulphate T.S. and carefully superimpose this mixture upon 3 cc. of sulphuric acid contained in a test tube: the zone of contact does not assume a brown or reddish-brown color (*nitrate*).

Assay—Place about 5 cc. of Tincture of Ferric Chloride in a tared weighing bottle, weigh accurately, transfer it to a tall beaker, and evaporate to dryness on a water bath. Add to the residue 2 cc. of hydrochloric acid and 5 cc. of solution of hydrogen dioxide, and again evaporate to dryness. Dissolve this residue in 3 cc. of hydrochloric acid, and transfer to a 250 cc. glass-stoppered flask by means of 25 cc. of distilled water. Add about 1 Gm. of potassium iodide, and allow the mixture to stand for thirty minutes at a temperature of 40° C., the flask being securely stoppered while it is being warmed. Cool the solution, add 100 cc. of distilled water, and titrate the liberated iodine with tenth-normal sodium thiosulphate. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1467.

Preserve in amber-colored, glass-stoppered bottles, protected from light.

Alcohol content, by volume, 58 to 64 per cent.

U. S. P. Preparation—Liquor Ferri et Ammonii Acetatis.

N. F. Preparation—Elixir Chloridorum.

Uses—Tincture of ferric chloride is undoubtedly one of the most important liquid iron preparations that is used; it is an efficient chalybeate tonic and styptic. The dose is from eight to thirty minims (0.5 to 2 cc.), diluted with water; it should be drawn through a glass tube, to prevent injury to the teeth.

FERRI ET AMMONII CITRAS. U. S. Iron and Ammonium Citrate

[**Ferr. et Ammon. Cit.**—Soluble Ferric Citrate, Ammonio-ferric Citrate]

Iron and Ammonium Citrate is ferric citrate rendered more readily soluble by the presence of ammonium citrate and contains not less than 16 per cent and not more than 18 per cent of Fe (55.84).

Preparation—Iron and Ammonium Citrate may be made by the official process of 1890, in which a mixture of 100 cc. of solution of ferric citrate and

40 cc. of ammonia water were evaporated at a temperature not exceeding 60° C. to the consistence of syrup, and spread on glass plates to dry.

Prof. J. U. Lloyd modified this process with advantage by using, instead of ammonia water, a definite quantity of ammonium citrate in solution.

Description and Physical Properties—Thin, transparent, garnet-red scales or granules. It is odorless, and has a saline, mildly ferruginous taste. It is deliquescent in moist air.

Iron and Ammonium Citrate is readily soluble in water. It is insoluble in alcohol.

Tests for Identity—When strongly heated, it chars and finally leaves a residue of ferric oxide.

An aqueous solution of Iron and Ammonium Citrate (1 in 20) is neutral or but slightly acid or alkaline to litmus paper.

Heat about 0.1 Gm. of Iron and Ammonium Citrate with about 5 cc. of potassium hydroxide T.S.: a brownish-red precipitate is produced and ammonia is evolved.

Ammonia T.S. added to an aqueous solution of Iron and Ammonium Citrate (1 in 100) produces no precipitate, but darkens the solution.

Tests for Purity—Remove the iron from 10 cc. of an aqueous solution of Iron and Ammonium Citrate (1 in 10) by boiling it with an excess of potassium hydroxide T.S., filter, and then slightly acidulate 4 cc. of the filtrate with acetic acid: a portion of the cooled filtrate, when mixed with 2 cc. of calcium chloride T.S. and again heated to boiling, gradually deposits a white, crystalline precipitate. The remainder of the filtrate, when acidulated more strongly with acetic acid and allowed to stand for twenty-four hours, does not yield a white, crystalline precipitate (*tartrate*).

An aqueous solution of Iron and Ammonium Citrate (1 in 100) does not yield a blue precipitate with potassium ferrocyanide T.S. unless it is previously acidulated with hydrochloric acid (*ferric citrate*).

Assay—Dissolve about 1 Gm. of Iron and Ammonium Citrate, accurately weighed, in 25 cc. of distilled water and 7 cc. of hydrochloric acid, in a glass-stoppered flask or bottle, add 4 Gm. of potassium iodide, stopper the container securely, and keep it at a temperature of 40° C. for thirty minutes. Then cool, dilute with 100 cc. of distilled water, and titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1467.

Preserve in well-closed containers, protected from light

N. F. Preparation—Elixir Carnis et Ferri.

Uses—Iron and ammonium citrate is a useful modification of ferric citrate, the object of adding the ammonia water being to make the salt more quickly soluble. It is a valuable and popular hematinic, free from astringent or irritant properties. The average dose is four grains (0.25 Gm.).

Another commercial form of this salt, known as *iron and ammonium citrate, green* or *green iron citrate* is recognized by the N. N. R. It is largely used in solution in ampuls for intramuscular or subcutaneous injection. It contains the same amount of iron as the official salt but a larger content of ammonium citrate, and is claimed to cause less coagulation of proteins on injection than the official iron and ammonium citrate: Dose hypodermically, from ¼ to 1½ grains (0.015 to 0.1 gm.).

FERRI HYDROXIDUM CUM MAGNESII OXIDO. U. S. Ferric Hydroxide with Magnesium Oxide

[**Ferr. Hydrox. cum Mag. Oxid.**—Arsenic Antidote, Ferric Hydrate with Magnesia]

	Metric	Alternative
Solution of Ferric Sulphate	**40 cc.**	**1 fl. oz. 134 min.**
Magnesium Oxide	**10 Gm.**	**146 gr.**
Water, a sufficient quantity.		

Mix the solution of ferric sulphate with 125 cc. [4 fl. oz.] of water, and keep the liquid in a large, well-stoppered bottle. Rub the magnesium oxide with cold water to a smooth, thin mixture, transfer this to a bottle capable of holding about 1000 cc. [2 pints], fill it with water to about three-fourths of its capacity, and keep it tightly stoppered. When the preparation is needed, shake the magnesium oxide mixture until of a thin, creamy consistence, slowly add to it the diluted solution of ferric sulphate, and shake them together until a uniformly smooth mixture results.

NOTE—In this process the 10 Gm. [146 gr.] of magnesium oxide may be replaced by 300 cc. [9½ fl. oz.] of magnesia magma, diluting it with sufficient water to make the required volume.

The diluted solution of ferric sulphate and the magnesia mixture should be kept on hand in separate bottles ready for immediate use so that the antidote may be quickly prepared.

Uses—Ferric hydroxide is produced when the mixture of magnesium oxide is added to the diluted solution of ferric tersulphate, and, as the magnesium oxide is in excess and acidity thus prevented, no harm can result from not separating the by-products of the reaction. It contains, in addition to the ferric hydroxide, magnesium sulphate and hydroxide. The alternative use of milk of magnesia to replace the magnesium oxide mixture, as suggested by the Pharmacopœial note, is due to the difficulty experienced in keeping the magnesia-water mixture over an extended period without its solidifying. The magnesia magma exhibits no such tendency to become solid.

This preparation is used only as an antidote for arsenic poisoning. Because of the need of promptness in such emergency and as it is only efficient when freshly prepared, the pharmacist should always keep the solutions on hand ready for extemporaneous mixture.

Average dose—Four fluidounces (120 cc.).

SYRUPUS FERRI IODIDI. U. S. Syrup of Ferrous Iodide

Syrup of Ferrous Iodide contains not less than 6.5 Gm. and not more than 7.5 Gm. of FeI_2 in each 100 cc., representing approximately 5 per cent of FeI_2 (309.68), by weight.

This syrup is prepared by forming a solution of ferrous iodide by acting on iron wire with iodine in the presence of water; the details of the process will be found on page 276. The green solution of ferrous iodide, thus prepared, is then protected by the addition of sugar, and the syrup is poured into small, well-stoppered bottles which are to be completely filled. A small amount of diluted hypophosphorous acid is added to aid in its preservation. The syrup is often stored so that it will be exposed to bright daylight, to prevent the separation of free iodine, which is irritating. When an aqueous solution of iodine is exposed to light, colorless hydriodic acid is formed, and this is measurably protected from change through the intervention of the syrup.

Description and Physical Properties—A transparent, pale yellowish-green, syrupy liquid having a sweet, strongly ferruginous taste and a slightly acid reaction.

Specific gravity: about 1.37 at 25° C.

Tests for Identity—Add a few drops of potassium ferricyanide T.S. to 5 cc. of Syrup of Ferrous Iodide: a blue precipitate is produced.

Mix 5 cc. of Syrup of Ferrous Iodide with a few drops of starch T.S. and add three drops of chlorine T.S.: the liquid acquires a deep blue color.

Tests for Purity—No blue color is produced in Syrup of Ferrous Iodide by starch T.S. alone (*free iodine*).

Assay—Place exactly 10 cc. of Syrup of Ferrous Iodide in a flask, dilute it with 30 cc. of distilled water, add 50 cc. of tenth-normal silver nitrate and 5 cc. of nitric acid, and heat on a water bath until the precipitate of silver iodide is yellow. Cool, add 2 cc. of ferric ammonium sulphate T.S., and determine the residual silver nitrate by titration with tenth-normal potassium thiocyanate. Each cc. of tenth-normal silver nitrate corresponds to 0.01548 Gm. of FeI_2.

This assay is explained on page 1462.

Preserve in completely filled, tightly-stoppered bottles.

Uses—It is used as an alterative, the dose being from ten to thirty minims (0.6 to 2 cc.); it should be largely diluted, and drawn through a glass tube to protect the teeth from injury.

FERRI PHOSPHAS SOLUBILIS. U. S. Soluble Ferric Phosphate

[Fer. Phos. Sol.—Ferri Phosphas U.S.P. IX, Ferric Phosphate with Sodium Citrate]

Soluble Ferric Phosphate is ferric phosphate rendered soluble by the presence of sodium citrate and contains not less than 12 per cent of Fe (55.84).

Preparation—No process is given in the Pharmacopœia for this scaled salt; the process of the U. S. P. 1890 is appended.

	Metric	Alternative
Ferric Citrate	**50 Gm.**	10 oz. av.
Sodium Phosphate, uneffloresced	**55 Gm.**	11 oz. av.
Distilled Water	**100 cc.**	19 fl. oz.

Dissolve the ferric citrate in the distilled water by heating on a water bath. To this solution add the sodium phosphate, and stir constantly until it is dissolved. Evaporate the solution, on a water bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that when dry, the salt may be obtained in scales.

This scaled salt is very different from the insoluble, slate-colored powder of iron phosphate formerly official. It is not a definite chemical compound, but is sometimes termed sodio-ferric citro-phosphate. It resembles the official ferric pyrophosphate in its physical appearance.

Description and Physical Properties—Thin, bright green, transparent scales or granules. It is without odor, and has an acidulous, slightly saline taste. The salt is stable in dry air when protected from light, but when unprotected soon becomes discolored.

Soluble Ferric Phosphate is freely soluble in water. It is insoluble in alcohol.

Tests for Identity—An aqueous solution of Soluble Ferric Phosphate (1 in 10) is slightly acid to litmus paper.

The addition of an excess of ammonia T.S. to an aqueous solution of Soluble Ferric Phosphate produces a reddish-brown color but no precipitate.

Boil about 0.1 Gm. of Soluble Ferric Phosphate with 5 cc. of sodium hydroxide T.S.: a brownish-red precipitate is produced without the evolution of ammonia (*ammonium salts*).

Remove the iron from 10 cc. of an aqueous solution of Soluble Ferric Phosphate (1 in 10) by boiling it with an excess of sodium hydroxide T.S., filter out the precipitate, and strongly acidulate the filtrate with hydrochloric acid: a cooled portion of this liquid mixed with an equal volume of magnesia mixture T.S. and treated with a slight excess of ammonia T.S. produces an abundant white, crystalline precipitate. This precipitate after washing turns yellow when treated with a few drops of silver nitrate T.S. (*distinction from pyrophosphate*).

Assay—Dissolve about 1 Gm. of Soluble Ferric Phosphate, accurately weighed, in 25 cc. of distilled water and 15 cc. of hydrochloric acid, in a glass-stoppered bottle, then add 3 Gm. of potassium iodide, securely stopper the bottle, and keep it at a temperature of 40° C. for thirty minutes. Then cool, and titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1467.

Preserve in well-closed containers, protected from light.

N. F. Preparations—Elixir Cinchonæ Alkaloidorum et Ferri; Elixir Gentianæ et Ferri Phosphatis; Liquor Phosphatum Compositum; Syrupus Ferri, Quininæ et Strychninæ Phosphatum.

Uses—This is a non-astringent ferruginous tonic frequently used in anemia. It is given in doses of four to ten grains (0.25 to 0.65 Gm.).

FERRI SULPHAS. U. S. Ferrous Sulphate

[Ferr. Sulph.—Iron Protosulphate]

Ferrous Sulphate contains not less than 54.36 and not more than 57.07 per cent of anhydrous ferrous sulphate, corresponding to about 99.5 per cent of the crystallized salt [$FeSO_4.7H_2O = 278.01$].

Preparation—This salt is never made by the pharmacist, because the commercial article is sold at a very low price. The following is a former official British process:

Take of iron wire, 4 oz. av.; sulphuric acid, 4 fl. oz. [Imperial measure]; distilled water, 1½ pints [Imperial measure]. Pour the water on the iron placed in a porcelain dish, add the sulphuric acid, and, when the evolution of gas has nearly ceased, boil for ten minutes. Filter promptly through paper, and, after the lapse of twenty-four hours, separate the crystals which have been deposited from the solution. Let these be dried on filter paper placed on porous bricks, and be preserved in a stoppered bottle.

The salt is a by-product in the manufacture of hydrogen, the following being the reaction:

$$\underset{\text{iron}}{Fe_2} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{2H_2SO_4} = \underset{\substack{\text{ferrous}\\\text{sulphate}}}{2FeSO_4} + \underset{\text{hydrogen}}{4H}$$

Description and Physical Properties—Pale, bluish-green, monoclinic prisms. It is odorless and has a saline, styptic taste. The salt is efflorescent in dry air, but on exposure to moist air, the crystals rapidly oxidize and become coated with brownish-yellow, basic ferric sulphate. When it has thus deteriorated, the salt must not be used for any official or medicinal purpose.

One Gm. of Ferrous Sulphate is soluble in 1.4 cc. of water at 25° C. and in 0.4 cc. of boiling water. It is insoluble in alcohol.

When slowly heated to 115° C., the crystals disintegrate and the salt loses the greater part of its water of crystallization.

Tests for Identity—An aqueous solution of the salt (1 in 20) is acid to litmus paper.

Ferrous Sulphate responds to the reactions for ferrous salts, page 710, and for sulphates, page 581.

Tests for Purity—Dissolve 1 Gm. of the salt in about 50 cc. of distilled water containing 1 cc. of diluted sulphuric acid, heat the solution to boiling, oxidize it with nitric acid, mix it with a slight excess of ammonia T.S., and filter: the filtrate is colorless and after acidulating with hydrochloric acid meets the requirements of the test for *heavy metals*, page 1519.

Agitate 1 Gm. of Ferrous Sulphate, in small fragments, during four or five minutes with 10 cc. of alcohol, and filter the mixture: the filtrate does not immediately redden moistened blue litmus paper (*free acid*).

Assay—Dissolve about 1 Gm. of Ferrous Sulphate, accurately weighed, in 25 cc. of diluted sulphuric acid, and titrate with tenth-normal potassium permanganate until a permanent pink color is produced. Each cc. of tenth-normal potassium permanganate corresponds to 0.01519 Gm. of $FeSO_4$.

This assay is explained on page 1474.

Preserve in well-closed containers.

U. S. P. Preparations—Ferri Carbonas Saccharatus; Ferri Sulphas Exsiccatus; Ferri Sulphas Granulatus; Liquor Ferri Tersulphatis; Massa Ferri Carbonatis.

N. F. Preparation—Liquor Ferri Subsulphatis.

Uses—This is a very astringent iron salt. When used internally the exsiccated or granulated salt is preferred. The impure ferrous sulphate, called *copperas*,[1] is used as a disinfectant. The name, *green vitriol* is also applied to this salt. The dose of the sulphate is one to three grains (0.065 to 0.2 Gm.).

FERRI SULPHAS EXSICCATUS. U. S. Exsiccated Ferrous Sulphate

[**Ferr. Sulph. Exsic.**—Dried Ferrous Sulphate]

Exsiccated Ferrous Sulphate contains the equivalent of not less than 80 per cent of anhydrous ferrous sulphate [$FeSO_4 = 151.90$].

	Metric	Alternative
Ferrous Sulphate, in coarse powder.....	**100 Gm.**	25 oz. av.

Allow the salt to effloresce at a temperature of about 40° C. in dry air, and then heat it in a tared porcelain dish on a water bath, constantly stirring, until the product weighs from 64 to 65 Gm. [16 oz. av.]. Reduce the residue to a fine powder, and transfer it at once to dry bottles, which should be stoppered immediately.

[1] This unfortunate synonym, "*copperas*," has led to a great many errors, through the impression that this salt must contain copper. It is often confounded with the poisonous copper sulphate, or blue vitriol, and they have been substituted for each other.

This process does not deprive the ferrous sulphate of all of its water of crystallization, about 15 per cent being retained. One hundred parts of crystallized sulphate yield about 64 per cent of the exsiccated salt.

The reason for exposing it first to a temperature of 40° C. is that if a higher temperature is applied at the start, the salt melts in its water of crystallization and subsequent drying is much more difficult.

Description and Physical Properties —A grayish-white powder, slowly soluble in water.

Tests for Identity and Purity—A solution of the salt (1 in 20) in recently boiled distilled water is not more than slightly turbid, and when taken in proportionate amount, conforms to the reactions and tests under *Ferri Sulphas*, except the test for free acid.

Assay —Dissolve about 0.8 Gm. of Exsiccated Ferrous Sulphate, accurately weighed, in 25 cc. of diluted sulphuric acid, and titrate with tenth-normal potassium permanganate until a permanent pink color is produced. Each cc. of tenth-normal potassium permanganate corresponds to 0.01519 Gm. of $FeSO_4$.

This assay is explained on page 1474.

Preserve in tightly-stoppered bottles.

N. F. Preparations—Pilulæ Aloes et Ferri; Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ.

Uses—Exsiccated ferrous sulphate is a grayish-white powder, and is principally used in making pills, the crystallized sulphate being unfitted for the purpose on account of the large proportion of water that it contains. Five grains of the crystals are represented by three grains of the exsiccated sulphate. It must be kept in tightly-closed containers to prevent the absorption of moisture. The dose is one grain (0.065 Gm.).

FERRI SULPHAS GRANULATUS. U. S. Granulated Ferrous Sulphate

[**Ferr. Sulph. Gran.**—Precipitated Ferrous Sulphate]

	Metric	Alternative
Ferrous Sulphate	**100 Gm.**	4 oz. av.
Distilled Water	**100 cc.**	4 fl. oz.
Diluted Sulphuric Acid	**5 cc.**	1½ fl. dr.
Alcohol	**25 cc.**	1 fl. oz.

Add the diluted sulphuric acid to the distilled water, heat to boiling, dissolve the ferrous sulphate in the liquid, and filter the solution while hot. Evaporate the solution immediately in a tared porcelain dish on a sand bath until it weighs 150 Gm. [6 oz. av.], and cool it quickly with constant stirring. Transfer the product to a glass funnel fitted with a pledget of purified cotton, and when it has thoroughly drained pour the alcohol upon it. When this has also drained, spread the crystalline powder on bibulous paper, dry it quickly at room temperature, and transfer it at once to dry bottles, which should be stoppered immediately.

Description and Physical Properties—A pale, bluish-green, crystalline powder, which meets the requirements of the tests for identity and purity and the assay under *Ferri Sulphas*.

Preserve in tightly-stoppered bottles.

U. S. P. Preparation—Pilulæ Ferri Carbonatis.

Ferrous sulphate is insoluble in alcohol; hence, if a strong aqueous solution is poured into alcohol, it is precipitated in the form of a granular crystalline powder, and this method was used in the U. S. P. 1880 for preparing this salt. The process of subsequent Pharmacopœias differed in that the sulphate is not precipitated but granulated by evaporation and cooling, with constant stirring, and subsequently washing with alcohol to free it from impurities and to facilitate the drying of the granules.

Uses—Granulated ferrous sulphate should be used in preference to the large crystals at the prescription counter, the soluble impurities being washed out by the alcohol. It is much less liable to oxidation and change than the ordinary crystallized sulphate. The dose is about one and one-half grains (0.1 Gm.).

LIQUOR FERRI ET AMMONII ACETATIS. U.S. Solution of Iron and Ammonium Acetate

[**Liq. Ferr. et Ammon. Acet.**—BASHAM'S MIXTURE]

Solution of Iron and Ammonium Acetate contains, in each 100 cc., ammonium acetate corresponding to not less than 0.6 Gm. and not more than 0.8 Gm. of NH_3(13.03), and not less than 0.16 Gm. and not more than 0.20 Gm. of Fe (55.84).

Caution—This preparation must not be dispensed unless it has been recently prepared.

	Metric	Alternative
Tincture of Ferric Chloride	**40 cc.**	4 fl. dr.
Diluted Acetic Acid	**60 cc.**	6 fl. dr.
Solution of Ammonium Acetate	**500 cc.**	6¼ fl. oz.
Aromatic Elixir	**120 cc.**	1½ fl. oz.
Glycerin	**120 cc.**	1½ fl. oz.
Distilled Water, a sufficient quantity, To make	**1000 cc.**	12½ fl. oz.

To the solution of ammonium acetate (which must be slightly acid) add, successively, the diluted acetic acid, the tincture of ferric chloride, the aromatic elixir, and the glycerin, and lastly enough distilled water to make the product measure 1000 cc. [12½ fl. oz.].

While an excess of acid is necessary to avoid the precipitation of basic ferric acetate, yet care should be taken to avoid a large excess, since extreme acidity makes the solution unnecessarily disagreeable.

This solution is not intended to be permanent, and in time will decompose; besides, the freshly prepared solution, containing dissolved carbonic acid, is more agreeable to the taste than one which is "flat", hence the directions to prepare as needed.

Uses—This is a mild ferruginous solution, used especially in kidney diseases. The dose is four fluidrachms (15 cc.).

Description and Physical Properties—A clear, reddish-brown liquid, having an aromatic odor. Specific gravity: about 1.039 at 25° C.

Tests for Identity—The solution is acid to litmus paper.

The Solution yields a blue precipitate with potassium ferrocyanide T.S. No precipitate is produced upon the addition of ammonia T.S.

When Solution of Iron and Ammonium Acetate is heated with sodium hydroxide T.S., ammonia is evolved.

Add 1 cc. each of sulphuric acid and alcohol to 5 cc. of the Solution and boil the mixture: ethyl acetate is formed, recognizable by its odor.

Assay for Ammonia—Transfer to a distilling flask with the aid of distilled water exactly 25 cc. of Solution of Iron and Ammonium Acetate, and add sufficient distilled water to make about 200 cc. Add 20 cc. of 20 per cent sodium hydroxide solution, and distil about 150 cc., receiving the distillate in 40 cc. of half-normal sulphuric acid. Titrate the excess of acid with half-normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of half-normal sulphuric acid corresponds to 0.008520 Gm. of NH_3.

This assay is explained on page 1457.

Assay for Iron—Transfer to a dish with the aid of a little distilled water exactly 25 cc. of Solution of Iron and Ammonium Acetate. Evaporate to dryness and gently ignite. Heat the residue with 10 cc. of hydrochloric acid, and, when all of the iron has dissolved, add 10 cc. of solution of hydrogen dioxide, and evaporate to dryness on a water bath. Add 5 cc. of hydrochloric acid, warm until all is dissolved, and transfer the solution to a glass-stoppered flask with the aid of about 30 cc. of distilled water. Add about 2 Gm. of potassium iodide, allow to stand for thirty minutes at about 40° C., cool, and titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1467.

LIQUOR FERRI TERSULPHATIS. U.S. Solution of Ferric Sulphate

[Liq. Ferr. Tersulph.—Solution of Iron Tersulphate]

An aqueous solution containing normal ferric sulphate [$Fe_2(SO_4)_3$ = 151.90], corresponding to not less than 9.5 per cent and not more than 10.5 per cent of Fe (55.84).

	Metric	Alternative
Ferrous Sulphate	**500 Gm.**	12 oz. av. 19 gr.
Sulphuric Acid	**96 Gm.**	1 fl. oz. 103 min.
Nitric Acid,		
Distilled Water, each, a sufficient quantity,		
To make	**1000 Gm.**	1 pint

Add the sulphuric acid to about 250 cc. [3¾ fl. oz.] of distilled water in a tared, capacious porcelain dish, heat the mixture to nearly 100° C., then add 56 Gm. [7 fl. dr.] of nitric acid, and mix well. Divide the ferrous sulphate, coarsely powdered, into four approximately equal portions, and add these portions one at a time to the hot liquid, stirring after each addition until effervescence ceases. When all of the ferrous sulphate is dissolved, if the solution has acquired a black color, add nitric acid, a few drops at a time, heating and stirring until red fumes cease to be evolved, and the solution assumes a clear reddish-brown color; then boil the liquid until it is free from nitric acid, as indicated by the test given below. During the heating add distilled water from time to time to maintain about the original volume. Lastly, add enough distilled water to make the product weigh 1000 Gm. [or measure 1 pint]. Filter, if necessary.

This solution differs from the solution of ferric subsulphate merely in containing a larger proportion of sulphuric acid. It has the sp. gr. 1.432, and is a solution of the *true* tersulphate, $Fe_2(SO_4)_3$, or normal ferric sulphate. The reaction for solution of ferric sulphate is shown by the following equation:

$$\underset{\text{ferrous sulphate}}{6FeSO_4} + \underset{\text{sulphuric acid}}{3H_2SO_4} + \underset{\text{nitric acid}}{2HNO_3} = \underset{\text{ferric sulphate}}{3Fe_2(SO_4)_3} + \underset{\text{nitrogen dioxide}}{2NO} + \underset{\text{water}}{4H_2O}$$

Description and Physical Properties—A reddish-brown liquid, almost odorless, having an acid, strongly styptic taste, and an acid reaction.

Solution of Ferric Sulphate is miscible with water and alcohol.

Specific gravity: about 1.432 at 25° C.

Tests for Identity—Solution of Ferric Sulphate responds to the reactions for ferric iron, page 710, and for sulphates, page 581.

Tests for Purity—Mix 1 cc. of the Solution with 10 cc. of ferrous sulphate T.S. and superimpose it upon 5 cc. of sulphuric acid contained in a test tube: the line of contact does not assume a brown or brownish-black color (*nitrate*).

Add a few drops of freshly prepared potassium ferricyanide T.S. to 2 cc. of an aqueous dilution of the Solution (1 in 20): a brown color is produced without a tinge of green or greenish-blue (*ferrous salt*).

Assay—Transfer about 1.5 Gm. of Solution of Ferric Sulphate to a tared flask, stopper and weigh accurately, then add 5 cc. of hydrochloric acid, 25 cc. of distilled water, and 2 Gm. of potassium iodide, securely stopper the flask, and allow the mixture to stand for thirty minutes at a temperature of 40° C. Cool the liquid, dilute it with 50 cc. of distilled water, and titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1467.

U. S. P. Preparation—Ferri Hydroxidum cum Magnesii Oxido.

N. F. Preparation—Liquor Ferri Citratis.

Uses—This solution is largely used in pharmacy for preparing ferric hydroxide by precipitation with ammonia water (see p. 732). From this many of the iron salts and solutions are made. It is not used medicinally to any extent, the solution of the subsulphate being preferred.

FERRUM ALBUMINATUM. N. F. Albuminized Iron

[Ferr. Albumin.—Iron Albuminate]

Albuminized Iron is a compound of iron oxide and albumin, rendered soluble by the presence of sodium citrate. It contains not less than 17 per cent and not more than 19 per cent of Fe.

Description and Physical Properties—Reddish brown, lustrous granules, or a brown powder. It is odorless, or has not more than a slight odor.

Albuminized Iron is freely soluble in water yielding dark solutions. It is almost insoluble in alcohol.

Tests for Identity—The addition of acids to an aqueous solution of Albuminized Iron produces a precipitate which dissolves by warming with an excess of hydrochloric acid. The resulting solution yields the reactions characteristic of ferric iron.

An aqueous solution of Albuminized Iron (1 in 20) is neutral or slightly alkaline to litmus paper.

An aqueous solution (1 in 50) yields no blue color upon the addition of potassium ferrocyanide T.S. (absence of *ionic iron*).

Tests for Purity—Dissolve 1 Gm. of Albuminized Iron in 50 cc. of distilled water. Render the solution slightly alkaline, if necessary, by the addition of sodium hydroxide T.S., and precipitate the iron from the solution with hydrogen sulphide. Filter, add to the filtrate 5 cc. of diluted hydrochloric acid and evaporate almost to dryness on the water bath. Dissolve the residue in 10 cc. of distilled water, and to 5 cc. of the solution, rendered slightly alkaline with sodium hydroxide, add 2 cc. of alkaline cupric tartrate solution and heat. No red precipitate is produced (*sugar*).

Assay—Weigh accurately about 0.5 Gm. of Albuminized Iron and ignite it in a crucible to destroy the organic matter. Allow to cool, transfer the residue completely into a beaker, add 10 cc. of hydrochloric acid, heat until all the iron is dissolved, then add 10 cc. of hydrogen dioxide T.S., and evaporate almost to dryness on the water bath. Dissolve the residue by warming with 5 cc. of hydrochloric acid and 10 cc. of water and transfer the solution completely into a glass-stoppered flask, filtering if necessary, and washing the residue, and filter with small quantities of hot water until free from iron. Now add to the solution 3 Gm. of potassium iodide, allow to stand for one-half hour at about 40° C., cool and titrate the liberated iodine with tenth-normal sodium thiosulphate. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of iron (Fe).

This assay is explained on page 1467.

N. F. Preparation—Liquor Ferri Albuminati.

Uses—Albuminized iron was added to the N. F. for the preparation of the solution (see page 724). It is a blood tonic in doses of eight grains (0.5 Gm.).

LIQUOR FERRI ALBUMINATI. N. F. Solution of Albuminized Iron

[Liq. Ferr. Albumin.—Solution of Iron Albuminate]

	Metric	Alternative
Albuminized Iron	**50 Gm.**	1 oz. av. 293 gr.
Cinnamon Water	**200 cc.**	6 fl. oz. 192 min.
Aromatic Elixir	**400 cc.**	12 fl. oz. 384 min.
Alcohol	**120 cc.**	3 fl. oz. 403 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the albuminized iron in the cinnamon water and 150 cc. [4 fl. oz. 384 min.] of distilled water, add the aromatic elixir, the alcohol and sufficient distilled water to make the product measure 1000 cc. [2 pints]. Allow it to stand twelve hours, and filter.

In the N. F. IV this solution was prepared by mixing 180 cc. of fresh egg albumin with 130 Gm. of freshly made solution of ferric oxychloride, with constant stirring, and allowing the mixture to stand for two hours. Then a solution of 12.5 Gm. of sodium citrate in 100 cc. of water was added, followed by the amounts of alcohol and aromatic elixir given above and then distilled water to make 1000 cc.

Solution of Albuminized Iron is a clear, yellowish brown liquid, having an aromatic odor, and an aromatic taste.

Specific gravity: about 1.044 at 25° C.

Evaporate 10 cc. of the Solution on a water bath; it leaves not more than 1.661 Gm. of residue. Incinerate the residue from 10 cc. of the Solution; it leaves not more than 0.0625 Gm. of ash.

Dilute 5 cc. of the solution with 5 cc. of distilled water and add 1 cc. of hydrochloric acid and a few drops of potassium sulphocyanate T.S.: a blood red color is formed (*ferric iron*).

Preserve the Solution in dark amber-colored bottles.

Uses—It is used as a blood tonic in a dose of from one to two fluidrachms (4 to 8 cc.).

LIQUOR FERRI CITRATIS. N.F. Solution of Ferric Citrate

[Liq. Ferr. Cit.]

An aqueous solution containing ferric citrate corresponding to not less than 8.75 Gm. of Fe in each 100 cc.

	Metric	Alternative
Solution of Ferric Sulphate	**730 cc.**	23 fl. oz. 173 min.
Citric Acid	**375 Gm.**	12 oz. av. 226 gr.
Ammonia Water	**1100 cc.**	35 fl. oz. 96 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the ammonia water with 3000 cc. [6 pints] of cold water, and the solution of ferric sulphate with 10,000 cc. [20 pints] of cold water. Add the latter solution slowly to the diluted ammonia water, stirring constantly. Pour the mixture upon a wet muslin strainer, and allow the liquid to run off and the precipitate to drain. Then remove the moist mass from the strainer, mix it well with 6000 cc. [12 pints] of cold water, again pour it on the strainer, and let it drain. Repeat this washing with several successive portions of cold water, in the same manner, until the washings cease to produce more than a faint cloudiness with barium chloride T.S. Then allow the precipitate to drain completely, transfer it to a porcelain dish, add the citric acid, and heat the mixture on a water bath to 60° C., stirring constantly until the magma is dissolved. Lastly, filter the liquid, and evaporate it, at the above-mentioned temperature, until it measures 1000 cc. [2 pints].

Solution of Ferric Citrate is a dark reddish brown liquid, having a characteristic odor suggestive of caramel, and a saline, ferruginous and slightly astringent taste. It is acid to litmus paper.

Specific gravity: about 1.262 at 25° C.

Heat the Solution of Ferric Citrate with potassium hydroxide T.S.: it yields a brownish-red precipitate, without evolving ammonia (*difference from solution of Iron and Ammonium citrate*).

Precipitate the iron from Solution of Ferric Citrate by boiling with an excess of potassium hydroxide T.S., and acidulate the filtrate slightly with acetic acid: a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually afford a white, crystalline precipitate.

Another portion of the acidulated and cooled liquid, when allowed to stand for twenty-four hours, does not deposit a white, crystalline precipitate (*tartrates*).

Assay—Add 2 cc. of the Solution, accurately measured, to 2 cc. of hydrochloric acid and 10 cc. of solution of hydrogen dioxide and evaporate to dryness. Dissolve the residue in 2 cc. of hydrochloric acid and 40 cc. of distilled water, transfer to a flask, add 2 Gm. of potassium iodide, stopper the flask and warm the mixture to 40° C. for thirty minutes. Then cool and titrate the liberated iodine with tenth-normal sodium thiosulphate.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe. Each cc. of Solution of Ferric Citrate corresponds to not less than 15.7 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1467.

Preserve the Solution in dark amber-colored bottles.

Uses—It is used as an iron tonic in doses of ten minims (0.6 cc.).

FERRI GLYCEROPHOSPHAS. N.F. Ferric Glycerophosphate

[Ferr. Glycerophos.—Ferric Glycerinophosphate]

Ferric Glycerophosphate contains a variable quantity of $Fe_2(C_3H_7O_6P)_3$(622.02) corresponding to not less than 14 per cent and not more than 16 per cent of Fe.

Preparation—It may be prepared by adding solution of ferric sulphate to solution of barium glycerophosphate, filtering out the barium sulphate and evaporating the filtrate or by dissolving ferric hydroxide in glycerophosphoric acid and evaporating the solution.

$$\underset{\text{ferric sulphate}}{Fe_2(SO_4)_3} + \underset{\text{barium glycerophosphate}}{3Ba(C_3H_5(OH)_2PO_4)} = \underset{\text{barium sulphate}}{3BaSO_4} + \underset{\text{ferric glycerophosphate}}{Fe_2(C_3H_5(OH)_2PO_4)_3}$$

Description and Physical Properties—Ferric Glycerophosphate occurs as yellowish-green, transparent, amorphous scales or as a greenish-yellow powder; odorless and nearly tasteless.

One Gm. dissolves slowly in about 2 cc. of water at 25° C.; insoluble in alcohol. An aqueous solution is acid to litmus and becomes turbid when heated.

Tests for Identity—An aqueous solution of the salt (1 in 20) is colored dark blue by potassium ferrocyanide T.S.; on the subsequent addition of hydrochloric acid a dark blue precipitate is produced.

Heat a powdered mixture of about 0.1 Gm. of the salt with about 0.5 Gm. of potassium bisulphate; the pungent vapors of acrolein are evolved.

Tests for Purity—Not more than a slight yellow turbidity is produced at once on mixing 5 cc. of an aqueous solution of the salt (1 in 50) with 10 cc. of ammonium molybdate T.S. (*phosphate*), but on standing or on warming, a yellow precipitate is formed.

An aqueous solution of the salt (1 in 50), acidulated with hydrochloric acid, does not become more than slightly turbid on the addition of barium chloride T.S. (*sulphate*).

Another portion of this aqueous solution, acidulated with nitric acid, does not become more than slightly turbid on the addition of silver nitrate T.S. (*chloride*).

Assay—Dissolve about 0.5 Gm. of Ferric Glycerophosphate, accurately weighed, in 50 cc. of distilled water, in a 100 cc. glass-stoppered flask, add 5 cc. of hydrochloric acid and about 3 Gm. of potassium iodide. Warm to 40° C., and allow the mixture to stand one-half hour at this temperature in the stoppered flask, cool, and then titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe. Each Gm. of Ferric Glycerophosphate corresponds to not less than 25.07 cc. nor more than 28.65 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1467.

Preserve it in well-closed containers, protected from light.

N. F. Preparation—Elixir Glycerophosphatum Compositum.

Uses—It is used as a tonic and alterative, chiefly in the compound elixir. The dose is three grains (0.2 Gm.).

FERRIC HYPOPHOSPHIS. N. F. Ferric Hypophosphite

[Ferr. Hypophos.]

Ferric Hypophosphite contains not less than 98 per cent of $Fe(PH_2O_2)_3$ (251.01), corresponding to not less than 21.8 per cent of Fe.

Preparation—This is among the hypophosphites brought into notice in consequence of their recommendation by Doctor Churchill in the treatment of phthisis in which they were thought to be useful by the introduction of phosphorus into the system. This particular salt may be considered preferable to others when a marked condition of anemia indicates a deficiency of iron in the tissues. It may be made by the action of hypophosphorous acid on ferrous carbonate; but, as some difficulty has been found in obtaining this acid perfectly pure, preference has been given to the plan of double decomposition. This salt may be made by causing ferrous sulphate and calcium hypophosphite to react on each other in molecular proportions represented by 480 grains of crystallized ferrous sulphate and 299 grains of calcium hypophosphite—in the latter an allowance of 2 per cent being made for impurities ordinarily found in that salt. These quantities will yield about 320 grains of ferric hypophosphite and the reaction will be represented by the following formula:

$$\underset{\text{calcium hypophosphite}}{Ca(PH_2O_2)_2} + \underset{\text{ferrous sulphate}}{FeSO_4} = \underset{\text{calcium sulphate}}{CaSO_4} + \underset{\text{ferrous hypophosphite}}{Fe(H_2PO_2)_2}$$

Calcium sulphate is precipitated, and ferrous hypophosphite is held in solution. In this condition the salt is a ferrous compound, but on evaporation the ferrous salt becomes ferric, and acquires the properties detailed in the National Formulary.

Description and Physical Properties—Ferric Hypophosphite occurs as a white, or grayish-white powder, odorless and nearly tasteless; permanent in the air.

One Gm. dissolves in 2300 cc. of water at 25° C. and in 1200 cc. of boiling water; more readily soluble in the presence of hypophosphorous acid or in a warm, concentrated solution of an alkali citrate, forming with the latter a green solution.

Tests for Identity—When strongly heated in a dry test tube, the salt evolves spontaneously inflammable hydrogen phosphide gas, and finally leaves a residue of ferric pyrophosphate.

Ferric Hypophosphite is readily oxidized by nitric acid or other oxidizing agents.

Tests for Purity—Add 15 cc. of acetic acid to 1 Gm. of the salt; no effervescence occurs (*carbonate*). Heat the mixture to boiling and filter; the filtrate responds to the following tests.

Add to a portion of the filtrate a few drops of silver nitrate T.S. and warm; a brown to black coloration or precipitate is produced. To another portion of the filtrate add, drop by drop, an excess of mercuric chloride T.S.; a white precipitate of mercurous chloride is formed upon gently heating.

Another 5 cc. portion of the filtrate shows no turbidity with ammonium oxalate T.S. (*calcium*).

Dissolve 1 Gm. of the salt in 20 cc. of diluted hydrochloric acid, with the aid of heat, and add 1 cc. of barium chloride T.S.; not more than a slight turbidity is produced (*sulphate*).

Boil 0.5 Gm. of the salt with 10 cc. of sodium hydroxide T.S.: a reddish-brown precipitate is produced. Filter this mixture, slightly acidulate the filtrate with hydrochloric acid, add magnesia mixture T.S., and then an excess of ammonia water; no crystalline precipitate is produced (*phosphate*).

Dissolve 1 Gm. of the salt in about 25 cc. of boiling distilled water by the aid of sufficient hydrochloric acid, added, drop by drop, then add 2 cc. of nitric acid, boil and add a slight excess of ammonia water; the filtrate is colorless, and after acidulating with hydrochloric acid does not respond to the test for heavy metals (see page 1519).

Assay—To 1 Gm. of Ferric Hypophosphite accurately weighed, add 10 cc. of nitrohydrochloric acid and evaporate to dryness on a water bath. Dissolve the residue in 25 cc. of distilled

water and 10 cc. of hydrochloric acid, transfer the solution to a glass-stoppered flask, add 3 Gm. of potassium iodide, keep it at 40° C. for thirty minutes, cool and titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe, and 0.025101 Gm. of $Fe(PH_2O_2)_3$. Each Gm. of Ferric Hypophosphite requires not less than 39.04 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1467.

Preserve it in well-closed containers.

N. F. Preparations—Liquor Hypophosphitum Compositus, Syrupus Hypophosphitum Compositus.

Uses—Ferric hypophosphite is rarely used except as an ingredient of the syrup or elixir of hypophosphites. It has the hematinic action of the iron salts in general. The dose is from three to ten grains (0.2 to 0.6 Gm.).

FERRI LACTAS. N.F. Ferrous Lactate

[**Ferr. Lact.**—IRON LACTATE]

Ferrous Lactate contains not less than 97 per cent of Fe $(C_3H_5O_3)_2.3H_2O$ (288.00).

Preparation—It may be made by digesting iron filings with lactic acid until a neutral solution is produced, filtering and crystallizing.

Description and Physical Properties—Ferrous Lactate occurs as a greenish-white, crystalline powder, or in crystalline masses, having a slight, characteristic odor, and a mild, sweet and ferruginous taste.

One Gm. dissolves slowly but almost completely in 40 cc. of water at 25° C., and in 12 cc. of boiling water; freely soluble in solutions of the alkali citrates yielding a green-colored solution; almost insoluble in alcohol.

Tests for Identity—When strongly heated, the salt froths, gives out dense, white, acrid fumes, then chars and finally leaves a brownish-red residue.

An aqueous solution of the salt is greenish-yellow, slightly acid to litmus and separate portions give a deep blue precipitate with potassium ferricyanide T.S., and a light blue precipitate with potassium ferrocyanide T.S.

Tests for Purity—Separate portions of an aqueous solution of the salt (1 in 20), acidulated with nitric acid, do not give more than a slight opalescence with barium chloride T.S. (*sulphate*), or with silver nitrate T.S. (*chloride*).

Mix 25 cc. of an aqueous solution of the salt (1 in 50) with 5 cc. of diluted sulphuric acid, boil the mixture for a few minutes, then precipitate the iron by an excess of sodium hydroxide T.S., and filter; the filtrate, mixed with a few drops of alkaline cupric tartrate solution and heated to boiling, does not give a red precipitate (*sugar*).

A portion of the salt triturated with sulphuric acid does not develop an offensive odor (*butyric acid*); this mixture, after standing for five minutes, does not assume a brown color (*readily carbonizable impurities*).

Ignite 1 Gm. of the salt; the residue is not alkaline to moistened litmus paper, and does not contain anything soluble in water.

Assay—Dissolve, in a glass-stoppered flask, about 0.5 Gm. of Ferrous Lactate, accurately weighed, in 15 cc. of solution of hydrogen dioxide and 5 cc. of hydrochloric acid, and evaporate this solution on a water bath to 5 cc. Add 3 cc. of hydrochloric acid, boil the mixture for two minutes, cool to 40° C. and add 25 cc. of distilled water and 1 Gm. of potassium iodide. Allow this mixture to stand for one-half hour at 40° C., cool and then titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.0288 Gm. of $Fe(C_3H_5O_3)_2.3H_2O$. Each Gm. of Ferrous Lactate requires not less than 33.7 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1467.

Preserve it in well-closed containers.

N. F. Preparation—Syrupus Calcii Lactophosphatis et Ferri.

Uses—Used much like other iron tonics; it is especially known for its absence of marked astringency. Given in doses of two to ten grains (0.13 to 0.6 Gm.).

FERRI OXIDUM SACCHARATUM. N.F. Saccharated Ferric Oxide

[**Ferr. Oxid. Sacch.**—SOLUBLE FERRIC OXIDE, FERRUM OXYDATUM SACCHARATUM, EISENZUCKER]

Saccharated Ferric Oxide contains the equivalent of not less than 2.8 per cent of Fe.

	Metric	Alternative
Solution of Ferric Chloride	**300 Gm.**	2 oz. av. 175 gr.
Monohydrated Sodium Carbonate	**112 Gm.**	392 gr.
Water	**3000 cc.**	1½ pints
Sodium Hydroxide,		
Sucrose, in powder, each, a sufficient quantity,		
To make	**1000 Gm.**	8 oz. av.

Dilute the solution of ferric chloride with 1500 cc. [12 fl. oz.] of water and gradually add, with constant stirring, a solution of the monohydrated sodium carbonate in the remainder of the water. Wash the precipitate with water by decantation or siphoning until the washings, when diluted with five volumes of water, give only a slight opalescence with silver nitrate T.S. Then collect the precipitate on a cloth strainer, press it out, transfer the magma to a porcelain dish on a water bath, add 500 Gm. [4 oz. av.] of sucrose and a sufficient quantity (not more than 50 Gm. [175 gr.]) of a 15 per cent solution of sodium hydroxide to produce a clear solution. Evaporate the mixture to dryness on a water bath and if necessary add sufficient sucrose to make the product weigh 1000 Gm. [8 oz. av.].

An aqueous solution (1 in 20) yields no blue color with potassium ferrocyanide T.S.

Assay—Dissolve about 8 Gm. of Saccharated Ferric Oxide, accurately weighed, in 50 cc. of diluted hydrochloric acid; add 4 Gm. of potassium iodide and allow the solution to stand for thirty minutes at a temperature of 40° C. Cool the solution, dilute it with 100 cc. of distilled water and titrate the liberated iodine with tenth-normal sodium thiosulphate using starch T.S. as indicator.

Each cc. of tenth-normal sodium thiosulphate used corresponds to 0.005584 Gm. of Fe. Each Gm. of Saccharated Ferric Oxide corresponds to not less than 5.01 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1467.

N. F. Preparation—Syrupus Ferri Saccharati Solubilis.

Uses—This is a preparation of the German and Austrian Pharmacopœias and is a mild chalybeate. The dose is ten to thirty grains (0.6 to 2 Gm.).

FERRI PYROPHOSPHAS SOLUBILIS. N. F. Soluble Ferric Pyrophosphate [Ferr. Pyrophos. Sol.]

Soluble Ferric Pyrophosphate, rendered soluble by the presence of sodium citrate, and corresponding to not less than 10 per cent of Fe.

Preparation—It may be prepared by dissolving sodium pyrophosphate in a strong solution of an equal weight of ferric citrate, evaporating at not over 60° C. to syrupy consistence and scaling.

Description and Physical Properties—Soluble Ferric Pyrophosphate occurs in thin, apple-green, transparent scales, without odor, and having an acidulous slightly saline taste. The salt is permanent in dry air, when protected from light, but when unprotected soon becomes discolored.

It is freely and completely soluble in water; insoluble in alcohol. An aqueous solution of the salt is slightly acid to litmus.

Tests for Identity—Soluble Ferric Pyrophosphate, when boiled with sodium hydroxide T.S. produces a brownish-red precipitate without evolving ammonia.

Fuse 0.1 Gm. of the salt with 0.1 Gm. each of potassium nitrate and sodium carbonate, boil the residue with 10 cc. of distilled water and filter. The filtrate, after being rendered nearly, but not quite, neutral with highly dilute nitric acid, yields a yellow precipitate on the addition of silver nitrate T.S.

Tests for Purity—Boil an aqueous solution of the salt (1 in 10) with an excess of sodium hydroxide T.S. until the iron is precipitated, filter, strongly acidulate the filtrate with hydrochloric acid and cool. This liquid when mixed with an equal volume of magnesia mixture T.S., followed by a slight excess of ammonia water, yields a finely divided white precipitate, which, after collecting on a filter, and washing, does not turn yellow when treated with a few drops of silver nitrate T.S. (*phosphate*).

Assay—Dissolve about 1 Gm. of Soluble Ferric Pyrophosphate, accurately weighed, in 25 cc. of distilled water and 15 cc. of hydrochloric acid, in a glass-stoppered bottle, add 2 Gm. of potassium iodide, securely stopper the bottle, keep it at a temperature of 40° C. for thirty minutes, cool and then titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe.

This assay is explained on page 1467.

Preserve it in well-closed containers, protected from light.

N. F. Preparation—Elixir Ferri Pyrophosphatis, Quininæ et Strychninæ.

Uses—This is one of the best of the ferruginous tonics. It is very largely used on account of its solubility, freedom from astringency and the ease with which it can be administered either in pills or in solution. The dose is two to five grains (0.13 to 0.3 Gm.).

FERRUM PEPTONATUM. N. F. Peptonized Iron [Ferr. Pepton.—Iron Peptonate]

Peptonized Iron is a compound of iron oxide and peptone, rendered soluble by the presence of sodium citrate. It contains not less than 16 per cent and not more than 18 per cent of Fe.

Description and Physical Properties—Dark brown, lustrous granules, or a brown powder. It has a slight characteristic odor.

Peptonized Iron is freely soluble in water yielding dark solutions. It is almost insoluble in alcohol.

Tests for Identity—The addition of acids to an aqueous solution of Peptonized Iron produces a precipitate which dissolves upon warming with an excess of hydrochloric acid. The resulting solution yields the reactions characteristic of ferric iron.

An aqueous solution of Peptonized Iron (1 in 20) is neutral or slightly alkaline to litmus paper.

An aqueous solution (1 in 50) yields no blue color upon the addition of potassium ferrocyanide T.S. (absence of *ionic iron*).

Tests for Purity—Dissolve 1 Gm. of Peptonized Iron in 50 cc. of distilled water, render the solution slightly alkaline, if necessary, by the addition of sodium hydroxide T.S., and precipitate the iron from the solution with hydrogen sulphide. Filter, add to the filtrate 5 cc. of diluted hydrochloric acid and evaporate almost to dryness on the water bath. Dissolve the residue in 10 cc. of distilled water, and to 5 cc. of the solution, rendered slightly alkaline with sodium hydroxide, add 2 cc. of alkaline cupric tartrate solution and heat. No red precipitate is produced (*sugar*).

Assay—Weigh accurately about 0.5 Gm. of Peptonized Iron and ignite it in a crucible to destroy the organic matter. Allow to cool, transfer the residue completely into a beaker, add 10 cc. of hydrochloric acid, heat until all the iron is dissolved, then add 10 cc. of hydrogen dioxide T.S., and evaporate almost to dryness on the water bath. Dissolve the residue by warming with 5 cc. of hydrochloric acid and 10 cc. of water, and transfer the solution completely into a glass-stoppered flask, filtering, if necessary, and washing the residue and filter with small quantities of hot water until free from iron. Now add to the solution 3 Gm. of potassium iodide, allow to stand for one-half hour at about 40° C., cool and titrate the liberated iodine with tenth-normal sodium thiosulphate. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of iron (Fe).

This assay is explained on page 1467.

N. F. Preparations—Liquor Ferri Peptonati; Liquor Ferri Peptonati et Mangani.

Uses—This is used in the preparation of the corresponding N. F. solutions. It is supposed to be more readily assimilable than inorganic combinations of iron. The average dose is five grains (0.3 Gm.).

LIQUOR FERRI PEPTONATI. N. F. Solution of Peptonized Iron

[**Liq. Ferr. Pepton.**—Solution of Iron Peptonate]

	Metric	Alternative
Peptonized Iron	**17.50 Gm.**	256 gr.
Sodium Citrate	**20.00 Gm.**	292 gr.
Alcohol	**150.00 cc.**	4 fl. oz. 384 min.
Syrup	**50.00 cc.**	1 fl. oz. 288 min.
Glycerin	**50.00 cc.**	1 fl. oz. 288 min.
Oil of Orange	**0.15 cc.**	2⅓ min.
Acetic Ether	**0.20 cc.**	3 min.
Vanillin	**0.02 Gm.**	⅓ gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the peptonized iron in 450 cc. [14 fl. oz. 192 min.] of warm distilled water, add the sodium citrate and warm the mixture until the salts have dissolved. Dissolve the oil of orange, vanillin and acetic ether in the alcohol and add to the first solution. Then add the syrup and glycerin, and, when cold, sufficient distilled water to make the product measure 1000 cc. [2 pints].

The N. F. IV solution was prepared by mixing 90 Gm. of fresh egg albumen with 450 cc. of distilled water and straining. Five cc. of hydrochloric acid and 1 Gm. of pepsin, dissolved in 25 cc. of distilled water, was then added and the mixture digested at from 40° to 50° C., until no cloudiness was produced by adding two drops of nitric acid to 4 cc. of the solution.

The liquid was then neutralized with NaOH solution and 120 cc. of freshly prepared solution of ferric oxychloride and 20 Gm. of sodium citrate added and warmed until a solution results. The other ingredients are then added, as above, to make 1000 cc.

Solution of Peptonized Iron is a golden-brown, transparent liquid, having an aromatic odor and a saline, somewhat astringent taste.

To 1 cc. of the Solution add 1 cc. of water and a few drops of diluted hydrochloric acid: the addition of 1 drop of potassium ferrocyanide T.S. causes an immediate dark blue precipitate.

A brown precipitate is formed upon acidulation with hydrochloric acid; this precipitate is redissolved upon the addition of ammonia water.

Preserve the Solution in dark amber-colored bottles.

Uses—This solution is used in anemias. It has the advantages over some other ferruginous preparations of being less disagreeable to the palate and not prone to disturb digestion. It is given in a dose of one to two fluidrachms (4 to 8 cc.).

A solution containing a protein product of iron, equivalent to 0.4 Gm. of metallic iron in 100 cc., known as *ovoferrin*, is manufactured by the A. C. Barnes Co.

LIQUOR FERRI PEPTONATI ET MANGANI. N. F. Solution of Peptonized Iron and Manganese

[Liq. Ferr. Pepton. et Mangan.—Solution of Iron Peptonate and Manganese]

	Metric	Alternative
Peptonized Iron	**17.50 Gm.**	256 gr.
Soluble Manganese Citrate	**8.75 Gm.**	128 gr.
Alcohol	**150.00 cc.**	4 fl. oz. 384 min.
Syrup	**50.00 cc.**	1 fl. oz. 288 min.
Glycerin	**50.00 cc.**	1 fl. oz. 288 min.
Oil of Orange	**0.15 cc.**	$2\frac{1}{3}$ min.
Acetic Ether	**0.20 cc.**	3 min.
Vanillin	**0.02 Gm.**	$\frac{3}{10}$ gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the peptonized iron and soluble manganese citrate in 450 cc. (14 fl. oz. 192 min.) of warm distilled water. Dissolve the oil of orange, acetic ether and vanillin in the alcohol and add to the first solution. Then add the syrup and glycerin and when cold, sufficient distilled water to make the product measure 1000 cc. [2 pints].

Solution of Peptonized Iron and Manganese is a clear, reddish-brown liquid having a slight odor and taste.

Specific gravity: about 1.055 at 25° C.

Evaporate 10 cc. of the Solution on a water bath: it leaves not more than 1.812 Gm. of residue.

Incinerate the residue from 10 cc. of the Solution: it leaves not more than 0.255 Gm. of ash.

Dilute 5 cc. of the Solution with 5 cc. of distilled water, and add 4 drops of a saturated solution of potassium iodide and 4 cc. of mercuric nitrate T.S.: a yellow precipitate is formed (*peptonates*).

Dilute 5 cc. of the Solution with 5 cc. of distilled water and add 1 cc. of hydrochloric acid and a few drops of potassium thiocyanate T.S.: a blood red color is formed (*ferric iron*).

Treat the ash obtained in a preceding test with nitric acid with the aid of heat and take up with water and filter. To the filtrate add a few cc. of a 40 per cent ammonium persulphate solution and a few cc. of a 2 per cent silver nitrate solution: a pink color results (*manganese*).

Preserve the Solution in dark amber-colored bottles.

Uses—It combines the tonic properties of iron and manganese in a pleasantly flavored solution; the dose is two fluidrachms (8 cc.).

LIQUOR FERRI SALICYLATIS. N. F. Solution of Ferric Salicylate

[Liq. Ferr. Salicyl.—Salicylated Mixture of Iron]

	Metric	Alternative
Sodium Salicylate	**125.0 Gm.**	4 oz. av. 75 gr.
Tincture of Ferric Citrochloride	**125.0 cc.**	4 fl. oz.
Ammonium Carbonate	**6.5 Gm.**	95 gr.
Citric Acid	**8.5 Gm.**	124 gr.
Methyl Salicylate	**2.0 cc.**	31 min.
Glycerin	**175.0 cc.**	5 fl. oz. 288 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the citric acid in 200 cc. [6 fl. oz. 192 min.] of distilled water, add the ammonium carbonate and dissolve the sodium Salicylate in this solution. Then add the tincture of ferric citrochloride, glycerin and the methyl salicylate, and, after mixing, sufficient distilled water to make the product measure 1000 cc. [2 pints].

Solution of Ferric Salicylate is a dark red liquid, with an odor of methyl salicylate, stronger when freshly prepared.

Acidulate 1 cc. of the Solution with hydrochloric acid: the red color changes to yellow and a voluminous crystalline precipitate of salicylic acid separates.

Add 5 cc. of ether to the acidulated liquid and shake, the liquid will separate into two clear layers. A portion of the upper layer, transferred to a watch glass and evaporated, yields a characteristic crystalline residue of salicylic acid, which gives a violet color with ferric chloride T.S. A portion of the lower layer gives a blue color with three drops of potassium ferrocyanide T.S. (*iron*).

Preserve the Solution in dark amber-colored bottles.

Uses—Ferric salicylate ordinarily insoluble, is soluble in the presence of ammonium citrate in this solution. It is employed in chronic rheumatism, associated with anemia. Dose, one to two fluidrachms (4 to 8 cc.).

LIQUOR FERRI SUBSULPHATIS. N. F. Solution of Ferric Subsulphate

(U. S. P. IX)

[**Liq. Ferr. Subsulph.**—Monsel's Solution, Solution of Basic Ferric Sulphate]

An aqueous solution containing basic ferric sulphate corresponding to not less than 20 Gm. and not more than 22 Gm. of Fe in each 100 cc.

	Metric	Alternative
Ferrous Sulphate	1045 Gm.	34 oz. av. 387 gr.
Sulphuric Acid	55 cc.	1 fl. oz. 365 min.
Nitric Acid		
Distilled Water, each, a sufficient quantity,		
To make	1000 cc.	2 pints

Add the sulphuric acid to 800 cc. [25 fl. oz. 288 min.] of distilled water in a capacious porcelain dish, heat the mixture nearly to 100° C., then add 75 cc. [2 fl. oz. 192 min.] of nitric acid and mix well. Divide the ferrous sulphate, coarsely powdered, into four approximately equal portions, and add these portions one at a time to the hot liquid, stirring after each addition until effervescence ceases. If, after the ferrous sulphate has dissolved, the solution is of a black color, add nitric acid, a few drops at a time, with heating and stirring, until red fumes cease to be evolved. Boil the solution until it assumes a red color and is free from nitric acid, as indicated by the test below, maintaining the volume at about 1000 cc. [2 pints] by the addition of distilled water as needed. Cool, add enough distilled water to make the product measure 1000 cc. [2 pints], and filter if necessary.

This solution sometimes crystallizes when cooled, forming a semi-solid whitish mass. When this occurs, the application of a gentle heat will restore the liquid condition.

Note—Solution of Ferric Subsulphate is to be dispensed when *Solution of Persulphate of Iron* has been prescribed by the physician.

When ferrous sulphate is added to a hot mixture of nitric and sulphuric acids, a copious evolution of reddish-brown vapors of N_2O_4 takes place, and the iron assumes a black tint, due to the formation of a compound of the ferrous sulphate with the nitric oxide with the oxygen of the air. This black color disappears under the influence of heat or the addition of more nitric acid, and, when effervescence ceases, a dark reddish-brown liquid is left, which is widely known as *Monsel's Solution.*

Ferric subsulphate differs from ferric tersulphate in that a smaller proportion of sulphuric acid than is required to satisfy the valence of the ferric iron is used. The following equation represents approximately what takes place in the reaction:

$$\underset{\text{ferrous sulphate}}{12FeSO_4} + \underset{\text{nitric acid}}{4HNO_3} + \underset{\text{sulphuric acid}}{3H_2SO_4} = \underset{\text{ferric subsulphate}}{3Fe_4O(SO_4)_5} + \underset{\text{nitric oxide}}{4NO} + \underset{\text{water}}{5H_2O}$$

Solution of Ferric Subsulphate is a dark, reddish-brown liquid, odorless or nearly so, of an acid, strongly styptic taste, an acid reaction, and miscible with water and alcohol without decomposition.

Specific gravity: about 1.548 at 25° C.

Separate portions of an aqueous dilution of the Solution (1 in 20) yield a brownish-red precipitate with ammonia water, a blue precipitate with potassium ferrocyanide T.S., and a white precipitate, insoluble in hydrochloric acid, with barium chloride T.S.

Add a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of sulphuric acid and an aqueous dilution of the Solution (1 in 10): the crystal does not become brown, nor does a brownish-black color develop around it (*nitric acid*).

Add a few drops of freshly prepared potassium ferrocyanide T.S. to 2 cc. of an aqueous dilution of the Solution (1 in 20): a brown color is produced without a tinge of green or greenish-blue (*ferrous salt*).

Assay—Dilute 1 cc. of the Solution, accurately measured, with 25 cc. of distilled water, add 5 cc. of hydrochloric acid and 2 Gm. of potassium iodide, stopper the flask containing the mixture and allow to stand for 30 minutes at a temperature of 40° C. Cool the liquid, dilute it with 50 cc. of water and titrate it with tenth-normal sodium thiosulphate, starch T.S. being used as indicator.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.005584 Gm. of Fe. Each cubic centimeter of Solution of Ferric Subsulphate corresponds to not less than 35.8 cc. and not more than 39.3 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1467.

Preserve the Solution in well-stoppered, amber-colored bottles in a moderately warm place (not under 22° C.).

Uses—This preparation is probably the most valuable official styptic solution. It is less irritating than the solution of ferric sulphate, owing to the smaller proportion of sulphuric acid. It is used externally in stopping hemorrhages, and internally in doses of three to six minims (0.2 to 0.4 cc.), largely diluted with water.

Unofficial Salts of Iron

Ferri Acetas, $Fe(C_2H_3O_2)_3$ Ferric Acetate	Brownish-red, crystalline scales; soluble in water. Used in textile dyeing and as a tonic, in doses of from 3 to 10 grains (0.2 to 0.6 Gm.)
Ferri Arsenas, $Fe_3(AsO_4)_2.6H_2O$ Ferrous Arsenate	A green, amorphous powder; insoluble in water. It is used in medicine as an alterative. Dose, $\frac{1}{20}$ to $\frac{1}{8}$ grain (0.004 to 0.008 Gm.)
Ferri Benzoas, $Fe(C_7H_5O_2)_3.3H_2O$ Ferric Benzoate	A brown powder; insoluble in water, soluble in cod liver oil. Dose, 1½ to 3 grains (0.1 to 0.2 Gm.)
Ferri Bromidum, $FeBr_2$ Ferrous Bromide	A yellowish, crystalline powder; soluble in water. It is deliquescent and is used as an alterative and tonic. Dose, 1 to 3 grains (0.06 to 0.2 Gm.)
Ferri et Quininæ Citras (U. S. P. IX) Iron and Quinine Citrate	Iron and quinine citrate rendered more soluble by the presence of ammonium citrate. It should contain not less than 11.5 per cent of anhydrous quinine and not less than 13 per cent of iron. In thin, transparent scales, of a greenish or golden-yellow color; deliquescent and very soluble in water. The dose is 4 grains (0.25 Gm.)
Ferri et Sodii Pyrophosphas Iron and Sodium Pyrophosphate	Grayish-white scales or granular powder; slowly soluble in water. It is used as a tonic and astringent. Dose, 3 to 15 grains (0.2 to 1 Gm).
Ferri et Strychninæ Citras Iron and Strychnine Citrate	Garnet to brown, transparent, bitter scales; soluble in water. It is used as a tonic. Dose, 2 to 5 grains (0.12 to 0.3 Gm.)
Ferri et Ammonii Sulphas Ferric Ammonium Sulphate	Commonly called *ferric-alum*. Lilac to violet, efflorescent crystals having an acid and styptic taste. It is readily soluble in water and is used chiefly as an indicator in analytical chemistry
Ferri et Ammonii Tartras Iron and Ammonium Tartrate	Reddish-brown to garnet-brown, thin, transparent scales; soluble in water. It is used as a mild chalybeate. Dose, 5 to 20 grains (0.3 to 1.2 Gm.)
Ferri et Potassii Tartras Ferric and Potassium Tartrate	Garnet-red to reddish-brown scales; having a sweet ferruginous taste; soluble in water. This compound is used as a tonic and chalybeate. Dose, from 5 to 10 grains (0.3 to 0.6 Gm.)
Ferri Ferrocyanidum, $Fe_4(FeCN_6)_3$ Ferric Ferrocyanide	Commonly called *Prussian blue*. A dark blue powder; insoluble in water. It is the product formed when ferric salts are identified by means of potassium ferrocyanide yellow solution. It is used as a pigment in paints, in ink, and in bluing It has some use in medicine as a tonic. Dose, 2 to 5 grains (0.12 to 0.3 Gm.)
Ferri Hydroxidum Ferric Hydroxide Magma Ferri Hydroxidi (N. F. IV)	Prepared by adding 100 cc. of solution of ferric sulphate, previously diluted with 1000 cc. of cold water, to 138 cc. of ammonia water, which has been diluted with 500 cc. of cold water. Wash the magma thoroughly, drain on a strainer and add water to make 300 Gm. It is used as a basis for preparing iron salts such as the citrate, tartrate, and as an antidote to arsenic.
Ferri Nitras, $Fe(NO_3)_3$ Ferric Nitrate	Gray-white crystals; soluble in water. It is used as a mordant in dyeing and in calico-printing. It is also used as a tonic and astringent
Ferri Lactas, $Fe(C_3H_5O_3)_2.3H_2O$ Ferrous Lactate	Greenish-white crystals or small green scales; soluble in water. It is used as a tonic and alterative. Dose, 1 to 5 grains (0.06 to 0.3 Gm.)
Ferri Oxalas, $FeC_2O_4.2H_2O$ Ferrous Oxalate	A pale-yellow, odorless, crystalline powder; practically insoluble in water. It is used as a developer in photography, also as a tonic and alterative. Dose, 2 to 5 grains (0.12 to 0.3 Gm.)
Ferri Oxidum Magneticum, Fe_3O_4 Magnetic Iron Oxide	Also called *ferroso-ferric oxide*. A reddish-black, amorphous powder insoluble in water. It is used as an hematic tonic. Dose, 2 to 10 grains (0.12 to 0.6 Gm.)
Ferri Oxidum Rubrum, Fe_2O_3 Red Oxide of Iron	A dense, red powder; insoluble in water. It is chiefly used as a pigment in the manufacture of pottery and glass, and as a polishing powder
Ferri Phosphas Albus, $FePO_4.4H_2O$ White Ferric Phosphate	A yellowish-white powder; insoluble in water. It is used as a 10 to 20 per cent solution in diluted phosphoric acid, for carious teeth to which it is applied on cotton
Ferri Salicylas, $Fe(C_7H_5O_3)_3$ Ferric Salicylate	A violet-gray powder; slightly soluble in water. It is used in medicine as an astringent, antiseptic, and antirheumatic. Dose, 3 to 10 grains (0.2 to 0.6 Gm.)
Ferri Subcarbonas Ferric Oxyhydrate	A reddish-brown powder; insoluble in water. It is used as a mild chalybeate. Dose, 3 to 15 grains (0.2 to 1 Gm.)
Ferri Sulphidum, FeS Ferrous Sulphide	Dark brown or black metallic pieces, sticks, or granules. It is insoluble in water but is dissolved by acids with the evolution of hydrogen sulphide. It is used chiefly in the preparation of hydrogen sulphide
Ferri Valeras Ferric Valerate	An amorphous, brownish-red powder, with a valerian-like odor. It is insoluble in water and is used as a tonic and nervine. Dose, 3 to 15 grains (0.2 to 1 Gm.)

Chromium, Cr; 52.0

The word *chromium* is from the Greek and means color, alluding to the various colors exhibited by its compounds. It is found in nature as chrome-iron ore, deposits of which are found in southeastern Pennsylvania, but more largely in New Caledonia, Rhodesia, and Russia. It has been prepared by reducing Cr_2O_3 with carbon in the electric furnace, also by the alumino-thermic process whereby chromium oxide is reduced by finely powdered aluminum, when they are mixed and ignited. This metal is brittle, of a grayish-white color, and very hard, being capable of scratching glass. Its specific gravity is about 6.9. It forms a number of compounds with oxygen. Of these the monoxide, CrO, and the sesquioxide, Cr_2O_3, are well-known and are basic in char-

acter. The latter is useful as a green pigment. The chromium trioxide or chromic anhydride, CrO_3, is red and is the oxide of pharmaceutical interest. It is strongly acidic since it represents the anhydride of an acid of the formula H_2CrO_4.

Tests for Chromium Salts

Solutions of chromates or dichromates, free from mineral acids, yield with lead acetate T.S. a yellow precipitate, which is insoluble in acetic acid. When a chromate or a dichromate is acidulated with diluted sulphuric acid and hydrogen dioxide T.S. added, a blue color is produced. Upon shaking with ether, the blue color passes into the ethereal layer.

CHROMII TRIOXIDUM. U.S. Chromium Trioxide

[Chrom. Triox.—"Chromic Acid," Chromic Anhydride]

Chromium Trioxide contains not less than 95 per cent of CrO_3 (100.00).

Caution—Chromium Trioxide should not be brought into intimate contact with organic substances, as serious explosions are liable to result.

Preparation—Chromium trioxide, or chromic acid, as it is usually called, is readily obtained by mixing one hundred volumes of a cold saturated solution of potassium dichromate with one hundred and fifty volumes of sulphuric acid, and allowing the mixture to cool. The sulphuric acid unites with the potassium, and sets free the chromium trioxide, which is deposited in crystals. The mother liquor having been poured off, the crystals are transferred to a glass funnel, and the mother liquor displaced by nitric acid; they are then placed upon a porous tile to drain, and finally dried at from 60° to 80° C. to remove nitric acid.

$$\underset{\text{potassium dichromate}}{K_2Cr_2O_7} + \underset{\text{sulphuric acid}}{2H_2SO_4} = \underset{\text{chromium trioxide}}{2CrO_3} + \underset{\text{acid potassium sulphate}}{2KHSO_4} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Small, needle-shaped crystals or rhombic prisms, of a dark purplish-red color and metallic luster. It is odorless, and is deliquescent in moist air. Chromium Trioxide is destructive to animal and vegetable tissues.

One Gm. of Chromium Trioxide is soluble in 0.6 cc. of water at 25° C. One Gm. is soluble in 0.5 cc. of boiling water. When Chromium Trioxide is brought into contact with organic solvents (*e.g.*, alcohol), decomposition takes place, sometimes with dangerous violence.

When Chromium Trioxide is heated, it darkens and finally becomes black, but the color is restored on cooling. At about 190° C. it fuses to a reddish-brown liquid, which on cooling forms a dark red, brittle mass (often enclosing cavities filled with crystals), yielding a scarlet powder. Above 250° C. it begins to decompose into green chromic oxide and free oxygen, and after protracted heating leaves a residue of green chromic oxide.

Tests for Identity—When Chromium Trioxide is warmed with hydrochloric acid, chlorine is evolved.

Chromium Trioxide responds to the reactions for chromates, page 733.

Tests for Purity—A solution of 1 Gm. of Chromium Trioxide in 100 cc. of distilled water, previously acidulated with 3 cc. of hydrochloric acid, is not rendered turbid within one minute on the addition of 1 cc. of barium chloride T.S. (*sulphuric acid*).

Assay—Dissolve about 1 Gm. of Chromium Trioxide, accurately weighed in a stoppered weighing bottle, in sufficient distilled water to make 100 cc. Mix 15 cc. of this solution with 3 cc. of hydrochloric acid and 2 Gm. of potassium iodide in a glass-stoppered container, agitate the mixture, allow it to stand for five minutes, then dilute it with 100 cc. of distilled water, and titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.003333 Gm. of CrO_3.

This assay is explained on page 1466.

Preserve in glass-stoppered bottles.

Uses—Chromium trioxide is a powerful caustic and antiseptic. It is a very effective caustic in destroying warty growths. It is not used internally.

Unofficial Salts of Chromium

Chromii Bromidum, Cr_2Br_6 Chromium Bromide	An olive-green crystalline powder; insoluble in water. It is of little importance
Chromii Chloridum, $CrCl_3$ Chromium Chloride	A reddish-violet, crystalline powder. The anhydrous salt is insoluble in water but soluble in the presence of a trace of stannous chloride. The hydrous salt is water soluble. It is used as a mordant and in the manufacture of other chromium salts
Chromii Dichloridum, $CrCl_2$ Chromium Dichloride	The anhydrous salt is white but dissolves in water to form a blue solution which takes up oxygen and becomes green. The salt is a powerful reducing agent
Chromii Fluoridum, $CrF_3.4H_2O$ Chromium Fluoride	A green, crystalline powder, soluble in water. It corrodes glass and therefore should be kept in lead or wooden vessels. It is used in the printing and dyeing of woolen goods
Chromii Oxidum, Cr_2O_3 Chromic Oxide	Also known as *chromium sesquioxide* and as *chrome green*. A bright green, crystalline powder; insoluble in water and in acids. This compound is used as a green pigment because of its fine color and great permanence
Chromii Sulphas, $Cr_2(SO_4)_3.15H_2O$ Chromic Sulphate	Violet crystals, soluble in water, yielding a bluish-violet solution which becomes green on boiling. The double sulphate of chromium with potassium, sodium, or ammonium constitutes what is called a *chrome alum*

Uranium, U; 238.2

Uranium was named by its discoverer in honor of the planet Uranus. It is found in nature chiefly in the mineral *uraninite* (*uranite*) or *pitchblende*, which consists largely of U_3O_8, and in the mineral *carnotite*. It may be prepared by reducing the oxide with carbon in the electric furnace, or by reducing uranous chloride, UCl_4, with sodium. It is a white, malleable metal, fairly hard but softer than steel. Its specific gravity is very high; 18.7. In contact with air it tarnishes slowly. It is closely related chemically to chromium, molybdenum, and tungsten, and two classes of compounds, *i. e.*, *uranous*, derived from the oxide UO_2, and *uranyl*, containing the divalent group UO_2. It is especially well known because of its connection with radium. Becquerel, in 1896, discovered that pitchblende emitted special radiations, capable of influencing a photographic plate, and he attributed these properties to uranium, but in 1898 and 1899 Madame Curie and her husband Professor Curie showed that these properties were not due to the presence of uranium but to another substance to which they gave the name *radium*.

Uranium compounds are used in glass manufacture to produce a greenish-yellow glass, known as *uranium glass*.

Unofficial Salts of Uranium

Uranus Sulphate, $U(SO_4)_2.4H_2O$	Green crystals; decomposed by water. It is dissolved by dilute acids and is used as a reagent
Uranyl Acetate, $UO_2(C_2H_3O_2)_2.2H_2O$	Small yellow crystals; decomposed by light, soluble in cold water but decomposed by hot water. This salt is used in medicine and as a chemical reagent
Uranii Nitras, $UO_2(NO_3)_2.6H_2O$ (U. S. P. IX) Uranium Nitrate	Light yellow prisms; radioactive and somewhat efflorescent. It is very soluble in water. This salt should be used with caution. It has been used in the treatment of diabetes. The dose is ⅙ grain (0.01 Gm.)
Uranyl Sulphate, $(UO_2)SO_4.3H_2O$	A yellow, crystalline salt; soluble in water. When fused with glass, it imparts a greenish-yellow fluorescence. This salt is chiefly used as a laboratory reagent

CHAPTER LIII

NICKEL, COBALT, AND TIN

Ni; 58.68. Co; 58.97. Sn; 118.7

THE name *nickel* is from the German term "kupfer nickel", meaning false copper, because of the resemblance of a nickel ore (*niccolite*) to an ore of copper.

These metals and their compounds are not considered of sufficient medicinal importance to give them a place in the U. S. Pharmacopœia. Their salts are sometimes used medicinally, and several are among the official reagents. Two of the metals, nickel and tin, are important in many respects, particularly in the arts.

Nickel, Ni; 58.68

This metal is found in the magnetic iron pyrites of Sudbury, Ontario. Also as arsenic or *kupfer nickel* in Germany and Sweden, and as a mixed silicate called *garnierite* (or *genthite*), $2(Ni.Mg)\ Si_4O_{13} + 2H_2O$, in New Caledonia, Nova Scotia, and Norway. Its specific gravity ranges from 8.35 to 8.9 according to mechanical treatment. It is a white, malleable metal, and forms with copper and zinc a valuable alloy, known as *German silver*. This alloy is also used for making coins, for plating other metals, for manufacturing scale pans and laboratory utensils, and for many other purposes. Some of the salts have come into use as medicines; the Latin name of the metal is *niccolum*.

Tests for Compounds of Nickel

1. Ammonium sulphide produces with a solution of a nickel salt a black precipitate (sulphide). This precipitate is insoluble in diluted hydrochloric acid, but soluble in hot nitric acid.

2. Potassium or sodium hydroxide produces with nickel salts pale green precipitates of hydroxide insoluble in an excess.

3. Potassium cyanide produces a green precipitate with a solution of a nickel salt, soluble in an excess, but reprecipitated by hydrochloric acid.

Unofficial Salts of Nickel

Niccoli Bromidum, $NiBr_2$ Nickel Bromide	Brownish to golden-yellow, lustrous scales. Very hygroscopic and very soluble in water. It is used in medicine
Niccoli Carbonas, $NiCO_3$ Nickel Carbonate	A pale green to bluish-green, crystalline powder; insoluble in water. It is occasionally used in medicine
Niccoli Chloridum, $NiCl_2$ Nickel Chloride	Golden-yellow scales, deliquescent in moist air; very soluble in water. The hydrated salt is green. The anhydrous salt absorbs ammonia to form a white addition compound. Nickel chloride is used in sympathetic ink, as an antiseptic, and in gas masks to absorb ammonia
Niccoli Cyanidum, $Ni(CN)_2$ Nickel Cyanide	Poisonous, apple-green powder. Insoluble in water but soluble in an excess of potassium cyanide solution. Nickel cyanide is used in metallurgy and in electro-plating
Nickelous Oxide, NiO	A green, crystalline powder turning yellow when heated. It is insoluble in water and is used in the manufacture of nickel salts and in painting porcelain
Nickelic Oxide, Ni_2O_3	An insoluble grayish-black powder. It is decomposed by heat and is used in storage batteries and for producing oxygen on a small scale
Niccoli Sulphas, $NiSO_4 + 7H_2O$ Nickel Sulphate	The anhydrous salt is yellow but the hydrated salt is blue or green, depending upon the amount of water present. The salt is water-soluble and is used in nickel plating in the form of the double nickel and ammonium sulphate. Nickel sulphate is also used as a mordant in printing textiles
Nickel Sulphide, NiS	It is prepared by the action of alkali sulphides on solutions of soluble salts of nickel. When made by precipitation it is a black, insoluble, crystalline powder

Cobalt, Co; 58.97

The name *cobalt* is from Kobold, the demon of the German mines. The metal is usually found associated with arsenical ores in *cobaltite*, $CoAs_2.CoS_2$, and *smaltite*, $CoAs_2$. It is white, tough, and brittle, unalterable in the air, and strongly magnetic. Specific gravity about 8.8. It forms two classes of salts, cobaltous and cobaltic, in this respect resembling iron. The native ore *skutterudite*, $CoAs_3$, and other cobalt minerals containing arsenic, are often sold in commerce under the name of *flystone*. This material is used as a fly-poison by breaking it into small fragments and mixing them with sweetened water. The *chloride* and *sulphocyanate* have been used to make *barometer paper*, by dipping ordinary white paper into a solution and drying it; when dry the color is blue, but an increase of moisture in the air changes the color to pink. Salts of cobalt are used to give glass a blue color.

Cobaltous chloride is used officially as a reagent (see Chapter XCII). No other salts are official, and none of the unofficial salts is of pharmaceutical interest.

Tests for Salts of Cobalt

Solutions of cobaltous compounds yield a blue precipitate with sodium hydroxide T.S. This precipitate rapidly changes color, becoming olive-green, and, if boiled soon after its formation, becomes rose-red. Solutions of cobalt salts, when treated with an excess of potassium nitrite and acetic acid, yield a yellow precipitate.

Tin, Sn; 119.0

The exact origin of the word *tin* is unknown. The Latin name "stannum" was originally applied to an alloy but later to tin proper. The oxide (*cassiterite* or *tinstone*, SnO_2) is the form in which tin is usually found. Tin is a valuable white metal, of a silvery color, which, when bent, emits a peculiar crackling sound, termed the "cry of tin". Its specific gravity is 7.3. It forms two classes of compounds, called *stannous* and *stannic* salts. These are not used to any extent in medicine or pharmacy, but are of great importance in the arts. Stannous chloride is used officially in the arsenic test.

Tests for Compounds of Tin

When metallic zinc is placed in a solution of a salt of tin acidified with hydrochloric acid, the tin is precipitated in metallic form. The precipitated metal is soluble in boiling hydrochloric acid and the resulting solution yields a white or gray precipitate with mercuric chloride T.S.

Unofficial Salts of Tin

Stanni Chloridum, $SnCl_2.2H_2O$ Stannous Chloride (tin salt)	White, crystalline masses or prismatic needles. Soluble in water but easily converted into the insoluble oxychloride by absorbing oxygen from the air. It is largely used as a reducing agent and as a mordant (see Reagents, page 1542)
Stanni Hydroxidum, $Sn(OH)_2$ Stannous Hydroxide	A yellowish-white powder, insoluble in water but soluble in an excess of caustic potash or caustic soda to form stannites. It yields stannous salts upon treatment with acids
Stanni Sulphidum, SnS Stannous Sulphide	When made by precipitation from stannous chloride solution with hydrogen sulphide, it is a dark brown powder. When made by heating tin with sulphur, it forms a gray, crystalline mass. This compound is of interest as it is the compound found in the qualitative identification of stannous salts with hydrogen sulphide
Sodii Stannas, Na_2SnO_3 Sodium Stannate	Commonly called "preparing salt". It is found in white, crystalline powder or lumps, soluble in water, and is used as a mordant in dyeing
Acidum Stannicum, H_2SnO_3 Stannic Acid	The true metastannic acid. A white, crystalline powder, insoluble in water. When fused with caustic alkali, it is converted into soluble stannate. It is used in *putty powder*, a polishing agent, in the preparation of salts of tin and in the textile industry

CHAPTER LIV

LEAD, COPPER, SILVER, AND MERCURY

Pb; 207.20. Cu; 63.57. Ag; 107.88. Hg; 200.6

THIS group embraces four well-known metals, which furnish compounds of great value as medicines. They are allied to one another chemically, although they differ greatly in their physical properties.

Lead, Pb; 207.20

The name *lead* is translated from several words meaning a weight or a plummet. The Latin name *plumbum* is the root of the common word plumber, as he was originally a worker in lead. It is obtained from the native sulphide, *galena*, or *galenite*, by roasting in a reverberatory furnace until a part of the sulphide is changed into lead oxide and lead sulphate. The air supply is then cut off and the temperature increased when a reaction takes place as follows:

$$\underset{\text{lead sulphide}}{2PbS} + \underset{\text{lead sulphate}}{PbSO_4} + \underset{\text{lead oxide}}{2PbO} = \underset{\text{lead}}{5Pb} + \underset{\text{sulphur dioxide}}{3SO_2}$$

It is often associated with silver. It is a heavy, soft, ductile, bluish metal, with a specific gravity of 11.37. It melts at 327° C. Lead forms three well-known compounds with oxygen: 1. The monoxide or litharge, PbO. 2. The dioxide or peroxide, PbO_2. 3. The triplumbic tetroxide, Pb_3O_4, commonly called *red lead* or *minium*.

Tests for Compounds of Lead

Solutions of lead salts yield with diluted sulphuric acid a white precipitate which is slightly soluble in diluted hydrochloric or nitric acid, but completely soluble in warm sodium hydroxide T.S. With potassium chromate T.S., solutions of lead salts, free or nearly free from mineral acids, yield a yellow precipitate which is insoluble in acetic acid but soluble in sodium hydroxide T.S.

Poisonous Properties of Lead and Its Compounds

Pure water dissolves appreciable quantities of lead through the formation of a slightly soluble hydroxide or carbonate. If sulphates or carbonates are present in the water, an insoluble coating is formed on the surface of the metal, which protects it from further action. Lead pipes and lead tanks should only be used for "hard water".

PLUMBI ACETAS. U. S. Lead Acetate

[**Plumb. Acet.**—SUGAR OF LEAD]

Lead Acetate contains not less than 85.31 per cent and not more than 89.57 per cent of $Pb(C_2H_3O_2)_2$, corresponding to not less than 99.5 per cent of the crystallized salt [$Pb(C_2H_3O_2)_2.3H_2O = 379.32$].

Preparation—This important salt is made by adding lead oxide to acetic acid and gently heating the mixture until combination takes place.

$$\underset{\text{lead oxide}}{PbO} + \underset{\text{acetic acid}}{2HC_2H_3O_2} = \underset{\text{lead acetate}}{Pb(C_2H_3O_2)_2} + \underset{\text{water}}{H_2O}$$

The commercial or technical salt is unfit for pharmaceutical uses; it is not expected to be pure, and usually contains both carbonate and oxide. The official salt is thus described:

Description and Physical Properties—Colorless, shining, transparent, monoclinic prisms or plates, or heavy, white, crystalline masses or granular crystals. It has a faintly acetous odor, is efflorescent, and absorbs carbon dioxide on exposure to air.

One Gm. of Lead Acetate is soluble in 1.4 cc. of water, and in 38 cc. of alcohol, at 25° C. One Gm. is soluble in about 0.5 cc. of boiling water. It is freely soluble in glycerin.

When heated to 40° C., the salt loses its water of crystallization. When heated rapidly to 75° C., it liquefies in its water of crystallization, and at a temperature above 280° C. is decomposed, leaving a residue of finely divided metallic lead and lead oxide.

Tests for Identity—An aqueous solution of Lead Acetate (1 in 10) is slightly alkaline to litmus paper, and responds to the reactions for lead, page 737, and for acetates, page 800.

Tests for Purity—A solution of the salt (1 in 10) prepared with recently boiled, distilled water, is clear, or only slightly opalescent (*carbonate*), and yields with potassium ferrocyanide T.S. a precipitate which is neither blue nor red (*iron or copper*).

Assay—Dissolve about 5 Gm. of Lead Acetate, accurately weighed, in sufficient recently boiled, distilled water to make exactly 100 cc. Mix 10 cc. of this solution with 50 cc. of tenth-normal oxalic acid in a 200 cc. measuring flask, agitate the mixture thoroughly for five minutes and fill the flask to the mark with distilled water. Filter, and titrate the residual oxalic acid in 100 cc. of the filtrate with tenth-normal potassium permanganate, the filtrate being previously acidulated with 10 cc. of sulphuric acid and warmed to 80° C. Each cc. of tenth-normal oxalic acid corresponds to 0.01626 Gm. of $Pb(C_2H_3O_2)_2$.

This assay is explained on page 1473.

Preserve in well-closed containers.

U. S. P. Preparation—Liquor Plumbi Subacetatis.

N. F. Preparations—Liquor Alumini Acetatis; Lotio Alba Veterinaria; Lotio Plumbi et Opii; Mistura Adstringens; Pilulæ Opii et Plumbi.

Uses—Lead acetate is a valuable astringent and sedative; it is used both internally and externally. The dose is from one to three grains (0.065 to 0.2 Gm.). Its solution in water is usually turbid, due to the formation of a trace of carbonate through the carbonic acid present in the water; diluted acetic acid dissolves this precipitate and makes a clear solution.

Antidotes—(See Part XV, on Antidotes).

LIQUOR PLUMBI SUBACETATIS. U. S. Solution of Lead Subacetate

[Liq. Plumb. Subacet.—GOULARD'S EXTRACT]

An aqueous solution containing lead subacetate, approximately $Pb_2O(CH_3.COO)_2$, corresponding to not less than 18 per cent of Pb.

	Metric	Alternative
Lead Acetate	**220 Gm.**	3 oz. av. 294 gr.
Lead Monoxide	**140 Gm.**	2 oz. av. 147 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	1 pint

Triturate the lead monoxide to a smooth paste with 100 cc. [1½ fl. oz.] of distilled water, and transfer the mixture to a bottle of about 1000 cc. [1 pint] capacity, using an additional 100 cc. [1½ fl. oz.] of distilled water for rinsing. Dissolve the lead acetate in 700 cc. [11 fl. oz.] of distilled water, and add the solution to the lead oxide mixture. Shake vigorously for five minutes, then set it aside for seven days, shaking frequently during this time. Finally filter, protecting the solution from undue contact with the air, and pass enough distilled water through the filter to make the product measure 1000 cc. [1 pint].

This solution may also be prepared as follows:

Boil the mixture of lead acetate, lead monoxide, and water for half an hour in a suitable flask, adding small portions of distilled water as necessary to maintain the volume, then cool, and filter. The funnel during filtration should be covered to protect the solution from the action of air, and enough

boiled distilled water passed through the filter to make the product measure 1000 cc. [1 pint].

The object of this process is to furnish a concentrated solution of a lead compound containing a small proportion of acetic acid. The "subacetate" is not a definite salt, but as found in the official solution is a mixture of oxyacetates, produced by boiling the normal acetate in water, in contact with the oxide, or by permitting the mixture to stand with occasional shaking, during seven days.

$$\underset{\text{lead oxide}}{3PbO} + \underset{\text{lead acetate}}{3Pb(C_2H_3O_2)_2} = \underset{\text{lead oxyacetates}}{Pb_3O(C_2H_3O_2)_4} + Pb_3O_2(C_2H_3O_2)_2$$

Description and Physical Properties—A clear, colorless, odorless liquid, having a very sweet, astringent taste. It is alkaline to litmus paper but not to phenolphthalein T.S. On exposure to the air it absorbs carbon dioxide, which causes the formation of a white precipitate.

Tests for Identity—Specific gravity: about 1.25 at 25° C.

When 1 cc. of Solution of Lead Subacetate is added to 5 cc. of mucilage of acacia (1 in 10), it produces a dense white precipitate (*distinction from normal lead acetate*).

Solution of Lead Subacetate responds to the reactions for lead, page 737, and for acetates, page 800.

Test for Purity—Solution of Lead Subacetate yields with potassium ferrocyanide T.S. a white precipitate, tinged with neither red nor blue (*copper or iron*).

Assay—Place about 1 cc. of Solution of Lead Subacetate, accurately weighed, in a 200 cc. volumetric flask, dilute with 50 cc. of recently boiled distilled water, and add 50 cc. of tenth-normal oxalic acid. Agitate the mixture thoroughly for five minutes, fill to the mark with distilled water, shake, and filter, rejecting the first 20 cc. of the filtrate. Add 5 cc. of sulphuric acid to 100 cc. of the filtrate, warm to about 70° C., and titrate the residual oxalic acid with tenth-normal potassium permanganate. Each cc. of tenth-normal oxalic acid corresponds to 0.01036 Gm. of Pb.

This assay is explained on page 1473.

Preserve in well-stoppered bottles.

N. F. Preparations—Ceratum Plumbi Subacetatis; Liquor Plumbi Subacetatis Dilutus.

History—This preparation was first prepared and used by Thomas Goulard, a surgeon of Montpellier, France, in the 18th century. He published an account of it in a book called "The Extract of Saturn". The preparation of lead acetate itself, called *Saccharum Saturni* in the older literature was attributed to Basil Valentine.

Uses—This solution is sedative and astringent; it is employed externally as an application to bruises and sprains.

Antidotes—(See Part XV, on Antidotes).

PLUMBI MONOXIDUM. U. S. Lead Monoxide

[**Plumb. Monoxid.**—Plumbi Oxidum U. S. P. IX, Litharge]

Lead Monoxide, when freshly ignited, contains not less than 97 per cent of PbO (223.20).

Preparation—Litharge is lead oxide which has been rendered semi-crystalline by incomplete fusion. Almost all the litharge of commerce is obtained as a secondary product in the process for extracting silver from argentiferous galenite. After extracting the lead from the ore, the alloy is calcined in the open air, whereby the lead becomes oxidized, and by fusion passes into the state of litharge, while the silver remains unchanged. It is also made by directly heating lead in a current of air. Litharge is officially described as follows:

Description and Physical Properties—A heavy, yellowish or reddish-yellow powder, or minute scales, without odor or taste. On exposure to the air it slowly absorbs moisture and carbon dioxide.

Lead Monoxide is almost insoluble in water, to which, however, it imparts a faintly alkaline reaction. It is insoluble in alcohol. The Monoxide is dissolved by acetic acid, by diluted nitric acid, and by warm solutions of the hydroxides of fixed alkalies.

Test for Identity—When heated, the Monoxide becomes darker in color, but assumes its original color on cooling. It fuses at a red heat. When heated in contact with charcoal, it is reduced to metallic lead.

A solution of the Monoxide in diluted nitric acid (1 in 10) is colorless, and when nearly neutralized by ammonia T.S. responds to the reactions for lead, page 737.

Tests for Purity—Shake 5 Gm. of the Monoxide in a small flask with 5 cc. of distilled water and add 20 cc. of acetic acid. Boil the mixture for a few minutes, filter, wash the insoluble residue thoroughly with diluted acetic acid, and dry at 110° C.: the residue weighs not more than 0.10 Gm.

When strongly heated in a porcelain crucible, the Monoxide loses not more than 4 per cent of its weight (*carbonate or moisture*).

Assay—Dissolve about 0.4 Gm. of freshly ignited Lead Monoxide, accurately weighed, in 2 cc. of glacial acetic acid and 25 cc. of recently boiled, distilled water, in a 200 cc. volumetric flask, and mix the solution with 50 cc. of tenth-normal oxalic acid. Fill the flask to the 200 cc. mark with distilled water, mix well, filter through a dry filter into a dry flask, rejecting the first 20 cc. of filtrate, and titrate the residual oxalic acid in 100 cc. of the filtrate with tenth-normal potassium permanganate, the filtrate being previously acidulated with 20 cc. of diluted sulphuric acid, and warmed to 80° C. Each cc. of tenth-normal oxalic acid corresponds to 0.01116 Gm. of PbO.

This assay is explained on page 1473.

Preserve in well-closed containers.

U. S. P. Preparations—Emplastrum Plumbi Oleatis; Liquor Plumbi Subacetatis.

Uses—Lead Oxide is used officially for making several preparations (see above).

PLUMBI IODIDUM. N. F. Lead Iodide

[Plumb. Iod.]

Lead Iodide contains, when dried over sulphuric acid for 24 hours, not less than 99 per cent of PbI_2 (461.04).

Preparation—This iodide may be made by dissolving equal weights of lead nitrate and potassium iodide in sufficient distilled water to form solutions of each, then mixing the solutions. The precipitate of lead iodide is then collected on a filter, washed with distilled water and dried at a gentle heat.

This is an instance of double decomposition, lead iodide and potassium nitrate being formed. The nitrate is preferred to the acetate, because lead iodide is more soluble in solution of potassium acetate than in that of potassium nitrate. The following equation represents the reaction that takes place:

$$\underset{\text{potassium iodide}}{2KI} + \underset{\text{lead nitrate}}{Pb(NO_3)_2} = \underset{\text{lead iodide}}{PbI_2} + \underset{\text{potassium nitrate}}{2KNO_3}$$

Description and Physical Properties—Lead Iodide occurs as a heavy, bright yellow powder, without odor or taste; permanent in the air.

One Gm. dissolves in about 1300 cc. of water at 25° C. and in about 200 cc. of boiling water, separating from the latter solution on cooling in brilliant, golden yellow, crystalline laminæ; very slightly soluble in alcohol; soluble without color, in solutions of the fixed alkalies, in concentrated solutions of the alkali acetates, of potassium iodide, and of sodium thiosulphate, and in a hot solution of ammonium chloride.

Tests for Identity—When moderately heated, the salt fuses to a thick, reddish-brown liquid, which congeals, on cooling, to a yellow, crystalline mass. At a higher temperature it is decomposed with the evolution of violet vapors of iodine, leaving a lemon-yellow residue of lead oxyiodide.

Tests for Purity—Triturate 1 Gm. of the salt with 2 Gm. of ammonium chloride and 2 cc. of distilled water; a nearly white mixture results. Transfer this to a test tube and heat in a water bath for a few minutes; a clear almost colorless solution is formed (*chromate and other insoluble foreign salts*). On cooling this solution, a solid mass of nearly colorless, fine, silky crystals is produced, and on adding water or diluted sulphuric acid to this mass, yellow Lead Iodide separates.

Add 0.1 Gm. of the salt to 5 cc. of distilled water, and heat the mixture until it boils; cool the liquid and filter it into a test tube of about 40 cc. capacity, then add 5 cc. of sodium hydroxide T.S. and about 0.2 Gm. of aluminum wire; insert in the upper portion of the test tube a pledget of purified cotton, and over the mouth place a piece of moistened red litmus paper and then heat the tube on a water bath during fifteen minutes; no blue coloration of the paper will be discernible (*nitrate*).

Boil 1.5 Gm. of Lead Iodide for a few minutes with 15 cc. of distilled water, cool and filter. To 5 cc. of the filtrate add a slight excess of silver nitrate T.S., then a slight excess of hydrochloric acid and filter. Neutralize the filtrate with ammonia water and add a drop of ferric chloride T S. No red color is produced (*acetate*).

To another 5 cc. portion of the filtrate add an excess of hydrogen sulphide T.S., filter, evaporate to dryness and ignite; not more than 0.002 Gm. of residue remains.

Assay—Dry about 1 Gm. of Lead Iodide over sulphuric acid for twenty-four hours. Dissolve about 0.5 Gm. of the dried lead iodide, accurately weighed, in 30 cc. of sodium hydroxide T.S., heating on the water bath if necessary, to facilitate solution. Cool the solution, add 40 cc. of tenth-normal silver nitrate and follow it with diluted nitric acid until the solution is slightly acid, and add 15 cc. more of the nitric acid. Now titrate the excess of silver nitrate with tenth-normal potassium thiocyanate, using 3 cc. of ferric ammonium sulphate T.S., as indicator, and deduct from the volume of tenth-normal silver nitrate consumed the volume required for the chloride present in the 30 cc. of sodium hydroxide T.S. Each cc. of tenth-normal silver nitrate corresponds to 0.023047 Gm. of PbI_2.

This assay is explained on page 1463.

Preserve it in well-closed containers, protected from light.

N. F. Preparation—Unguentum Plumbi Iodidi.

Uses—Lead iodide may be given internally for glandular swelling, in doses of one to three grains (0.065 to 0.2 Gm.), but it is principally used externally in the form of a ten per cent ointment for glandular enlargements.

Antidotes—(See Part XV, on Antidotes).

PLUMBI OXIDUM RUBRUM. N. F. Red Oxide of Lead

[Plumb. Oxid. Rub.—Red Lead]

Lead orthoplumbate [Pb_2PbO_4 (685.6)] usually with some unconverted lead monoxide (PbO), corresponding to not less than 30 per cent of lead dioxide (PbO_2).

Preparation—This oxide is formed by the careful and prolonged heating of litharge (PbO) in a reverberatory or muffle furnace at from 450° to 500° C., so that it does not melt. It is also prepared by heating litharge with potassium chlorate in an oxidizing flame to a dark red heat.

Description and Physical Properties—Red Lead Oxide occurs as a heavy, orange-red powder without odor or taste. On exposure to the air it slowly absorbs moisture and carbon dioxide.

Almost insoluble in water, insoluble in alcohol, but dissolved by an excess of glacial acetic acid, also dissolved by lactic acid with the evolution of carbon dioxide and the odor of acetaldehyde.

Tests for Identity—When heated in a porcelain crucible, Red Lead Oxide at first changes color from red to a violet and then to a blackish tint, and regains its original color on cooling, but, when the heating is continued, it slowly decomposes, forming lead monoxide and oxygen. When heated in contact with charcoal, it is reduced to metallic lead.

Tests for Purity—Treat 5 Gm. of Red Lead Oxide with 50 cc. of diluted nitric acid; little effervescence results (*carbonate*), and a brown, insoluble residue of lead dioxide (PbO_2) remains, which, upon the addition of solution of hydrogen dioxide, dissolves with the evolution of oxygen, forming a colorless solution. Boil this solution for fifteen minutes, cool, and filter; the undissolved residue weighs not more than 0.1 Gm. (*silicate or lead sulphate*). On completely precipitating a portion of the solution from the foregoing test, representing 1 Gm. of Red Lead Oxide, with hydrogen sulphide, the filtrate on evaporation yields not more than 0.01 Gm. of residue.

Separate portions of the solution obtained in the last test yield with hydrogen sulphide T.S. a black precipitate; with potassium iodide T.S. a yellow precipitate; and with diluted sulphuric acid, a white precipitate; the latter two precipitates being soluble in a solution of sodium hydroxide (1 in 4).

From a solution of 0.5 Gm. of Red Lead Oxide in diluted nitric acid, obtained by the aid of solution of hydrogen dioxide, precipitate the lead with sulphuric acid and filter the mixture. After the addition of an excess of ammonia water this filtrate does not develop more than a slight, bluish tint (*copper*), nor yield more than traces of a reddish-brown precipitate (*iron*).

Heat a mixture of 1 Gm. of Red Lead Oxide with 50 cc. of distilled water to boiling, cool, and filter. The filtrate is colorless, is not more than faintly alkaline to litmus and, when evaporated to dryness, leaves not more than 0.01 Gm. of residue (*soluble impurities*).

Assay—Add about 1 Gm. of Red Lead Oxide accurately weighed, to a cool solution of 40 Gm. of crystallized sodium acetate and 2 Gm. of potassium iodide in 50 cc. of 50 per cent acetic acid, agitate the mixture until all of the Red Lead Oxide has dissolved and then titrate the solution with tenth-normal sodium thiosulphate.

Each cc. of tenth-normal sodium thiosulphate corresponds to 0.01195 Gm. of lead dioxide (PbO_2). Each Gm. of Red Lead Oxide corresponds to not less than 25.9 cc. of tenth-normal sodium thiosulphate.

This assay is explained on page 1469.

N. F. Preparations—Emplastrum Fuscum Camphoratum; Unguentum Fuscum.

Uses—It is largely used as a pigment and also in the preparation of the better grades of flint glass. Officially it is used in the N. F. in making a plaster similar to lead plaster.

LIQUOR PLUMBI SUBACETATIS DILUTUS. N.F. Diluted Solution of Lead Subacetate

(U. S. P. IX)

[**Liq. Plumb. Subacet. Dil.**—LEAD WATER]

An aqueous solution containing lead subacetate corresponding to not less than 0.70 and not more than 0.80 Gm. of Pb in each 100 cc.

	Metric	Alternative
Solution of Lead Subacetate	**35 cc.**	1 fl. oz. 58 min.
Distilled Water, recently boiled	**965 cc.**	30 fl. oz. 422 min.
To make about	**1000 cc.**	2 pints

Mix them.

Diluted Solution of Lead Subacetate is a colorless liquid, usually showing a slight turbidity; it has a sweet, astringent taste, and an alkaline reaction.

A white precipitate is formed when 5 cc. of the Solution is mixed with 5 cc. of mucilage of acacia.

Separate portions of Diluted Solution of Lead Subacetate diluted with 5 volumes of recently boiled, distilled water, yield a black precipitate with hydrogen sulphide T.S., a yellow precipitate with potassium iodide T.S., a white precipitate with diluted sulphuric acid, and a white precipitate, tinged with neither red nor blue, with potassium ferrocyanide T.S.

Assay—Transfer 50 cc. of the Solution, accurately measured, to a 200 cc. measuring flask, dilute with 50 cc. of recently boiled, distilled water, then add 50 cc. of tenth-normal oxalic acid and agitate the mixture thoroughly for five minutes. Add enough distilled water to make 200 cc., filter, rejecting the first 20 cc. of filtrate, add 5 cc. of sulphuric acid to 100 cc. of the subsequent filtrate, warm to about 70° C. and titrate with tenth-normal potassium permanganate.

Each cc. of tenth-normal oxalic acid corresponds to 0.01036 Gm. of Pb.

This assay is explained on page 1473.

Preserve this Solution in small, well-filled and tightly stoppered bottles.

Uses—Lead water is used as a soothing application in irritation of the skin.

Antidotes—(See Part XV, on Antidotes).

Unofficial Salts and Preparations of Lead

Plumbi Bromidum, $PbBr_2$ Lead Bromide	White, shining needles that darken on exposure to sunlight. It can be made by precipitation from solutions of lead acetate and potassium bromide. Lead bromide is insoluble in water
Lead Carbonate White Lead, Flake White	A mixture of lead carbonate and hydroxide, approximately $(PbCO_3)_2$ $Pb(OH)_2$. A heavy, white, opaque powder, or a pulverulent mass without odor or taste, permanent in the air. Insoluble in water or in alcohol. Largely used in the arts, especially in paints. Its external use is dangerous, producing lead poisoning and it should not be used in face powders
Plumbi Chloridum, $PbCl_2$ Lead Chloride	A white, crystalline powder, insoluble in cold water. It is of analytical interest and is used in preparing other salts of lead
Plumbi Chromas, $PbCrO_4$ Lead Chromate	Commonly called *chrome yellow* and *Leipzig yellow*. Yellow crystals or yellow crystalline powder; insoluble in water. It is made by precipitation from solutions of a soluble salt, and a soluble chromate, and is largely used as a pigment
Plumbi Dioxidum, PbO_2 Lead Dioxide	A brown, crystalline powder; insoluble in water. It must be stored and shipped with caution because of its strong oxidizing action. It is used in the manufacture of salts of lead
Plumbi Hydroxidum, $Pb(OH)_2$ Lead Hydroxide	A white powder, slightly soluble in water. Like other soluble lead compounds it is poisonous. It is used in the manufacture of salts of lead
Plumbi Nitras, $Pb(NO_3)_2$ Lead Nitrate	Colorless crystals or a white, crystalline powder; readily soluble in water. Lead nitrate is largely used in the manufacture of other lead compounds, and in the preparation of mordants, pigments, and matches
Plumbi Saccharas Lead Saccharate	A white powder, insoluble in cold water. This compound is of little importance but has been used in medicine
Plumbi Sulphas, $PbSO_4$ Lead Sulphate	A white, crystalline powder; insoluble in cold water and slightly soluble in hot water. It forms an insoluble coating in lead pipes that are used for conducting tap water which contains sulphates. Because of its insolubility and permanence it is used in paints

Copper, Cu; 63.57

The word *copper* comes from the Latin word "cuprum" which in turn is corrupted from the Latin "aes cyprium" alluding to Cyprus, the Roman source of the element, in the time of Pliny. It is found naturally in its metallic

condition, but chiefly in combination as sulphide or oxide. It is also found as sulphate, carbonate, phosphate, or arsenate. It is a brilliant metal, of a red color, having a specific gravity of 8.92 to 8.95. It forms two oxides: red cuprous oxide, Cu_2O and black cupric oxide, CuO.

Tests for Compounds of Copper

Solutions of copper compounds acidulated with hydrochloric acid deposit a red film of metallic copper upon a bright, untarnished surface of metallic iron. An excess of ammonia T.S. added to a solution of a copper salt produces a blue color. With potassium ferrocyanide T.S. solutions of cupric salts yield a red precipitate.

CUPRI SULPHAS. U. S. Cupric Sulphate

[Cupr. Sulph.—Copper Sulphate]

Cupric Sulphate contains not less than 63 per cent and not more than 66.8 per cent of $CuSO_4$ (159.63), corresponding to not less than 98.5 per cent of the crystallized salt [$CuSO_4.5H_2O = 249.71$].

Preparation—This salt is economically made by acting on scrap copper with diluted sulphuric acid, heating, evaporating the solution, and crystallizing.

Oxygen of the air assists in changing the copper into sulphate. The reaction may be expressed as follows:

$$\underset{\text{copper}}{2Cu} + \underset{\text{sulphuric acid}}{2H_2SO_4} + \underset{\text{oxygen}}{O_2} = \underset{\text{copper sulphate}}{2CuSO_4} + \underset{\text{water}}{2H_2O}$$

In another largely used process the scrap copper is heated in a reverberatory furnace with sulphur, the reaction being controlled in order to obtain a maximum yield of sulphate. The mass is then thrown into diluted sulphuric acid and any unchanged oxide, sulphide, or metal is converted into copper sulphate.

Description and Physical Properties—Deep blue, triclinic crystals or a blue, granular powder. It is odorless, and has a nauseous, metallic taste. It is slowly efflorescent in dry air.

One Gm. of Cupric Sulphate is soluble in 2.5 cc. of water, 500 cc. of alcohol, and in 2.8 cc. of glycerin, at 25° C. One Gm. is soluble in 0.5 cc. of boiling water.

Tests for Identity—When heated to 30° C., Cupric Sulphate loses part of its water of crystallization and is converted into a pale blue, amorphous powder. More water is lost at 100° C. and finally at 200° C. a white, anhydrous powder remains. At a still higher temperature, sulphur dioxide and oxygen are given off, and a residue of black cupric oxide remains.

An aqueous solution of the salt (1 in 20) has a blue color, and is acid to litmus paper.

An aqueous solution of the salt (1 in 10) responds to the reactions for copper, page 743, and for sulphates, page 581.

Test for Purity—Dissolve 1 Gm. of Cupric Sulphate in 50 cc. of distilled water, add 1 cc. of diluted hydrochloric acid, and pass hydrogen sulphide through the solution until all of the copper is precipitated: upon evaporating the filtrate and igniting, the weight of the residue does not exceed 0.003 Gm. (*other metals*).

Assay—Dissolve about 1 Gm. of Cupric Sulphate, accurately weighed, in 50 cc. of distilled water, add 4 cc. of acetic acid and 3 Gm. of potassium iodide, and titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.01596 Gm. of $CuSO_4$.

Cupric Sulphate may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1466.

Preserve in well-closed containers.

N. F. Preparation—Mistura Adstringens.

Uses—Copper sulphate, called commercially *bluestone* or *blue vitriol*, is used internally as an emetic, in doses of four grains (0.25 Gm.); as an astringent or tonic, from one-fifth to one-half grain (0.01 to 0.03 Gm.) is given. It is used as an injection in gonorrhea and other diseases, and also as a

stimulant wash, and in substance as an escharotic. It is also antidotal to phosphorus.

Under the name "*Cupricsticks*", the Tappan-Zee Surgical Company offer small wooden sticks tipped with a mixture containing 25 per cent copper sulphate, combined with alum and potassium nitrate. They are for local application as a styptic, each stick to be used but once.

Antidotes—(See Part XV, on Antidotes).

Unofficial Salts of Copper

Cupric Ammonium Sulphate, $CuSO_4.4NH_3.H_2O$	A dark blue, crystalline powder; soluble in water, forming a deep blue solution. It is used in calico printing and in the manufacture of other copper compounds
Cupric Acetate, $Cu(C_2H_3O_2)_2 + H_2O$	A greenish-blue powder. It is soluble in water and is used in the production of insecticides, textiles, and ceramics. It has also been used in medicine. It is poisonous
Cupric Arsenate, $Cu_3As_2O_8 + 4H_2O$	A bluish-green, amorphous powder; insoluble in water. It is poisonous and is used as an insecticide and as a pigment
Cupric Bromide, $CuBr_2$	Dark, lustrous crystals resembling iodine; very soluble in water, deliquescent. It is converted into cuprous bromide by heat, with the liberation of bromine. This compound is of little importance
Cupric Chloride, $CuCl_2 + 2H_2O$	Greenish-blue, deliquescent crystals; very soluble in water. It is used in sympathetic ink, as a mordant, as an oxidizing agent, and in the production of certain aniline dyes
Cupric Citrate (N. N. R., 1925)	A green or bluish-green, crystalline powder; sparingly soluble in water; readily soluble in a solution of an alkali citrate. It is used in medicine as an astringent and antiseptic. Copper citrate is more fully described in the New and Non-official Remedies of 1925
Cupric Nitrate, $Cu(NO_3)_2$	Blue, deliquescent crystals; readily soluble in water. It is used in the manufacture of other copper compounds, also in dyeing, and in calico printing
Cupric Oxide, CuO	A brownish-black, amorphous powder; insoluble in water. It is used as an oxidizing agent in analytical chemistry and to impart green and blue colors to glass, porcelain, and stoneware
Cupric Subacetate, $Cu(OH)_2.Cu(C_2H_3O_2)_2$ Verdigris	A poisonous, greenish-blue powder; soluble in water. It is used as an insecticide, as a pigment, and in dyeing and printing fabrics
Cupric Tartrate	This salt is present in the well-known Fehling's solution which is an alkaline solution of cupric tartrate (see page 1554). Cupric tartrate is of very little importance otherwise
Cuprous Bromide, Cu_2Br_2	A brown, crystalline mass, made by boiling a solution of cupric bromide with copper. It is of very little importance
Cuprous Chloride, Cu_2Cl_2	A yellowish, crystalline mass; insoluble in cold water. It forms several addition compounds with ammonia and its ammoniacal solution reacts with acetylene to form the explosive *cuprous acetylide*
Cuprous Iodide, Cu_2I_2	The only known iodide of copper. A white powder; practically insoluble in water. This interesting compound offers a means of separating iodides from bromides and chlorides, since cuprous iodide is precipitated when copper sulphate solution is added to a mixture of all three salts in solution
Cupric Fluoride, CuF_2	A blue, crystalline substance; soluble in water; poisonous. It is used in ceramics and in enamels

Silver, Ag; 107.88

The word *silver* is derived from a Greek word referring to the brightness of the metal. It is found in the metallic state, but usually as a sulphide, sometimes associated with lead sulphide, or *galena*. Its sulphide also occurs abundantly as *argentite* or *silver glance*. Its Latin name is *argentum*.

Silver is a brilliant white metal, very malleable and ductile, having a specific gravity of 10.4 to 10.6 and melting at 960° C. It forms but one oxide, Ag_2O.

Tests for Silver Salts

Solutions of silver salts yield with hydrochloric acid a white, curdy precipitate, which is insoluble in nitric acid but is easily soluble in ammonia T.S.

Protein and Colloidal Combinations of Silver, Etc.

These combinations of silver do not possess the caustic action of silver salts of mineral acids, but retain the germicidal and antiseptic action, although in a less degree. They are described under the organic combinations of silver, page 874.

ARGENTI NITRAS. U. S. Silver Nitrate

[Arg. Nit.]

Silver Nitrate, when finely powdered and dried to constant weight in the dark over sulphuric acid, contains not less than 99.8 per cent of $AgNO_3$ (169.89).

Preparation—Mix 3 parts of metallic silver with 10 parts of nitric acid (25 per cent HNO_3) in a large porcelain dish and warm the mixture until the reaction begins. Invert a funnel over the liquid to prevent it from spurting, and, when the silver is dissolved, rinse the sides of the funnel with a little distilled water. Filter the solution through glass wool, if necessary, and evaporate it on a sand bath to dryness. Then raise the temperature until the salt melts and the nitrous fumes escape, which will soon occur if the silver is pure. If copper is present, as it is likely to be if coin has been used as the source of silver, it being recognized by the bluish color of the solution, it requires longer heating and the reaction is complete when gas no longer escapes and the mass becomes black from the formation of copper oxide. The fused mass is then dissolved in twice its weight of water, filtered, and set aside to crystallize. The reaction is indicated by the following equation:

$$\underset{\text{silver}}{3Ag} + \underset{\substack{\text{nitric}\\\text{acid}}}{4HNO_3} = \underset{\substack{\text{silver}\\\text{nitrate}}}{3AgNO_3} + \underset{\substack{\text{nitric}\\\text{oxide}}}{NO} + \underset{\text{water}}{2H_2O}$$

Description and Physical Properties—Colorless, odorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light in the presence of organic matter.

One Gm. of Silver Nitrate is soluble in 0.4 cc. of water and in 30 cc. of alcohol, at 25° C. One Gm. is soluble in slightly more than 0.1 cc. of boiling water and in 6.5 cc. of boiling alcohol. It is slightly soluble in ether.

When heated in a porcelain crucible to about 200° C., Silver Nitrate melts, forming a faintly yellow liquid, which on cooling, congeals to a pure white, crystalline mass. At a higher temperature it gradually decomposes with the evolution of nitrogen oxides.

Tests for Identity—An aqueous solution of the salt (1 in 50) responds to the reactions for silver, page 744.

Mix an aqueous solution of the salt (1 in 10) in a test tube with a drop of diphenylamine T.S. and then carefully superimpose it upon sulphuric acid: a deep blue color appears at the line of contact.

Tests for Purity—An aqueous solution of the salt (1 in 10) is clear and colorless, and is neutral to litmus paper.

An aqueous solution of the salt (1 in 10) is not colored even faintly blue by the addition of an excess of ammonia T.S. (*copper*).

Assay—Dissolve about 0.8 Gm. of finely powdered Silver Nitrate, previously dried in the dark over sulphuric acid and accurately weighed, in 5 cc. of distilled water. Add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01699 Gm. of $AgNO_3$.

Silver Nitrate may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1462.

Preserve in dark amber-colored, glass-stoppered vials, protected from light.

Preparation—Argenti Nitras Fusus.

History—This salt was described by Geber in the seventh century A.D. It was first used in medicine in the eighteenth century in Pilulæ Lunares. Christopher Glaser, the apothecary to Louis XIV of France, first prepared it in sticks for use as a caustic.

Uses—Silver nitrate is used externally as a caustic and germicide. In dilute solution it is valuable for its astringent and disinfectant powers and is widely employed as a local application to inflamed mucous membranes as well as wounds. Internally, it is given in gastritis and diarrhea, in doses of one-fifth to one-half grain (0.01 to 0.03 Gm).

Antidotes—(See Part XV, on Antidotes).

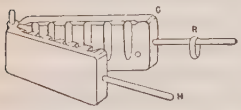
ARGENTI NITRAS FUSUS. U. S. Fused Silver Nitrate

[**Arg. Nit. Fus.**—Molded Silver Nitrate, Lunar Caustic]

Fused Silver Nitrate contains not less than 94.5 per cent of $AgNO_3$(169.89).

The official process for making this preparation has been deleted. It was formerly made by fusing silver nitrate with the addition of hydrochloric acid, added in small proportions to produce a small amount of silver chloride, which had the effect of toughening the fused mass and making the sticks less brittle. E. J. Hughes found that when a small proportion of sodium chloride was used instead of the hydrochloric acid, the process was very much improved, and the preparation was equally efficient.

Fig. 431



Caustic cone mold

In order to keep the sticks from becoming discolored during the molding process, it is advisable to add a little diluted nitric acid (1 in 5) occasionally to the melted nitrate, and carefully prevent the mass from becoming overheated. Fig. 431 illustrates the silver molds used in molding the cones.

Description and Physical Properties—A white, hard, odorless solid, generally in the form of pencils or cones, showing a fibrous fracture and becoming gray or grayish-black on exposure to light.

Fused Silver Nitrate, with the exception of about 5 per cent which is silver chloride, possesses the solubility described under *Argenti Nitras*.

Tests for Identity and Purity—A filtered, aqueous solution of Fused Silver Nitrate (1 in 10) is neutral to litmus paper, and conforms to the tests for identity and purity under *Argenti Nitras*.

Assay—Add about 0.8 Gm. of Fused Silver Nitrate, accurately weighed, to 50 cc. of distilled water, and, when the silver nitrate has dissolved, filter the solution. Thoroughly wash the filter and sediment with distilled water, add 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S. to the mixed filtrate and washings, and titrate with tenth-normal potassium thiocyanate. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01699 Gm. of $AgNO_3$.

Fused Silver Nitrate may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1462.

Preserve in dark, amber-colored, glass-stoppered vials, protected from light.

Uses—Fused silver nitrate is used as an escharotic and germicide, especially for small septic wounds and ulcers. A good caustic holder may be made from a glass stirring rod of the same diameter as the cone by joining it to the cone with a short length of rubber tubing. The cone may be protected from the action of the air by slipping over it another short length of rubber tubing, having a very short piece of glass rod in the other end as a stopper.

Death has resulted more than once through the careless use of silver nitrate in cauterizing the throat, the cone having slipped out of the fingers and then been swallowed by the patient.

The Tappan-Zee Surgical Company offer small wooden sticks, with the tip dipped in 75 per cent fused silver nitrate, for application as a local caustic. They are called "*causticks*". Each stick is to be used for a single treatment.

Antidotes—(See Part XV, on Antidotes).

Unofficial Salts of Silver

Argenti Acetas, $AgC_2H_3O_2$ Silver Acetate	A white, crystalline salt; slightly soluble in water, freely soluble in hot water. It has been used in medicine
Argenti Bromidum, AgBr Silver Bromide	A pale yellow, crystalline powder, darkening on exposure to light. Only very slightly soluble in water but readily soluble in solutions of potassium bromide, potassium cyanide, or sodium thiosulphate. Its chief use is in photography
Argenti Chloridum, AgCl Silver Chloride	A white, granular powder that darkens on exposure to light. Practically insoluble in water but dissolved by ammonia water or by solutions of potassium cyanide and by sodium thiosulphate. It is of analytical interest as the product of the well-known identity test for silver salts in solution. It is used in silver plating and in photography
Argenti Chromas, Ag_2CrO_4 Silver Chromate	A red, crystalline powder, practically insoluble in water. The pink to red color that appears when potassium chromate is used as an indicator, in the presence of silver nitrate, is due to the formation of this compound
Argenti Citras, $Ag_3C_6H_5O_7$ (N. N. R.) Silver Citrate	Dry, white, crystalline needles or powder; difficultly soluble in water. It is used in medicine as a non-irritating antiseptic, applied directly to wounds, and in 1 to 4000 to 1 to 10,000 solutions for urethral injections
Argenti Cyanidum, AgCN (U. S. P. VIII) Silver Cyanide	A very poisonous white powder that darkens on exposure to light. It is insoluble in water, potassium cyanide solution, and in sodium thiosulphate solution. It is used in medicine and in silver plating. At one time used in the extemporaneous preparation of hydrocyanic acid, see page 991
Argenti Nitras Mitigatus Mitigated Silver Nitrate	A diluted form of silver nitrate made by fusing together thirty parts of silver nitrate and sixty parts of potassium nitrate. Its chief use is as a caustic
Argenti Iodidum, AgI Silver Iodide	A yellow powder that darkens on exposure to light. It is insoluble in water but dissolves readily in hydriodic acid, potassium iodide, potassium cyanide, and sodium thiosulphate solutions. It is chiefly used in medicine and in photography. Silver iodide is made by double decomposition between potassium iodide and silver nitrate solutions and is largely used as a suspension in gelatin solution, acacia, tragacanth, Irish moss, or other mucilage, in a strength of from 2 to 5 per cent
Argenti Lactas, N. N. R., $AgC_3H_5O_3 + H_2O$ Silver Lactate	This salt is made by boiling silver carbonate with lactic acid and collecting and drying the precipitate. It is soluble in water and is used in medicine as an antiseptic. Silver lactate is more fully described in the New and Non-official Remedies of 1925
Argenti Oxalas, $Ag_2C_2O_4$ Silver Oxalate	A sparingly soluble, white salt, made by precipitation of silver nitrate by a soluble oxalate. It is easily decomposed by heat, yielding metallic silver
Argenti Oxidum, Ag_2O (U. S. P. IX) Silver Oxide	A heavy, brownish-black powder, easily reduced by exposure to light. It is very slightly soluble in water to which it imparts an alkaline reaction. Silver oxide is of no medicinal value although it was formerly employed in chronic nervous diseases
Argenti Phosphas, Ag_3PO_4 Silver Phosphate	A yellow powder, turning brown on exposure to light. It is only very slightly soluble in water, and is used in certain photographic emulsions instead of the nitrate
Argenti Sulphas, Ag_2SO_4 Silver Sulphate	A white, crystalline powder; only sparingly soluble in cold water. This salt is of little importance, but a considerable amount of it has been produced in separating silver from gold, by means of concentrated sulphuric acid

Mercury, Hg; 200.6

The name *mercury* comes from the mythological Mercury, the messenger of the gods. The ancient chemists symbolized the metal by the sign used for the planet Mercury. It is frequently called quicksilver and is found most abundantly as sulphide, or *cinnabar;* the principal mines are in Spain and California. The native metal is also occasionally found in tiny globules. It is a brilliant, silver-white metal, liquid above $-38.8°$ C. and having the specific gravity 13.596. In addition to the two main series of compounds, namely, the *mercurous* and *mercuric*, mercury forms a variety of chemical combinations of a complex nature. It is used more largely in medicine in the metallic state than any other element.

Tests for Compounds of Mercury

Solutions of mercury salts free from excess of nitric acid, when applied to bright copper foil, yield a deposit, which, upon rubbing, becomes bright and

silvery in appearance. With an excess of hydrogen sulphide, mercury compounds yield a black precipitate which is insoluble in ammonium sulphide T.S. or in boiling diluted nitric acid.

Mercuric compounds in solution yield a yellow precipitate with sodium hydroxide T.S. They also yield in neutral solutions a scarlet precipitate with potassium iodide T.S. This precipitate is very soluble in an excess of potassium iodide T.S.

Mercurous compounds are blackened by ammonia T.S. and by sodium hydroxide T.S. Solutions of mercurous salts yield with hydrochloric acid a white precipitate which is blackened by ammonia T.S. With potassium iodide T.S. a yellow precipitate is produced.

HYDRARGYRUM. U.S. Mercury

[**Hydrarg.**—QUICKSILVER]

Mercury contains not less than 99.5 per cent of Hg (200.6).

Mercury for pharmaceutical uses should be pure. To separate mechanical impurities, moisture, or small quantities of oxide, mercury may be filtered by collecting it in a clean piece of chamois leather and, gathering the corners together, forcibly squeezing the particles through the pores of the leather. Mercury is also purified chemically by allowing it to descend in tiny drops through a column of diluted nitric acid. This treatment removes any baser metals that may be present and does not seriously attack the mercury, but distillation is preferable in most cases to purify the metal effectually. This may be accomplished by a process formerly official in the British Pharmacopœia, as follows:

"Take of mercury, 3 pounds [avoirdupois]; hydrochloric acid, 3 fluidrachms; distilled water, a sufficiency. Place the mercury in a glass retort or iron bottle, and, applying heat, cause two pounds and a half of the metal to distil over into a flask employed as a receiver. Boil on this for five minutes the hydrochloric acid diluted with 9 fluidrachms of distilled water, and having, by repeated affusions of distilled water and decantations, removed every trace of acid, let the mercury be transferred to a porcelain capsule, and dried first by filter paper, and finally on a water bath."

Description and Physical Properties—A shining, silver-white metal, liquid at ordinary temperatures and easily divisible into spherical globules. When cooled to about −40° C., it forms a ductile, malleable mass.

Tests for Identity—Specific gravity: about 13.5 at 25° C.

Mercury is insoluble in the ordinary solvents, in concentrated hydrochloric acid, and at ordinary temperatures, in sulphuric acid, but it dissolves in the latter when boiled with it. It is readily and completely dissolved by nitric acid.

Mercury boils at about 358° C.

Tests for Purity—When volatilized at about 300° C., Mercury yields not more than 0.02 per cent of residue.

When globules of Mercury are dropped upon white paper, they roll about freely, retaining their globular form and leaving no streaks or traces.

Mercury should present a bright surface, even after agitation in contact with air.

Assay—Dissolve about 0.4 Gm. of Mercury, accurately weighed, in a mixture of 10 cc. of distilled water and 10 cc. of nitric acid, warm the solution gently until red fumes cease to be evolved and the solution is colorless, and add 150 cc. of distilled water. Then add 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate until a permanent reddish color is produced. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01003 Gm. of Hg.

Mercury may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1461.

Preserve in strong, well-closed containers.

U. S. P. Preparations—Hydrargyrum cum Creta; Massa Hydrargyri; Unguentum Hydrargyri Fortius; Unguentum Hydrargyri Mite (from Mercurial Ointment).

N. F. Preparations—Petroxolinum Hydrargyri; Unguentum Hydrargyri Nitratis.

History—This metal was known to the peoples of very ancient times. Compounds of mercury, however, were first prepared and described by Geber in the seventh century A.D. Among these were red precipitate and corrosive sublimate.

Uses—Mercury, in bulk, is used only for pharmaceutical purposes in preparing blue mass, gray powder, mercurial ointment, etc.

MASSA HYDRARGYRI. U.S. Mass of Mercury

[Mass. Hydrarg.—Blue Mass, Blue Pill]

Mass of Mercury contains not less than 32 per cent and not more than 34 per cent of Hg (200.6). The formula will be found on page 488.

Assay—Place about 0.5 Gm. of Mass of Mercury, accurately weighed and rolled into one or two pills, in a Kjeldahl flask of about 300 cc. capacity. Add 10 cc. of sulphuric acid, and heat on a water bath during ten minutes, gently agitating at frequent intervals to disintegrate the mass. Insert a small funnel in the neck of the flask, and slowly add 10 cc. of nitric acid. Heat the mixture with a Bunsen burner, at first gently, gradually increasing the heat until the solution is colorless or only slightly yellow, adding more nitric acid if necessary, and keep the funnel in the neck of the flask during heating. Allow the solution to cool sufficiently, and add carefully through the funnel about 30 cc. of distilled water, rinsing the stem of the funnel with a few cc. of distilled water and allowing the rinsings to run into the flask. Then add potassium permanganate T.S. to the warm solution, until a slight pink color persists. Cool the solution, discharge its color by the addition of just sufficient oxalic acid T.S., add 3 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate to a permanent reddish color. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01003 Gm. of Hg.

This assay is explained on page 1462.

N. F. Preparations—Pilulæ Aloes, Hydrargyri et Podophylli; Pilulæ Digitalis, Scillæ et Hydrargyri.

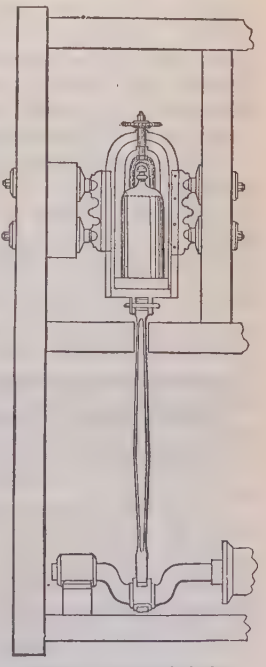
By using the official formula the pharmacist is enabled to make blue mass extemporaneously with very little labor. The mass should not be *forcibly pressed*, or the globules of mercury will run together, and will grow larger instead of smaller. The mercury is best distributed by a rapid, beating motion.

History—The first pills containing metallic mercury were introduced into European medicine by Barbarossa, a famous Algerian pirate, who sent the formula to Francis I, of France, about the middle of the sixteenth century.

Uses—The object of this preparation is to furnish mercury in a finely divided condition. It is used chiefly as a purgative and is supposed to possess cholagogic powers.

Dose—five to ten grains (0.39 to 0.6 Gm.).

Fig. 432



Squibb's mercurial shaker

Fig. 432 illustrates the mercurial shaker invented by Doctor Squibb. It consists of a stout wooden frame to which is attached a metal cage for holding a strong glass gallon bottle; this is held in place by a cup-shaped screw clamp which rests on a cloth collar placed around the top of the bottle above the shoulder; the sides of the cage move in guides which are bolted to the wooden frame. A vertical shaft operated by the horizontal shaft at the bottom communicates an "up and down" motion to the bottle, and, when speeded properly, the mercury and a mixture containing honey in the bottle is thrown back and forth from the top to the bottom rapidly, and the mercury is thus quickly extinguished. The mixture is afterwards incorporated with the powders, placed

in a large vessel and the mass is finished. In making mercurial ointment, the mercury is placed in the bottle holding the lard, and both are shaken together; the mixture is afterwards incorporated with the melted suet. This process of extinguishing mercury is termed "succussion".

Pot mills (Fig. 230) are also used on a manufacturing scale for extinguishing Mercury in making both the mass and the ointment.

HYDRARGYRUM CUM CRETA. U.S. Mercury with Chalk

[**Hydrarg. c. Cret.**—Gray Powder]

Mercury with Chalk contains not less than 37 per cent and not more than 39 per cent of Hg.

	Metric	Alternative
Mercury	**38 Gm.**	166 gr.
Honey	**10 Gm.**	44 gr.
Prepared Chalk	**57 Gm.**	249 gr.
Water, a sufficient quantity,		
To make	**100 Gm.**	1 oz. av.

Weigh the mercury and honey successively into a strong bottle of the capacity of 100 cc. [1 fl. oz.] and add 2 cc. [10 min.] of water. Cork the bottle, and shake it for about half an hour at a time until the aggregate time of shaking reaches ten hours, or until the globules of mercury are no longer visible under a lens magnifying four diameters. The shaking may be more conveniently performed by mechanical means. Rub the prepared chalk with water in a mortar to a thick, creamy paste, and, having added the contents of the bottle, wash out the last portions with a little water, and triturate the whole to a uniform mixture. Finally dry the mixture, first between ample layers of bibulous paper, and afterwards in a dish at the ordinary temperature until it weighs 100 Gm. [1 oz. av.]. Then reduce it to a uniform powder without trituration.

The intention here is to furnish mercury in a finely divided condition in the form of a powder. The above process is a very tedious one. In Matter's process, fifty-three grains of powdered acacia are mixed with fifty-three grains of chalk, enough water added to form a thin paste, and one hundred and sixty-six grains of mercury added and triturated until extinguished. One hundred and sixty-six grains of chalk are made into a paste with water, and added to it, and the water evaporated from the mixture in a water bath; it is rubbed to powder when dry.

Description and Physical Properties—A light gray, rather damp powder, free from grittiness. It is odorless, and has a slightly sweet taste.

Test for Identity—Digest 0.1 Gm. of the powder with 20 cc. of warm acetic acid. The chalk dissolves with effervescence, and a residue of finely divided mercury remains.

Tests for Purity—On filtering the mixture obtained in the preceding test, the filtrate becomes not more than slightly opalescent on the addition of a few drops of hydrochloric acid (*mercurous oxide*).

Digest 0.1 Gm. of the powder with 20 cc. of warm diluted hydrochloric acid, and filter; the filtrate is not rendered more than slightly brown by hydrogen sulphide T.S. (*mercuric oxide*).

Assay—Dissolve about 1 Gm. of Mercury with Chalk, accurately weighed, in a mixture of 10 cc. of distilled water and 10 cc. of nitric acid, and heat on a water bath until red fumes cease to be evolved and the liquid becomes colorless. Then add 150 cc. of distilled water and 2 cc. of ferric ammonium sulphate T.S. and titrate the solution with tenth-normal potassium thiocyanate. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01003 Gm. of Hg.

Mercury with Chalk may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1462.

Preserve in well-closed containers, protected from light.

Uses—Mercury with chalk is a mild mercurial cathartic, frequently given to children. In small doses it is occasionally used as an antisyphilitic. It should be free from mercurous or mercuric oxide; through exposure to air old specimens frequently contain both. The dose is four grains (0.25 Gm.).

HYDRARGYRUM AMMONIATUM. U. S. Ammoniated Mercury

[**Hydrarg. Ammon.**—White Precipitate, Mercurammonium Chloride]

Ammoniated Mercury contains $HgNH_2Cl$ (252.08), corresponding to not less than 78 per cent and not more than 80 per cent of Hg (200.6).

Preparation—The U. S. P. X does not include the process for the manufacture, but the U. S. P. VIII process was as follows:

Dissolve 100 Gm. [1 oz. av.] of corrosive mercuric chloride in 2000 cc. [20 fl. oz.] of warm distilled water, filter the solution, and allow it to cool. Pour the filtered liquid gradually, and with constant stirring, into 150 cc. [1½ fl. oz.] of ammonia water, taking care that the latter shall remain in slight excess. Collect the precipitate on a filter, and, when the liquid has drained from it as much as possible, wash it with a mixture of 400 cc. [4 fl. oz.] of distilled water and 20 cc [1½ fl. dr.] of ammonia water. Finally, dry the precipitate between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C., and keep it in well-stoppered bottles, protected from light.

In this process the ammonium of one-half of the ammonium chloride, which is formed upon mixing the solutions, has two of its hydrogen atoms replaced by one atom of bivalent mercury, NH_4Cl becoming NH_2HgCl.

$$\underset{\text{mercuric chloride}}{HgCl_2} + \underset{\text{ammonia water}}{2NH_4OH} = \underset{\text{ammonium chloride}}{NH_4Cl} + \underset{\text{mercurammonium chloride}}{NH_2HgCl} + \underset{\text{water}}{2H_2O}$$

Description and Physical Properties—White, pulverulent pieces, or a white, amorphous powder. It is odorless, and is stable in the air.

Ammoniated Mercury is insoluble in water and in alcohol. By prolonged washing with water, it is gradually decomposed, assuming a yellow color and becoming converted into a basic salt. It is readily soluble in warm hydrochloric, nitric, and acetic acids and in a cold solution of ammonium carbonate. One Gm. is completely soluble in a cold solution of 5 Gm. of sodium thiosulphate in 5 cc. of water, with the evolution of ammonia. When the latter solution is heated for a short time, red mercuric sulphide is precipitated which upon protracted boiling turns black.

Tests for Identity—At a temperature below a red heat Ammoniated Mercury is decomposed without fusion, and at a red heat it is volatilized.

When heated with sodium hydroxide T.S., Ammoniated Mercury turns yellow, with the evolution of ammonia.

A solution of Ammoniated Mercury in diluted nitric acid yields with potassium iodide T.S. a red precipitate, soluble in an excess of the reagent. The nitric acid solution yields a white precipitate with silver nitrate T.S.

Tests for Purity—When volatilized at about 300° C., Ammoniated Mercury leaves not more than 0.2 per cent of residue.

Ammoniated Mercury is completely soluble in warm hydrochloric acid (*mercurous salts*) without effervescence (*carbonates*).

Assay—Dissolve about 0.5 Gm. of Ammoniated Mercury, accurately weighed, in 2 cc. of hydrochloric acid and 10 cc. of distilled water, warming gently until solution is effected, then dilute with 300 cc. of distilled water, and proceed as directed under *Hydrargyri Chloridum Corrosivum*, page 752, beginning with the word "Pass" in the third line of the assay. The weight of mercuric sulphide obtained, multiplied by 0.862, indicates its equivalent in mercury (Hg). Each Gm. of Ammoniated Mercury corresponds to not less than 0.9047 Gm. and not more than 0.9279 Gm. of mercuric sulphide.

Ammoniated Mercury may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1479.

Preserve in well-closed containers, protected from light.

U. S. P. Preparation—Unguentum Hydrargyri Ammoniati.

History—White precipitate was first described by Beguin, a chemist and writer, in 1632. A soluble double chloride of mercury and ammonium was known to the alchemists by the names *sal alembroth* and *sal sapientiæ*.

Uses—This compound of mercury is not used internally; it is applied externally in the form of ointment chiefly in cutaneous affections. It is a frequently used ingredient in proprietary freckle-removing creams and skin bleaches, many of which are dangerous for indiscriminate use.

HYDRARGYRI CHLORIDUM CORROSIVUM. U. S. Corrosive Mercuric Chloride

[**Hydrarg. Chlor. Corr.**—Bichloride of Mercury, Corrosive Sublimate, Mercuric Chloride, Perchloride of Mercury]

Corrosive Mercuric Chloride, when dried to constant weight over sulphuric acid, contains not less than 99.5 per cent of $HgCl_2$ (271.52).

Preparation—This important mercuric salt may be made by the former official process, as follows:

Take of mercury, 24 oz.; sulphuric acid, 36 oz.; sodium chloride, 18 oz. Boil the mercury with the sulphuric acid, by means of a sand bath, until a dry, white mass remains. Rub this, when cold, with the sodium chloride in an earthenware mortar; then sublime the mixture with a gradually increasing heat.

By boiling sulphuric acid in excess with mercury to dryness, a white salt (mercuric sulphate) is formed, according to the reaction:

$$\underset{\text{sulphuric acid}}{2H_2SO_4} + \underset{\text{mercury}}{Hg} = \underset{\text{mercuric sulphate}}{HgSO_4} + \underset{\text{sulphur dioxide}}{SO_2} + \underset{\text{water}}{2H_2O}$$

When this is mixed with sodium chloride, and the mixture exposed to a subliming heat, decomposition takes place, according to the reaction:

$$\underset{\text{mercuric sulphate}}{HgSO_4} + \underset{\text{sodium chloride}}{2NaCl} = \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{mercuric chloride}}{HgCl_2}$$

The mercuric chloride thus formed sublimes, and the sodium sulphate remains.

Description and Physical Properties—Heavy, colorless, odorless, rhombic crystals, or crystalline masses, or a white powder.

Caution—Corrosive Mercuric Chloride is extremely poisonous.

One Gm. of Corrosive Mercuric Chloride is soluble in 13.5 cc. of water, 3.8 cc. of alcohol, about 12 cc. of glycerin, and in 22 cc. of ether, at 25° C. One Gm. is soluble in 2.1 cc. of boiling water and in 1.6 cc. of boiling alcohol.

The salt fuses to a colorless liquid at about 265° C., and at about 300° C. volatilizes as a dense, white vapor.

Tests for Identity—An aqueous solution of Corrosive Mercuric Chloride (1 in 20) is acid to litmus paper, but becomes neutral upon the addition of sodium chloride.

An aqueous solution of the salt (1 in 20) responds to the reactions for mercuric compounds, page 747, and for chlorides, page 567.

Tests for Purity—When volatilized at about 300° C., Corrosive Mercuric Chloride leaves not more than 0.1 per cent of residue.

Not more than 0.5 per cent of residue remains on dissolving finely powdered Corrosive Mercuric Chloride in ether or alcohol.

Assay—Dry about 0.5 Gm. of Corrosive Mercuric Chloride to constant weight over sulphuric acid, weigh accurately, and dissolve in 300 cc. of warm water to which 1 cc. of hydrochloric acid has been added. Pass hydrogen sulphide through the cold solution until saturated, when the precipitate of mercuric sulphide readily subsides, leaving a clear supernatant liquid. Collect the precipitate on counterpoised filters or on a Gooch crucible, wash it well with cold distilled water, and finally with three portions of about 10 cc. each of alcohol. Then close the tip of the funnel with a cork stopper, add sufficient carbon tetrachloride to cover the precipitate, cover the funnel with a watch-glass, and allow it to stand for about half an hour. Then drain off the solvent, and wash the precipitate with further portions of carbon tetrachloride until, after evaporating about 1 cc. of the filtrate, no visible residue remains. Remove the adhering carbon tetrachloride by washing, with several portions of 10 cc. each of alcohol, and, after drying in the air, transfer to an oven and dry to constant weight at about 110° C. The weight of mercuric sulphide obtained, when multiplied by 1.167, indicates its equivalent in $HgCl_2$. Each Gm. of Corrosive Mercuric Chloride, previously dried to constant weight, corresponds to not less than 0.8526 Gm. of Mercuric sulphide.

This assay is explained on page 1479.

Corrosive Mercuric Chloride, previously dried to constant weight, may also be assayed by the electrolytic method, page 1515.

Preserve in well-closed containers.

U. S. P. Preparation—Toxitabellæ Hydrargyri Chloridi Corrosivi.

N. F. Preparations—Elixir Chloridorum; Lotio Flava; Mulla Hydrargyri Chloridi Corrosivi.

History—Although the discovery of corrosive sublimate is credited to Geber of the seventh century, it does not appear to have been used in medicine until the middle of the eighteenth century when it was first employed in syphilis by Baron von Swieten, a pupil of Boerhaave.

Uses—Pharmaceutically, mercuric chloride is used in several preparations to furnish the mercury in the compounds. Medicinally, as an alterative, it is one of the most valuable internal remedies in syphilis and chronic rheumatism, the dose being one-twentieth of a grain (0.003 Gm.). Externally, it is used as a germicide and escharotic. It is very extensively employed in antiseptic surgery. For this purpose it is usually sold in the form of tablets, mixed with sodium chloride, ammonium chloride, or citric acid which render it more readily soluble. These tablets have been so commonly sold and so often mistaken for headache tablets, with fatal results, that the Pharmacopœia and the laws of many States have established rigid regulations for their appearance so as to render them distinctive and readily recognized as poisonous. See *Toxitabellæ Hydrargyri Chloridi Corrosivi* (page 500). Corrosive Mercuric Chloride is a powerful antiseptic, but it must be used with great care on account of its poisonous properties.

Antidotes—(See Part XV, on Antidotes).

HYDRARGYRI CHLORIDUM MITE. U. S. Mild Mercurous Chloride

[**Hydrarg. Chlor. Mit.**—Mercurous Chloride, Calomel, Protochloride of Mercury, Subchloride of Mercury]

Mild Mercurous Chloride, when dried to constant weight over sulphuric acid, contains not less than 99.6 per cent of HgCl (236.06).

Preparation—The former official process may be used to prepare mercurous chloride, as follows:

Take of mercury, 48 oz.; sulphuric acid, 36 oz.; sodium chloride, 18 oz.; distilled water, a sufficient quantity. Boil, by means of a sand bath, 24 oz. of the mercury with the sulphuric acid, until a dry, white mass remains. Rub this, when cold, with the remainder of the mercury, in an earthenware mortar, until they are thoroughly mixed. Then add the sodium chloride, and, having rubbed it with the other ingredients until globules of mercury cease to be visible, sublime the mixture into a large chamber so that the sublimate may fall in powder. Wash the sublimed matter with boiling distilled water until the washings afford no precipitate with ammonia water, and dry it.

In this preparation mercuric sulphate is first made; this is then triturated with a quantity of mercury equal to that used in forming it; mercurous sulphate is produced, and when this is mixed with sodium chloride and sublimed, mercurous chloride is produced as a fine white sublimate, and sodium sulphate remains behind.

$$\underset{\text{sulphuric acid}}{2H_2SO_4} + \underset{\text{mercury}}{Hg} = \underset{\text{mercuric sulphate}}{HgSO_4} + \underset{\text{sulphur dioxide}}{SO_2} + \underset{\text{water}}{2H_2O}$$

$$\underset{\text{mercuric sulphate}}{HgSO_4} + \underset{\text{mercury}}{Hg} = \underset{\text{mercurous sulphate}}{Hg_2SO_4}$$

$$\underset{\text{mercurous sulphate}}{Hg_2SO_4} + \underset{\text{sodium chloride}}{2NaCl} = \underset{\text{mercurous chloride}}{2HgCl} + \underset{\text{sodium sulphate}}{Na_2SO_4}$$

Description and Physical Properties—A heavy, white, impalpable powder, becoming yellowish-white when triturated with strong pressure, and showing only small, isolated crystals when viewed under a lens having a magnifying power of one hundred diameters. It is odorless, and is stable in the air.

Mild Mercurous Chloride is insoluble in water, alcohol, ether, and in cold dilute acids.

When heated to about 383° C., Mild Mercurous Chloride is volatilized without fusion or the evolution of brown vapors.

Tests for Identity—The salt is blackened by contact with calcium hydroxide T.S. with a solution of an alkali hydroxide, or with ammonia T.S.

When heated in a dry glass tube with an equal weight of dried sodium carbonate (free from chloride), Mild Mercurous Chloride yields a sublimate of metallic mercury. When the residue is dissolved in nitric acid and filtered, silver nitrate T.S. produces in the filtrate a white, curdy precipitate, insoluble in nitric acid.

Tests for Purity—When volatilized at about 300° C., Mild Mercurous Chloride leaves not more than 0.1 per cent of residue.

Shake 2 Gm. of the salt with 20 cc. of ether for five minutes, filter, and allow the filtrate to evaporate spontaneously: the residue, dissolved in 10 cc. of distilled water and 2 drops of diluted nitric acid, shows no more *chloride* than corresponds to 0.1 cc. of fiftieth-normal hydrochloric acid (*mercuric chloride*), page 1520.

Heat 1 Gm. of the salt with sodium hydroxide T.S.: no ammonia is evolved (*ammoniated mercury*).

Assay—Dry about 0.7 Gm. of Mild Mercurous Chloride to constant weight over sulphuric acid, weigh accurately, mix well with 10 cc. of distilled water in a glass-stoppered flask, and add 50 cc. of tenth-normal iodine and 5 Gm. of potassium iodide dissolved in 10 cc. of distilled water. Stopper the flask, allow the mixture to stand with occasional agitation until complete solution has taken place, and then titrate the residual iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal iodine corresponds to 0.02361 Gm. of HgCl.

Mild Mercurous Chloride, previously dried to constant weight, may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1471.

Preserve in well-closed containers, protected from light.

U. S. P. Preparation—Pilulæ Hydrargyri Chloridi Mitis Compositæ.

N. F. Preparations—Lotio Nigra; Pulvis Hydrargyri Chloridi Mitis et Jalapæ; Tabellæ Santonini Compositæ; Unguentum Hydrargyri Chloridi Mitis.

History—Calomel is stated to have been first introduced into medical practice by Sir Theodore Turquet de Mayerne, favorite physician of Henry IV, of England. He was a noted character of his time and was one of the compilers of the first London Pharmacopœia of 1618. It was called *Aquila Alba* or *Draco Mitigatus* by early chemical and medical writers. The name calomel is of doubtful origin. It was also called *dulcified mercury*.

Uses—Calomel is a valuable cholagogue cathartic, about two and one-half grains (0.15 Gm.) being given, usually divided into ten or more doses. It is also used as a diuretic and as an intestinal antiseptic, and as an alterative in syphilis and other chronic disorders. It is employed locally for its disinfectant properties, either as a dusting powder or in a 30 per cent ointment which is now official in the N. F. (see page 508).

HYDRARGYRI IODIDUM FLAVUM. U.S. Yellow Mercurous Iodide

[**Hydrarg. Iod. Flav.**—Mercurous Iodide; Protoiodide of Mercury, Yellow Iodide of Mercury]

Yellow Mercurous Iodide, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of HgI (327.52).

Preparation—The process for its manufacture official in the U. S. P. VIII is as follows:

Mix 20 cc. [5 fl. dr.] each of nitric acid and distilled water, and, when the liquid is cold, pour it upon 50 Gm. [1 oz. av. 293 gr.] of mercury contained in a glass beaker. Set the mixture aside in a dark place, and keep it at a temperature between 25° and 30° C. with occasional agitation, until the reaction ceases and a little mercury still remains undissolved. Separate the crystals of mercurous nitrate, which will have formed, from the mother liquor, allow them to drain in a glass funnel, and dry them on bibulous paper, in a dark

place. When the salt is dry, dissolve 40 Gm. [584 gr.] of it in 650 cc. [20½ fl. oz.] of distilled water to which 6 cc. [92 min.] of nitric acid have previously been added. Having prepared a solution of 16 Gm. [233 gr.] of potassium iodide in 32 cc. [1 fl. oz.] of distilled water, slowly pour the solution of potassium iodide into the solution of mercurous nitrate, with constant stirring, which should be continued for fifteen minutes; allow the precipitate to subside, decant the supernatant liquid, and wash the precipitate by decantation with ten successive portions of 500 cc. [1 pint] each of distilled water. Finally, transfer the precipitate to a filter, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 40° C. and keep it in dark amber-colored vials, with the least possible exposure to light.

Instead of weighing off 40 Gm. [584 gr.] of the mercurous nitrate as above directed, the whole of the crystallized salt may be taken and the amount of potassium iodide, etc., adjusted to the proportions given above.

Description and Physical Properties—A bright yellow, amorphous powder, without odor or taste. By exposure to light it becomes greenish in proportion as it undergoes decomposition into metallic mercury and mercuric iodide.

Yellow Mercurous Iodide is practically insoluble in water, and is insoluble in alcohol and in ether.

Tests for Identity—When slowly and moderately heated, Yellow Mercurous Iodide assumes at first an orange and then a red color, becoming yellow again on cooling. When quickly and strongly heated, it is at first partially decomposed into mercury and mercuric iodide, and finally is volatilized.

When heated in a dry glass tube with an equal weight of dried sodium carbonate, Yellow Mercurous Iodide yields a sublimate of metallic mercury.

When Yellow Mercurous Iodide is heated with sulphuric acid and a little manganese dioxide, the vapor of iodine is evolved.

Tests for Purity—When volatilized at about 300° C., Yellow Mercurous Iodide leaves not more than 0.2 per cent of residue.

Place 0.5 Gm. of Yellow Mercurous Iodide in a 10 cc. glass-stoppered cylinder, add 10 cc. of alcohol, shake by inverting the cylinder ten times, allow to stand protected from light for two minutes and shake again by inverting the cylinder ten times. Filter at once, refiltering if necessary until the filtrate is clear, and to 5 cc. of the filtrate add an equal volume of hydrogen sulphide T.S. The color produced is not darker than that produced by 5 cc. of hydrogen sulphide T.S. in a mixture of 1 cc. of mercuric chloride solution (made by dissolving 0.5 Gm. of mercuric chloride in 1000 cc. of distilled water) and 4 cc. of alcohol (*mercuric iodide*).

Assay—Dry about 1 Gm. of Yellow Mercurous Iodide to constant weight over sulphuric acid, weigh accurately, transfer to a glass-stoppered flask, add 50 cc. of tenth-normal iodine and 5 Gm. of potassium iodide dissolved in 10 cc. of distilled water. Stopper the flask, and allow the mixture to stand with occasional agitation until complete solution has taken place, and then titrate the residual iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal iodine corresponds to 0.03275 Gm. of HgI.

Yellow Mercurous Iodide, previously dried to constant weight, may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1472.

Preserve in well-closed containers, protected from light.

Uses—Yellow mercurous iodide is used as an alterative. It is better adapted for internal administration than the red iodide, because it is milder. The dose is from one-sixth to one grain (0.01 to 0.065 Gm.).

Antidotes—(See Part XV, on Antidotes).

HYDRARGYRI IODIDUM RUBRUM. U.S. Red Mercuric Iodide

[**Hydrarg. Iod. Rub.**—Biniodide of Mercury, Mercuric Iodide, Red Iodide of Mercury]

Red Mercuric Iodide, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of HgI_2 (454.44).

Preparation—The process for its manufacture official in the U.S.P. VIII is as follows:

	Metric	Alternative
Corrosive Mercuric Chloride	**40 Gm.**	1 oz. av. 148 gr.
Potassium Iodide	**50 Gm.**	1 oz. av. 293 gr.

Distilled Water, a sufficient quantity.

Dissolve 40 Gm. [1 oz. av. 148 gr.] of corrosive mercuric chloride and 50 Gm. [1 oz. av. 293 gr.] of potassium iodide, each, in 800 cc. [25½ fl. oz.] of distilled water, and filter the solutions separately. Pour both solutions, simultaneously and in a thin stream, with constant and very active stirring, into 2000 cc. [4 pints] of distilled water. When the precipitate has subsided, decant the supernatant liquid, collect the precipitate on a filter, and wash it with cold distilled water until the washings give not more than a slight opalescence with silver nitrate test solution. Finally, dry it in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C., and keep it in well-stoppered bottles, protected from light.

In this process mercuric iodide and potassium chloride are formed by double decomposition.

$$\underset{\text{mercuric chloride}}{HgCl_2} + 2KI = \underset{\text{mercuric iodide}}{HgI_2} + \underset{\text{potassium chloride}}{2KCl}$$

As mercuric iodide is soluble in solutions both of mercuric chloride or of potassium iodide, it is not profitable to use an excess of either. It may be obtained in handsome crystals by dissolving it in hot hydrochloric acid to saturation and allowing the solution to cool slowly.

Description and Physical Properties—A scarlet-red, amorphous powder without odor. It is stable in the air.

Caution—Red Mercuric Iodide is extremely poisonous.

Red Mercuric Iodide is practically insoluble in water. One Gm. is soluble in 115 cc. of alcohol, 910 cc. of chloroform, and in 120 cc. of ether, at 25° C. One Gm. is soluble in 20 cc. of boiling alcohol. It is dissolved by solutions of the soluble iodides, mercuric chloride, sodium thiosulphate, and by hot solutions of the alkali chlorides.

When heated to about 150° C., Red Mercuric Iodide becomes yellow, but again assumes a red color on cooling. At about 250° C. it fuses to a dark yellow liquid, which, on cooling, forms a yellow, crystalline mass. At about 350° C. it is volatilized.

Tests for Identity—Boil about 0.1 Gm. of the salt with 2 cc. of sodium hydroxide T.S., filter, and strongly acidify the filtrate with nitric acid: the liquid becomes yellow from the liberation of iodine, which produces a blue color upon the addition of a few drops of starch T.S.

Heat the salt with potassium hydroxide T.S. and add a little lactose: metallic mercury is precipitated.

Tests for Purity—When volatilized at about 300° C., Red Mercuric Iodide leaves not more than 0.2 per cent of residue.

Agitate thoroughly about 0.5 Gm. of Red Mercuric Iodide with 10 cc. of distilled water, and filter: the filtrate does not become more than slightly colored upon the addition of hydrogen sulphide T.S. (*soluble mercury salts*).

Not more than 0.004 Gm. of insoluble residue remains on dissolving 2 Gm. of Red Mercuric Iodide in 100 cc. of distilled water containing 2 Gm. of potassium iodide.

Assay—Dry Red Mercuric Iodide over sulphuric acid to constant weight and assay by the electrolytic method, page 1515.

Preserve in well-closed containers, protected from light.

U. S. P. Preparation—Liquor Arseni et Hydrargyri Iodidi.

Uses—This iodide is used internally in the treatment of syphilis, in doses of one-twentieth of a grain (0.003 Gm.); it is frequently combined with potassium iodide. It is also offered in one per cent suspension in neutral oil, mixed with benzocaine. Externally, it is often used in the form of an ointment, of the strength of sixteen grains in an ounce of simple ointment.

Antidotes—(See Part XV, on Antidotes).

HYDRARGYRI OXIDUM FLAVUM. U. S. Yellow Mercuric Oxide [Hydrarg. Oxid. Flav.]

Yellow Mercuric Oxide, when dried to constant weight at 150° C., contains not less than 99.5 per cent of HgO (216.60).

Preparation—The process for its manufacture official in the U. S. P. VIII is as follows:

Dissolve 100 Gm. [3 oz. av. 148 gr.] of corrosive mercuric chloride in 1000 cc. [2 pints] of warm distilled water, and filter the solution. Dissolve 40 Gm. [1 oz. av. 147 gr.] of sodium hydroxide (which should contain at least 90 per cent of pure, anhydrous sodium hydroxide) in 1000 cc. [2 pints] of cold distilled water, and into this solution pour gradually, and with constant stirring, the solution of corrosive mercuric chloride. Allow the mixture to stand for an hour at a temperature of about 30° C., stirring frequently. Then decant the supernatant, clear liquid from the precipitate, and wash the latter repeatedly by the addition and decantation of portions of distilled water, using 1000 cc. [2 pints] of water each time. Collect the precipitate on a strainer, and continue the washing with warm distilled water, until a small portion of the washings, when poured on a little mercuric chloride test solution, no longer produces a yellowish turbidity at the line of contact of the two liquids. Then allow the precipitate to drain, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. and keep it in well-stoppered bottles, protected from light.

$$\underset{\text{mercuric chloride}}{HgCl_2} + \underset{\text{sodium hydroxide}}{2NaOH} = \underset{\text{mercuric oxide}}{HgO} + \underset{\text{sodium chloride}}{2NaCl} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—A light orange-yellow, odorless, amorphous, heavy, impalpable powder. It is stable in the air, but turns darker on exposure to light.

Yellow Mercuric Oxide is practically insoluble in water, and insoluble in alcohol. It is readily dissolved by diluted hydrochloric or nitric acid, forming colorless solutions.

Test for Identity—When moderately heated, Yellow Mercuric Oxide assumes a red color. At about 600° C. it is completely decomposed into oxygen and metallic mercury, and is volatilized.

Tests for Purity—When volatilized at about 300° C., Yellow Mercuric Oxide leaves not more than 0.2 per cent of residue.

When moistened with hot, distilled water, Yellow Mercuric Oxide is not alkaline to litmus paper.

A solution of 0.5 Gm. of Yellow Mercuric Oxide in 25 cc. of either diluted hydrochloric or diluted nitric acid is not more than slightly turbid.

Heat 0.5 Gm. of Yellow Mercuric Oxide for two hours in a test tube, on a water bath, with a solution of 1 Gm. of oxalic acid in 10 cc. of distilled water and 1 cc. of ammonia T.S., replacing from time to time the water lost by evaporation: it is converted into white or yellowish-white mercuric oxalate (*distinction from red mercuric oxide*).

Assay—Dry about 0.5 Gm. of Yellow Mercuric Oxide to constant weight at 150° C., weigh accurately, and dissolve it in a mixture of 10 cc. of distilled water and 5 cc. of nitric acid, and further dilute the solution with 150 cc. of distilled water. Then add 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01083 Gm. of HgO.

Yellow Mercuric Oxide, previously dried to constant weight, may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1461.

Preserve in well-closed containers, protected from light.

U. S. P. Preparations—Oleatum Hydrargyri; Unguentum Hydrargyri Oxidi Flavi.

Uses—Yellow mercuric oxide is used in making the oleate of mercury (see page 350) and in the official ointment (see page 505); it is employed only externally for its antiseptic powers. The official ointment is now only 1 per cent and is largely used for inflammation of the eyelids. The U. S. P. IX ointment was 10 per cent and was used for vermin in the hair.

HYDRARGYRI SALICYLAS. U.S. Mercuric Salicylate

[Hydrarg. Salicyl.—Mercuric Subsalicylate]

Mercuric Salicylate is a compound of mercury and salicylic acid containing not less than 54 per cent and not more than 59.5 per cent of Hg.

Preparation—The formula for this salt is indefinite, but has been given as $Hg.C_6H_4O.CO_2$. The mercury replaces both carboxyl and hydoxyl hydrogen

in the salicylic acid. It is sometimes called *salicylated mercury*. It may be prepared as follows:

Dissolve 27 parts of corrosive mercuric chloride in 600 parts of distilled water, and filter. Dissolve 10.8 parts of sodium hydroxide in 600 parts of cold distilled water, and pour the corrosive sublimate solution into this with constant stirring. Allow it to stand for an hour, with frequent stirring, at a temperature of about 30° C. (86° F.) and then wash the precipitated mercuric oxide. Now digest this freshly precipitated oxide with a little water and 15 parts of salicylic acid at a boiling temperature until the mixture becomes white; collect the mercuric salicylate on a filter, wash until the filtrate is no longer acid and dry at a temperature between 30° and 40° C. (86° and 104° F.) and finally at 100° C. (212° F.).

Description and Physical Properties—An odorless, white, slightly yellowish or slightly pinkish powder.

Mercuric Salicylate is practically insoluble in water and in alcohol. It is dissolved by solutions of the fixed alkalies or their carbonates and by warm solutions of the alkali halides, with the formation of double salts.

Tests for Identity—Heat 1 Gm. of Mercuric Salicylate with 10 cc. of hydrochloric acid: a solution is obtained from which salicylic acid separates on cooling. A piece of copper foil added to a portion of the filtered solution, nearly neutralized with ammonia T.S., immediately becomes coated with metallic mercury.

To a mixture of 1 Gm. of Mercuric Salicylate with 10 cc. of distilled water add a few drops of ferric chloride T.S.: a violet color is produced.

Tests for Purity—When volatilized at about 300° C., Mercuric Salicylate leaves not more than 0.2 per cent of residue.

Mercuric Salicylate does not redden moistened blue litmus paper (*free salicylic acid*).

No dark color results at once on shaking about 0.1 Gm. of Mercuric Salicylate with 5 cc. of hydrogen sulphide T.S. (*foreign mercury compounds*). About 0.2 Gm. of Mercuric Salicylate dissolves completely in 4 cc. of normal sodium hydroxide.

Assay—Digest about 0.5 Gm. of Mercuric Salicylate, accurately weighed, in a mixture of 15 cc. of sulphuric acid and 10 cc. of nitric acid contained in a long neck flask in which a small funnel is inserted. Heat it upon a sand bath until the mixture is nearly colorless, then add another 10 cc. of nitric acid, and heat until the mixture is decolorized. Cool the solution, dilute it with 150 cc. of distilled water, add 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate until a permanent yellowish-red color is produced. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01003 Gm. of Hg.

Mercuric Salicylate may also be assayed by the electrolytic method, page 1515.

This assay is explained on page 1461.

Preserve in well-closed containers, protected from light.

Uses—It is used medicinally as an intra-muscular injection in syphilis; dose, 1 grain (0.06 Gm.) twice a week, suspended (1 in 10) in neutral oil. Wollheim recommends the following formula for its suspension for hypodermic injection: 2 Gm. of quinine and urea hydrochloride, 2 cc. of distilled water, 12 Gm. of anhydrous wool fat, 10 Gm. of mercuric salicylate and sufficient olive oil to make 100 cc. (see also *Ampuls of Mercuric Salicylate*). The mixture should be sterilized before use. Some mixtures contain cacao butter.

HYDRARGYRI OXIDUM RUBRUM. N. F. Red Mercuric Oxide

(U. S. P. IX)

[Hydrarg. Oxid. Rub.—Red Precipitate]

Red Mercuric Oxide contains, when dried to constant weight at 150° C., not less than 99.5 per cent of HgO (216.60).

Preparation—This oxide may be prepared by dissolving 36 oz. av. of mercury in 24 oz. av. of nitric acid and water to make 2 pints, with the aid of gentle heat, the acid and the water being previously mixed. The solution is then evaporated to dryness when a residue of mercuric nitrate is obtained. The dry mass is then rubbed into a powder and heated in a

very shallow vessel until red vapors are no longer evolved. By this time the heat has decomposed the salt leaving a residue of mercuric oxide. The equation is as follows:

$$\underset{\text{mercuric nitrate}}{2Hg(NO_3)_2} = \underset{\text{mercuric oxide}}{2HgO} + \underset{\text{nitrogen dioxide}}{4NO_2} + \underset{\text{oxygen}}{O_2}$$

Description and Physical Properties—Red Mercuric Oxide occurs as heavy, orange-red, crystalline scales, or as a crystalline powder, acquiring a yellow color when finely divided; odorless and having a somewhat metallic taste, permanent in the air.

Red Mercuric Oxide is almost insoluble in water; insoluble in alcohol; readily dissolved by diluted nitric acid, or by hydrochloric acid.

Tests for Identity—When heated to about 400° C., Red Mercuric Oxide becomes dark violet or almost black, but assumes its original color on cooling. At a red heat it is completely decomposed into oxygen and metallic mercury, and is finally volatilized without leaving more than 0.2 per cent of residue.

A solution of 0.5 Gm. of Red Mercuric Oxide in 25 cc. of either hydrochloric or nitric acid is not more than slightly turbid.

Tests for Purity—Heat 0.5 Gm. of Red Mercuric Oxide for two hours, in a test tube on a water bath, with a solution of 1 Gm. of oxalic acid in 10 cc. of distilled water and 1 cc. of ammonia water, replacing, from time to time, the water lost by evaporation; it will not change color within two hours (distinction from yellow mercuric oxide).

Mix 1 Gm. of Red Mercuric Oxide with 5 cc. of distilled water, add 2 cc. of sulphuric acid, cool the mixture and carefully pour upon it 2 cc. of ferrous sulphate T.S.; no brown zone develops at the line of contact (*nitrate*).

Assay—Dissolve about 0.5 Gm. of Red Mercuric Oxide, previously dried to constant weight at 150° C. and accurately weighed, in 10 cc. of distilled water and 5 cc. of nitric acid, and further dilute the solution with 150 cc. of distilled water. Then add 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate to the production of a permanent yellowish-red color.

Each cc. of tenth-normal potassium thiocyanate used corresponds to 0.01083 Gm. of HgO. Each Gm. of Red Mercuric Oxide, previously dried to constant weight, corresponds to not less than 91.9 cc. of tenth-normal potassium thiocyanate.

This assay is explained on page 1461.

Red Mercuric Oxide, previously dried to constant weight, may also be assayed by the electrolytic method (see U. S. P. X).

Preserve it in well-closed containers, protected from light.

N. F. Preparation—Unguentum Hydrargyri Oxidi Rubri.

Uses—Red mercuric oxide has the same chemical composition as the yellow oxide. It is used in the form of ointment for inflamed eyelids, in skin diseases, and for destroying body vermin. A 10 per cent ointment is official in the N. F. (see page 509). There is difficulty in rubbing down the crystalline powder to a smooth ointment. In fact, when reduced to a proper degree of fineness, it corresponds to the yellow oxide, and the Pharmacopœia has adopted only the yellow oxide for the preparation of its 1 per cent ointment. The yellow oxide is largely replacing the red oxide.

Unofficial Salts of Mercury

Hydrargyri Acetas, $Hg(C_2H_3O_2)_2$ Mercuric Acetate	A white, crystalline powder. It is soluble in water and is poisonous. It is used in medicine
Hydrargyri Benzoas, $Hg(C_6H_5COO)_2.H_2O$ Mercuric Benzoate	A white, crystalline salt; slightly soluble in water. Its chief use is in medicine
Hydrargyri Bromidum, $HgBr_2$ Mercuric Bromide	A poisonous, white, crystalline salt; slightly soluble in water. It is used in medicine
Hydrargyri Carbonas, Hg_2CO_3 Mercurous Carbonate	An unimportant black, or yellow powder; insoluble in water. It is readily decomposed by heat and by hot water
Hydrargyri Chloras, $Hg(ClO_3)_2$ Mercuric Chlorate	White, crystalline needles, easily decomposed by heat; slightly soluble in water. It has been used in medicine but is of little importance
Hydrargyri Chromas, $HgCrO_4$ Mercuric Chromate	A dark red crystalline powder; slightly soluble in water. It is decomposed by heat and by acids
Hydrargyri Cyanidum, $Hg(CN)_2$ Mercuric Cyanide	Poisonous, colorless, transparent crystals which darken on exposure to light. It is soluble in water and is used in medicine, in photography, and in the manufacture of cyanogen gas
Hydrargyri Oxycyanidum $Hg(CN)_2.HgO$ Mercuric Oxycyanide	White, crystalline needles, slightly soluble in water. Used as a germicide; more powerful than mercuric chloride and does not corrode steel instruments
Hydrargyri Subsulphas Flavus, $Hg(HgO)_2SO_4$ Yellow Mercuric Subsulphate	A yellow powder commonly called *turpeth mineral*. It is practically insoluble in water. The salt reddens when heated, turning yellow again when cooled. It is decomposed at higher temperatures
Hydrargyri Sulphidum Nigrum, HgS Black Mercuric Sulphide Ethiops Mineral	A black powder; insoluble in water but soluble in sodium sulphide solution. It is used as a pigment

Unofficial Salts of Mercury—*Continued*

Hydrargyri Sulphidum Rubrum, HgS Red Mercuric Sulphide Vermilion	A fine, bright scarlet powder. It is insoluble in water and is used in medicine and as a pigment in paints and in sealing wax
Hydrargyri Nitras, $HgNO_3 + H_2O$ Mercurous Nitrate	White or colorless crystals, readily soluble in water but decomposed by an excess of warm or hot water, with the formation of the basic nitrate. It is used as a reagent and in the manufacture of mercurous salts by precipitation
Hydrargyri Sulphas, $HgSO_4$ Mercuric Sulphate	A white, crystalline powder. It is decomposed at red heat and is decomposed by water, yielding basic mercuric sulphate as the result of its hydrolysis. It is used in medicine and in the manufacture of calomel and corrosive sublimate
Potassii Hydrargyri Iodidum, K_2HgI_4 Potassium Mercuric Iodide	Yellow crystals that are deliquescent and very soluble in water. It is formed when mercuric iodide is dissolved in an excess of potassium iodide solution. Potassium mercuric iodide is the active ingredient in Mayer's reagent and in Nessler's solution. It is also used in medicine and is more fully described in the New and Non-official Remedies of 1925

See also organic mercury compounds, Chapter LXI, page 878

CHAPTER LV

ANTIMONY, ARSENIC, AND BISMUTH

Sb; 120.2. As; 74.96. Bi; 209.0

These three metals have the Latin names *Antimonium*, *Arsenium*, and *Bismuthum*. They form a group which presents several analogies. Arsenic is regarded by a number of chemists as not metallic, and on account of some of its chemical relations is classed by them with the non-metallic elements, but in some of its physical properties, notably its luster, specific gravity, etc., it closely resembles the metals, and it is therefore considered in the group with antimony and bismuth.

Antimony (Stibium), Sb; 120.2

The exact derivation of the name *antimony* is unknown. There is a legend that certain monks were poisoned by it by Basil Valentine, its alleged discoverer, and that the name is derived from anti, "against", and moine, "a monk", so that the name antimony means "monk's bane", or something of that sort.

Several centuries ago metallic antimony was employed in medicine in pill form. The pills were called *Pilulæ Perpetuæ* or everlasting pills, because they were recovered from the stool of the patient, cleansed by washing and used over and over again.

The metal is found in nature in a free state, but more frequently as a sulphide, oxide, or oxysulphide. The native sulphide (called *antimonite*) is the chief source of the metal, and roasting with iron and sodium sulphide is the process generally resorted to for obtaining it. It is a brittle, brilliant metal, of a lamellated texture, of a silver-white color when pure, but bluish-white as it occurs in commerce. When rubbed between the fingers, it imparts a distinctive odor. Its specific gravity is 6.7, and its fusing point 432° C. (809.6° F.), or about a red heat. It forms three combinations with oxygen—*antimony trioxide* (antimonous oxide), Sb_2O_3; *antimony tetroxide*, Sb_2O_4 (by some considered to be an antimonate of the tetroxide of antimony, Sb_4O_8); and *antimony pentoxide* (antimonic oxide), Sb_2O_5. The first of these unites with water to form *ortho-* or meta-antimonous acid, the salts of which are called *meta-antimonites*; the third unites with water to from *ortho-, meta-, or pyro-antimonic acid,* the salts of which are called *ortho-, meta-, or pyro-antimonates.*

Tests for Salts of Antimony

1. If hydrogen sulphide is added to an acidified solution of salt of antimony, an orange-red precipitate of sulphide will be produced. This is soluble in ammonium sulphide, but is again precipitated upon the addition of an acid.

2. If hydrochloric acid is added to the sulphide, so as to form a strong solution of antimonous chloride, and this mixed with water, a white precipitate of oxychloride will be produced.

3. Zinc and iron precipitate antimony as a black powder from its solutions; copper precipitates it as a metallic film; this may be dissolved by potassium permanganate, and this solution will yield antimony sulphide with hydrogen sulphide.

ANTIMONII ET POTASSII TARTRAS. U. S. Antimony and Potassium Tartrate

[**Antim. et Pot. Tart.**—Antimonyl Potassium Tartrate, Tartrated Antimony, Tartar Emetic]

Antimony and Potassium Tartrate contains not less than 98.5 per cent of $K(SbO)C_4H_4O_6.\frac{1}{2}H_2O$ (332.36).

Preparation—This, the most important antimonial compound, may be made by a former official process, as follows:

Take of antimony oxide, in very fine powder, 2 oz.; potassium bitartrate, in very fine powder, 2½ oz.; distilled water, 18 fl. oz. To the water, heated to the boiling point in a glass vessel, add the powders, previously mixed, and boil for an hour; then filter the liquid while hot, and set it aside that crystals may form. Lastly, dry the crystals, and keep them in a well-stoppered bottle. By further evaporation, the mother water may be made to yield more crystals, which should be purified by a second crystallization.

Like potassium and sodium tartrate, this is a double salt. Two replaceable hydrogen atoms of tartaric acid ($H_2C_4H_4O_6$) are substituted by one of antimonyl (SbO) and one of potassium (K). The group (SbO) is hypothetical.

$$\underset{\text{acid potassium tartrate}}{2KHC_4H_4O_6} + \underset{\text{antimonous oxide}}{Sb_2O_3} = \underset{\text{antimony and potassium tartrate}}{2K(SbO)C_4H_4O_6} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Colorless, odorless, transparent crystals of the rhombic system, or a white granular powder. The crystals effloresce upon exposure to air.

One Gm. of Antimony and Potassium Tartrate is soluble in 12 cc. of water and in 15 cc. of glycerin, at 25° C. One Gm. is soluble in 3 cc. of boiling water. It is insoluble in alcohol.

Tests for Identity—An aqueous solution of Antimony and Potassium Tartrate (1 in 20) is slightly acid to litmus paper.

When heated to redness, it chars, emits an odor resembling that of burning sugar, and leaves a blackened residue. This residue has an alkaline reaction, and when a small fragment of it is held in a non-luminous flame, a violet tint is produced.

In an aqueous solution of Antimony and Potassium Tartrate (1 in 20), acidulated with hydrochloric acid, hydrogen sulphide T.S. produces an orange-red precipitate, which is soluble in ammonium sulphide T.S. or potassium hydroxide T.S.

Tests for Purity—A 10 cc. portion of an aqueous solution of the salt (1 in 100) acidulated with acetic acid does not at once assume a blue color on the addition of 5 drops of potassium ferrocyanide T.S. (*iron*).

Dissolve 0.1 Gm. of Antimony and Potassium Tartrate in 5 cc. of concentrated hydrochloric acid: the solution meets the requirements of Bettendorf's Test for *arsenic*, page 1512.

Assay—Dissolve about 0.5 Gm. of Antimony and Potassium Tartrate, accurately weighed, in 30 cc. of distilled water, add 25 cc. of a cold, saturated solution of sodium bicarbonate and a few drops of starch T.S., and immediately titrate with tenth-normal iodine to the production of a permanent blue color. Each cc. of tenth-normal iodine corresponds to 0.01662 Gm. of $K(SbO)C_4H_4O_6.\frac{1}{2}H_2O$.

This assay is explained on page 1470.

Preserve in well-closed containers.

U. S. P. Preparations—Mistura Glycyrrhizæ Composita; Syrupus Scillæ Compositus.
N. F. Preparation—Tinctura Antimonii.

History—Adrian Mynsicht, the celebrated German physician of the early seventeenth century, who invented Elixir of Vitriol, is also credited with having first discovered and used tartar emetic. Glauber in 1648 described in detail the process of preparing *Mynsicht's Emetic Tartar* as it was then called.

Uses—Tartar emetic is now rarely used as an emetic. It is employed chiefly as a diaphoretic and expectorant. It also is of value in certain chronic infections, especially African sleeping sickness.

Dose—One-twentieth grain (0.003 Gm.).

Antidotes—(See Part XV, on Antidotes).

ANTIMONII OXIDUM. N. F. Antimony Oxide
[Antim. Oxid.]

Antimony Oxide contains not less than 97 per cent of antimonous oxide ($Sb_2O_3 = 288.4$).

Preparation—It may be prepared by pouring a solution of antimonous chloride into a large bulk of water to precipitate the oxychloride and then decomposing this by the addition of sodium carbonate.

Description and Physical Properties—Antimony Oxide is a white or grayish-white powder, odorless and tasteless.

It is insoluble in water, alcohol or nitric acid; readily dissolved by hydrochloric acid without effervescence, and also by a warm aqueous solution of tartaric acid or by a boiling aqueous solution of potassium bitartrate.

When heated Antimony Oxide turns yellow, but it again becomes white on cooling. At a dull red heat it fuses to a yellowish liquid and at a higher temperature it volatilizes.

Tests for Identity—Dissolve Antimony Oxide in a slight excess of hydrochloric acid and dilute the solution with a large volume of distilled water; a white precipitate is produced which is changed to orange by hydrogen sulphide.

Tests for Purity—A solution of 0.1 Gm. of the Oxide in 3 cc. of hydrochloric acid and 5 cc. of distilled water is not rendered turbid at once by a few drops of barium chloride T.S. (*sulphate*).

A solution of 0.1 Gm. of the Oxide in 10 cc. of distilled water and 1 Gm. of tartaric acid does not become more than slightly opalescent on the addition of 0.2 cc. of nitric acid and 0.2 cc. of silver nitrate T.S. (*chloride*).

Dissolve 0.5 Gm. of the Oxide in 10 cc. of hydrochloric acid, dilute the solution with distilled water until it begins to become permanently turbid and then precipitate with hydrogen sulphide. This precipitate when thoroughly washed with distilled water dissolves in ammonium sulphide T.S. or sodium sulphide T.S., without leaving a black insoluble residue (*copper* or *lead*).

A solution of 0.1 Gm. of Antimony Oxide in 5 cc. of hydrochloric acid does not respond to Bettendorf's test for arsenic (see page 1512).

Assay—Dissolve about 0.2 Gm. of Antimony Oxide, accurately weighed, by warming it in a solution of 1 Gm. of tartaric acid in 10 cc. of distilled water (adding a few drops of hydrochloric acid to aid the solution). Nearly neutralize the solution with sodium carbonate, then add 40 cc. of a cold saturated solution of sodium bicarbonate and titrate at once with tenth-normal iodine, using starch T.S. as indicator.

Each cc. of tenth-normal iodine corresponds to 0.00721 Gm. of Sb_2O_3. One Gm. of Antimony Oxide corresponds to not less than 134.5 cc. of tenth-normal iodine.

This assay is explained on page 1470.

N. F. Preparation—Pulvis Antimonialis.

Uses—It is rarely given uncombined. It is an ingredient in antimonial powder (see page 481). The dose is one grain (0.06 Gm.).

Unofficial Salts of Antimony

Antimonii Bromidum, $SbBr_3$ Antimony Bromide	A yellowish-white, crystalline salt; deliquescent; decomposed by water, yielding a basic bromide of antimony. It is used as a reagent
Antimonii Chloridum, $SbCl_3$ Antimony Trichloride	Commonly called *butter of antimony*. A colorless, transparent, crystalline mass; soluble in water but decomposed by a large amount of water, yielding the insoluble basic chloride. It is used in the manufacture of antimony salts, in bronzing iron and steel, as a mordant, and as a caustic in veterinary practice
Antimonii Fluoridum, SbF_3 Antimony Fluoride	Heavy colorless, deliquescent crystals; soluble in water containing potassium fluoride. It is used in ceramics and as a mordant for cotton goods
Antimonii Iodidum, SbI_3 Antimony Iodide	A brownish-red, crystalline mass. It is decomposed by water, yielding a basic compound
Antimonii Pentasulphidum, Sb_2S_5 Antimony Pentasulphide	Called *golden sulphide of antimony*. An orange-red, insoluble powder that dissolves in alkali sulphide solutions. It is decomposed by heat, yielding antimony trisulphide and sulphur. It is used in the vulcanizing of rubber
Antimonii Sulphas, $Sb_2(SO_4)_3$ Antimony Sulphate	An explosive white powder; decomposed by water. It is used in explosives and in pyrotechnics
Antimonii Sulphidum, Sb_2S_3 Antimony Trisulphide (U. S. P. 1890)	A grayish-black, crystalline powder when from the natural source. This is called *black antimony*. When made by precipitation it is an orange-red, crystalline powder. Both forms are insoluble in water and both are used as pigments. The black antimony is also employed in medicine and in condition powders for horses and cattle
Antimonii Sulphidum Purificatum, Sb_2S_3 Purified Antimony Sulphide (U. S. P. 1890)	A heavy, grayish-black powder; insoluble in water but dissolved in hydrochloric acid with the evolution of hydrogen sulphide. It is purified by treatment with ammonia water
Antimonium Sulphuratum, Sb_2S_3 and Sb_2O_3 (N. F. IV) Sulphurated Antimony, Antimony Oxysulphide Kermes Mineral	A brown-red powder, insoluble in water, becoming lighter on exposure to air. It is odorless and tasteless and is insoluble in water and in alcohol. It is used as an alterative and diaphoretic in doses of from one to five grains (0.06 to 0.3 Gm.)

Arsenic, As; 74.96

The name *arsenic* is probably from the Greek word "arsen" signifying male. The yellow sulphide of arsenic was known to Dioscorides who called it "arsenikon", probably on account of its powerful properties. It is found in many minerals, generally as sulphides (*realgar*, As_2S_2, and *orpiment*, As_2S_3,) or as *arsenopyrite*, FeAsS. It may be easily obtained from arsenous oxide by heating it with charcoal. Arsenic is a brilliant crystalline element, of a steel-gray color when freshly sublimed; upon exposure to the air its surface becomes blackish and dull. Its specific gravity is 5.63 to 5.73. It forms two combinations with oxygen, arsenous and arsenic oxides, As_2O_3 and As_2O_5, respectively, the corresponding acids to the first being *arsenous acid* (H_3AsO_3, known only in solution) and *metarsenous acid* ($HAsO_2$, known only in salts) and to the second *ortho-arsenic acid* (H_3AsO_4), *pyro-arsenic acid* ($H_4As_2O_7$), and *meta-arsenic acid* ($HAsO_3$), and three with sulphur,—namely, the disulphide, or *realgar*, As_2S_2; the trisulphide, or *orpiment*, As_2S_3, corresponding in composition to arsenous oxide; and the pentasulphide, As_2S_5, corresponding to arsenic oxide.

Tests for Arsenic and its Salts

Arsenates—Soluble arsenates yield with silver nitrate T.S. a dark red precipitate which is soluble in diluted nitric acid. When hydrogen sulphide is passed into a solution of an arsenate containing hydrochloric acid, a yellow precipitate is slowly formed. This precipitate is soluble in ammonium sulphide T.S. Soluble arsenates yield a white precipitate with magnesia mixture T.S.

Arsenous Compounds—Solution of arsenous compounds, to which hydrochloric acid has been added, yield with hydrogen sulphide a yellow precipitate which is insoluble in strong hydrochloric acid but soluble in ammonium carbonate T.S.

ARSENI TRIOXIDUM. U.S. Arsenic Trioxide

[Arsen. Triox.—Arsenous Acid, Arsenous Oxide, White Arsenic]

Arsenic Trioxide, when dried to constant weight at 100° C., contains not less than 99.8 per cent of As_2O_3(197.92).

Note—*Powdered Arsenic Trioxide when administered in solid form, as in powders, tablets, and pills, must consist of particles not greater than* 0.0125 *mm. in diameter.*

Preparation—Arsenic trioxide, or, as it is commonly termed, *arsenic*, is made by roasting arsenical ores in reverberatory furnaces with long, horizontal flues; the arsenic trioxide collects as a solid sublimate, which is afterwards resublimed in cast iron vessels with conical heads. It is also formed by burning metallic arsenic in air. In either case the roasting or the burning effects a direct combination of arsenic with oxygen as expressed by the equation:

$$\underset{\text{arsenic}}{As_2} + \underset{\text{oxygen}}{3O_2} = \underset{\text{arsenic trioxide}}{2As_2O_3}$$

Chemically, it is an oxide, As_2O_3, the acid being formed when the oxide is dissolved in water.

$$\underset{\text{arsenic trioxide}}{2As_2O_3} + \underset{\text{water}}{6H_2O} = \underset{\text{arsenous acid}}{4H_3AsO_3}$$

Description and Physical Properties—A white powder, or irregular masses of two varieties, one amorphous, transparent, and colorless, like glass; the other, crystalline, opaque and white, resembling porcelain. Frequently the same piece has an opaque, white, outer crust enclosing the

glassy variety. Contact with moist air gradually changes the glassy into the white, opaque variety. All varieties are odorless.

Caution—Arsenic Trioxide is extremely poisonous.

Arsenic Trioxide is slowly soluble in water, the amorphous or glassy variety being somewhat more soluble than the crystalline. It is slightly soluble in alcohol and in ether, and freely soluble in glycerin. It is dissolved by hydrochloric acid and by solutions of alkali hydroxides and carbonates.

Tests for Identity—An aqueous solution of Arsenic Trioxide is faintly acid to litmus paper.

When slowly heated in a dry test tube of hard glass, Arsenic Trioxide yields a sublimate of minute crystals. When heated rapidly to about 200° C., the amorphous variety fuses, then sublimes, while the crystalline variety sublimes without fusing.

When Arsenic Trioxide is covered with charcoal in an ignition tube and strongly heated, it is reduced to metallic arsenic which is deposited on the cooler portion of the tube as a mirror, having a metallic luster. This mirror is rapidly soluble in solutions of chlorinated lime or chlorinated soda.

Hydrogen sulphide T.S. colors an aqueous solution of Arsenic Trioxide (1 in 100) yellow. Upon the addition of a few drops of hydrochloric acid to the colored solution, a lemon-yellow precipitate of arsenic trisulphide is produced.

Tests for Purity—Not more than 0.1 per cent of residue remains upon the ignition of 1 Gm. of Arsenic Trioxide.

Dissolve 1 Gm. of Arsenic Trioxide in 10 cc. of ammonia T.S. with the aid of gentle heat: a clear, colorless solution results.

Dissolve about 0.2 Gm. of Arsenic Trioxide in 50 cc. of distilled water with the aid of 2 cc. of hydrochloric acid and completely precipitate by hydrogen sulphide. Allow the precipitate to subside, and pour off the clear liquid: the precipitate dissolves completely upon the addition of an excess of ammonium carbonate T.S. (*antimony, tin, or cadmium*).

Assay—Dissolve about 0.2 Gm. of Arsenic Trioxide, previously dried to constant weight at 100° C. and accurately weighed, in 20 cc. of boiling distilled water, and gradually add sodium hydroxide T.S. until complete solution results. Neutralize this solution with diluted sulphuric acid, using phenolphthalein T.S. as indicator, cool, dissolve in it 2 Gm. of sodium bicarbonate, and titrate the mixture with tenth-normal iodine, using starch T.S. as indicator. Each cc. of tenth-normal iodine corresponds to 0.004948 Gm. of As_2O_3.

This assay is explained on page 1470.

U. S. P. Preparations—Liquor Acidi Arsenosi; Liquor Potassii Arsenitis.

N. F. Preparations—Liquor Auri et Arseni Bromidi; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Fortiores; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Mites.

Uses—Arsenic trioxide is used as an alterative and tonic in doses of one-thirtieth of a grain (0.002 Gm.); externally, it is employed as an escharotic, and, mixed with various substances in the form of a paste, is often applied to cancers and ulcers.

Antidotes—An antidote to arsenical poisoning is official (see page 717), and the treatment of arsenic poisoning is discussed in Part XV, under Antidotes.

NOTE—*The fine degree of subdivision of the powdered form of this arsenic trioxide renders it more soluble and therefore more effective than the powder previously official. This should be borne in mind in adjusting the dosage.*

LIQUOR ACIDI ARSENOSI. U. S. Solution of Arsenous Acid

[**Liq. Acid. Arsen.**—HYDROCHLORIC SOLUTION OF ARSENIC, SOLUTION OF ARSENIC CHLORIDE]

Solution of Arsenous Acid contains, in each 100 cc., the equivalent of not less than 0.975 Gm. and not more than 1.025 Gm. of As_2O_3.

	Metric	Alternative
Arsenic Trioxide	**10 Gm.**	73 gr.
Diluted Hydrochloric Acid	**50 cc.**	384 min.
Distilled Water, a sufficient quantity, To make	**1000 cc.**	1 pint

Mix the diluted hydrochloric acid with 250 cc. [4 fl. oz.] of distilled water in a flask, add the arsenic trioxide, and boil the liquid until the arsenic trioxide is completely dissolved. Allow the solution to cool, transfer it to a 1000 cc. [1 pint] graduated flask or cylinder, rinse the vessel in which the solution was boiled, with several portions of distilled water, and add the rinsings and

enough distilled water to make the product measure 1000 cc. [1 pint]. Filter if necessary.

This is simply a solution of arsenous acid in diluted hydrochloric acid, no chemical action taking place.

Description and Physical Properties—A clear, colorless liquid without odor.

Solution of Arsenous Acid is acid to litmus paper.

Test for Identity—Hydrogen sulphide T.S. added to Solution of Arsenous Acid produces a lemon-yellow precipitate of arsenic trisulphide, which is completely soluble in ammonium carbonate T.S.

Assay—Measure exactly 20 cc. of Solution of Arsenous Acid and dilute with about 50 cc. of distilled water, dissolve enough sodium bicarbonate in this solution to make it distinctly alkaline (usually about 2 Gm.), and titrate with tenth-normal iodine, using starch T.S. as indicator. Each cc. of tenth-normal iodine corresponds to 0.004948 Gm. of As_2O_3.

This assay is explained on page 1471.

Uses—Solution of arsenous acid is used as an alterative, in doses of three minims (0.2 cc.).

LIQUOR POTASSII ARSENITIS. U.S. Solution of Potassium Arsenite

[**Liq. Pot. Arsen.**—Fowler's Solution, Liquor Arsenicalis Fowleri P. I.]

Solution of Potassium Arsenite contains, in each 100 cc., the equivalent of not less than 0.975 Gm. and not more than 1.025 Gm. of As_2O_3.

	Metric	Alternative
Arsenic Trioxide	**10 Gm.**	73 gr.
Potassium Bicarbonate	**20 Gm.**	146 gr.
Compound Tincture of Lavender	**30 cc.**	230 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	1 pint

Boil the potassium bicarbonate and arsenic trioxide in a flask with 100 cc. [1½ fl. oz.] of distilled water until solution is effected. Cool the solution, and transfer it to a 1000 cc. [1 pint] graduated container, rinsing the flask in which the liquid was boiled with several portions of distilled water to make a solution measuring 970 cc. [15 fl. oz.]. Add the compound tincture of lavender, mix thoroughly, and filter if necessary.

$$\underset{\text{potassium bicarbonate}}{2KHCO_3} + \underset{\text{arsenic trioxide}}{As_2O_3} = \underset{\text{potassium metarsenite}}{2KAsO_2} + \underset{\text{carbon dioxide}}{2CO_2} + \underset{\text{water}}{H_2O}$$

When arsenic trioxide is boiled with acid potassium carbonate in concentrated solution, carbon dioxide is evolved, and potassium metarsenite is produced; but, owing to the fact that the salts are soluble in the quantity of water directed in the formula, a solution can be effected without involving any chemical change. The proportionate quantity of potassium bicarbonate was doubled in the U. S. P. 1890. The corresponding British solution (Liquor Arsenicalis) is made from dilute solutions, and its title does not indicate any chemical action.

Description and Physical Properties—A clear or faintly opalescent liquid, having a pink color and a slight odor of lavender. It is alkaline to litmus paper.

Test for Identity—Add to 10 cc. of the Solution an excess of hydrochloric acid and an equal volume of hydrogen sulphide T.S.: a yellow precipitate is produced which is soluble in ammonium carbonate T.S.

Test for Purity—Acidulate 4 cc. of Solution of Potassium Arsenite with diluted nitric acid, add 1 cc. of silver nitrate T.S. and superimpose a layer of ammonia T.S. upon this liquid: no red or reddish-brown color is observed at the line of contact (*arsenate*).

Assay—Measure exactly 20 cc. of Solution of Potassium Arsenite, dilute with 75 cc. of distilled water, acidify the mixture very slightly with diluted hydrochloric acid, then dissolve

in the solution 2 Gm. of sodium bicarbonate, and titrate the resulting liquid with tenth-normal iodine, starch T.S. being used as indicator. Each cc. of tenth-normal iodine corresponds to 0.004948 Gm. of As_2O_3.

Alcohol content, by volume, 1 to 3 per cent.

This assay is explained on page 1471.

History—This preparation was given publicity by Thomas Fowler, M.D., an English physician of the latter part of the eighteenth century. He based it upon a proprietary preparation called "tasteless ague and fever drops" which he analysed with the aid of a local pharmacist named Hughes. He proposed for it the name of *Liquor Mineralis* to conceal the presence of arsenic from the patient.

Uses—Solution of potassium arsenite is largely used as an alterative and tonic in doses of three minims (0.2 cc.).

Antidotes—(See Part XV, on Antidotes).

See "A Century of the United States Pharmacopœia—1820-1920—Liquor Potassii Arsenitis", by H. A. Langehan—(J. A. Ph. A., 1925, pages 408, 507, and 579).

ARSENI IODIDUM. U. S. Arsenous Iodide

[**Arsen. Iod.**—Arsenic Tri-iodide, Arsenic Iodide]

Arsenous Iodide, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of AsI_3 (455.72).

Preparation—In a former official process this iodide was made by a direct combination of the elements as follows:

Take of arsenic trioxide, 60 grains; iodine, 300 grains. Rub the arsenic trioxide in a mortar until reduced to a fine powder; then add the iodine, and rub them together until they are thoroughly mixed. Put the mixture into a small flask or a test tube, loosely stoppered, and heat it very gently until liquefaction occurs. Then incline the vessel in different directions, in order that any portion of the iodine, which may have condensed on its surface, may be returned into the melted mass. Lastly, pour the melted iodide on a porcelain slab, and when it is cold break it into pieces, and keep it in a well-stoppered bottle.

By this process it is difficult to secure entire combination but a purer salt can be made if the pieces are rubbed in a mortar to a powder, chloroform added until as much as possible is dissolved, the solution evaporated, and the crystalline powder washed and dried. A better process consists in pouring a solution of 10 Gm. of arsenic trioxide in 250 cc. of hydrochloric acid into a solution of 51 Gm. of potassium iodide in 40 cc. of hot water, extracting the residue with chloroform, evaporating the solution, and washing and drying the crystalline powder.

Description and Physical Properties—An orange-red, inodorous, crystalline powder, stable when protected from direct sunlight and kept in a cool place.

Caution—Arsenous Iodide is extremely poisonous.

One Gm. of Arsenous Iodide is soluble in about 12 cc. of water at 25° C. with partial decomposition. It is soluble in alcohol, chloroform, ether, and carbon disulphide.

A freshly prepared aqueous solution of the salt is colorless, but upon standing it gradually decomposes with the formation of arsenous and hydriodic acids and becomes yellow, due to the liberation of iodine.

No loss of iodine occurs when dry Arsenous Iodide is heated on a water bath, but at higher temperatures it volatilizes.

Tests for Identity—An aqueous solution of Arsenous Iodide (1 in 50) responds to the reactions for arsenous compounds, page 764, and for iodides, page 575.

Test for Purity—When volatilized, Arsenous Iodide leaves not more than 0.5 per cent of residue.

Assay—Proceed as directed under the assay for iodides, page 575, using about 0.5 Gm. of Arsenous Iodide, previously dried to constant weight over sulphuric acid and accurately weighed. Each cc. of tenth-normal silver nitrate corresponds to 0.01519 Gm. of AsI_3.

This assay is explained on page 1462.

Preserve in amber-colored glass stoppered vials, in a cool place, protected from light.

U. S. P. Preparation—Liquor Arseni et Hydrargyri Iodidi.

Uses—The principal use of this salt is in making solution of arsenous and mercuric iodides. The dose is one-twelfth of a grain (0.005 Gm.) as an alterative.

Antidotes—(See Part XV, on Antidotes).

LIQUOR ARSENI ET HYDRARGYRI IODIDI. U. S. Solution of Arsenous and Mercuric Iodide

[Liq. Arsen. et Hydrarg. Iod.—DONOVAN'S SOLUTION]

Solution of Arsenous and Mercuric Iodide is an aqueous solution containing, in each 100 cc., not less than 0.95 Gm. and not more than 1.05 Gm. of AsI_3(455.72), and not less than 0.95 Gm. and not more than 1.05 Gm. of HgI_2 (454.44).

	Metric	Alternative
Arsenous Iodide	**10 Gm.**	**73 gr.**
Red Mercuric Iodide	**10 Gm.**	**73 gr.**
Distilled Water, a sufficient quantity, To make	**1000 cc.**	**1 pint**

Triturate the arsenous iodide and red mercuric iodide in a mortar, add 150 cc. [2½ fl. oz.] of distilled water, and continue the trituration until solution is effected. Filter the solution, and pass sufficient distilled water through the filter to make the product measure 1000 cc. [1 pint]. Mix thoroughly.

It must not be dispensed if darker than pale yellow.

This solution, in which no chemical change occurs, should be of a light straw color; when darker than this, free iodine is probably present, and if a globule of mercury or a few grains of metallic arsenic are dropped into the bottle containing the solution, and the whole well agitated and filtered, the proper color may be restored.

Description and Physical Properties—A clear, colorless or pale yellowish liquid.

Tests for Identity—Lead acetate T.S. produces in Solution of Arsenous and Mercuric Iodide, diluted with 10 volumes of distilled water, a bright yellow precipitate.

Add 5 drops of Solution of Arsenous and Mercuric Iodide to a mixture of about 0.5 Gm. of zinc and 5 cc. of diluted hydrochloric acid in a test tube, and cover the mouth of the test tube with mercuric bromide test paper: a yellow stain appears upon the inner surface of the test paper within one minute.

Solution of Arsenous and Mercuric Iodide responds to the tests for mercury, page 747.

Assay for Arsenous Iodide—Measure accurately 25 cc. of Solution of Arsenous and Mercuric Iodide into a flask, dilute with 25 cc. of distilled water, then dissolve 2 Gm. of sodium bicarbonate in this solution, and titrate with tenth-normal iodine, using starch T.S. as indicator. Each cc. of tenth-normal iodine corresponds to 0.02279 Gm. of AsI_3.

This assay is explained on page 1471.

Assay for Mercuric Iodide—Measure accurately 25 cc. of Solution of Arsenous and Mercuric Iodide into a flask, add 5 cc. of potassium hydroxide T.S. and 5 cc. of formaldehyde T.S. and warm the mixture on a water bath until the mercuric salt has been completely reduced to metallic mercury. Carefully decant the clear, supernatant liquid from the residue of metallic mercury, and wash the mercury carefully by decantation with two successive portions of 25 cc. each of distilled water. Dissolve the residue of metallic mercury in 5 cc. of nitric acid by the application of gentle heat, dilute the solution with 50 cc. of distilled water, add 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth-normal potassium thiocyanate. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.02272 Gm. of HgI_2.

This assay is explained on page 1462.

Preserve in well-filled, amber-colored bottles.

Uses—Solution of arsenous and mercuric iodide is used as an alterative in syphilis and chronic skin diseases. The dose is one and one-half minims (0.1 cc.), largely diluted.

SODII ARSENAS. N. F. Sodium Arsenate

For an account of the preparation and uses of this salt, see page 635. It is now official in the N. F.

SODII ARSENAS EXSICCATUS. N. F. Exsiccated Sodium Arsenate

For the official method of preparation and its uses, see page 636.

LIQUOR SODII ARSENATIS. N. F. Solution of Sodium Arsenate

For the formula, tests and uses, see page 637.

LIQUOR SODII ARSENATIS DILUTUS. N. F. Diluted Solution of Sodium Arsenate

For the formula, tests and uses, see page 637.

LIQUOR AURI BROMIDI ET ARSENI. N. F. Solution of Gold Bromide and Arsenic

[**Liq. Aur. Brom. et Arsen.**—Liquor Auri et Arseni Bromidi, N. F. IV]

	Metric	Alternative
Arsenic Trioxide	**2.50 Gm.**	36½ gr.
Bromauric Acid	**3.25 Gm.**	47 gr.
Bromine	**4.00 Gm.**	58 gr.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Place the arsenic trioxide and bromine in a flask, add 135 cc. [4 fl. oz. 154 min.] of distilled water and heat the mixture gently until solution is effected and all free bromine has disappeared. Then add bromine water, 1 to 2 cc. [15 to 30 min.] at a time, until it is present in slight excess, or until the solution retains a bromide color during thirty minutes. Transfer the solution to a porcelain dish, expel the excess of bromine with the aid of gentle heat, and dilute the solution with distilled water to about 600 cc. [19 fl. oz.]. Dissolve the bromauric acid in this solution and add sufficient distilled water to make the product measure 1000 cc. [2 pints].

Solution of Gold and Arsenic Bromide is a clear liquid having a reddish-brown color. It is acid to litmus paper.

Specific gravity: about 1.004 at 25° C.

Evaporate 10 cc. of the solution at a temperature not exceeding 100° C.: not more than 0.0394 Gm. of residue remains.

Incinerate the residue from 10 cc. of the solution: it leaves not less than 0.129 Gm. of ash corresponding to not less than 0.0104 Gm. of Au.

To 10 cc. of the solution add 5 cc. of tenth-normal silver nitrate and 5 cc. of ammonium carbonate T.S., digest the mixture for ten minutes, on a water bath, then cool and filter. The filtrate, on supersaturating with nitric acid, does not become more than slightly opalescent (chloride).

Uses—It is used chiefly in diabetes. Dose, three minims (0.2 cc.).

One average dose contains the equivalent of about:
0.0005 Gm. or $\frac{1}{125}$ grain of Arsenic Trioxide.
0.0007 Gm. or $\frac{1}{90}$ grain of Bromauric Acid.

Unofficial Compounds of Arsenic

Acetoarsenite of Copper, $Cu(C_2H_3O_2)_2.3Cu(AsO_2)_2$ Paris Green, Schweinfurth's Green	A green powder, used extensively for the destruction of potato bugs by dusting it from the vines. The commercial product is rarely pure. It is very poisonous and the antidotes are the same as for other arsenic poisoning (see Antidote, Part XV)
Arseni Bromidum, $AsBr_3$ Arsenic Bromide	Yellowish-white, poisonous crystals; soluble in water. It is used in medicine and as a chemical reagent
Arseni Chloridum, $AsCl_3$ Arsenic Chloride	A colorless, pungent, oily liquid. When poured into a large quantity of water it deposits arsenous oxide. It is poisonous
Arseni Disulphidum, As_2S_2 Arsenic Disulphide	An orange-red powder, poisonous; insoluble in water. It occurs in nature as the mineral *realgar*. It is used as a pigment and in the manufacture of colored fires
Arseni Trisulphidum, As_2S_3 Arsenic Trisulphide	Commonly called *orpiment*. A yellow or orange-yellow powder, insoluble in water. It is poisonous and is used as a pigment and in medicine
Arsenite of Copper, $Cu_3(AsO_3)_2$ Copper Arsenite, Copper Orthoarsenite, Scheele's Green	Used in the treatment of diarrhea and cholera morbus, also as a remedy for anemia. Dose, one-hundredth to one-twentieth grain (0.0006 to 0.003 Gm.)

Bismuth, Bi; 208.0

The origin of the name *bismuth* is not definitely known. Miners often call the element "wismuth" and it has been suggested that this word comes from "wisse" or "wiese", meaning meadow, because it has often been found in the mines covered with incrustations of various colors resembling a meadow covered with flowers. It is found in the metallic state, and as sulphide, known as *bismuthinite* (Bi_2S_3) and occasionally as the oxide (Bi_2O_3). It is a crystalline, brittle, pulverizable, brilliant metal, having a silver color, with a reddish tint. Its specific gravity is 9.8. It closely resembles metallic antimony in appearance.

Tests for Salts of Bismuth

When dissolved in a slight excess of nitric or hydrochloric acid, bismuth salts yield a white precipitate upon dilution with water. This precipitate is blackened by hydrogen sulphide, and the resulting compound dissolves in a warm mixture of equal parts of nitric acid and water.

BISMUTHI SUBCARBONAS. U.S. Bismuth Subcarbonate

[Bism. Subcarb.—Basic Bismuth Carbonate, Bismuth Oxycarbonate]

Bismuth Subcarbonate is a basic salt of varying chemical composition, which, when dried to constant weight at 100° C., yields upon ignition not less than 90 per cent of bismuth oxide [$Bi_2O_3 = 466.00$].

Preparation—Bismuth subcarbonate may be made as follows:

Take of bismuth in pieces, 2 oz. troy; nitric acid, 8½ oz. troy; ammonia water, 5 fl. oz., sodium carbonate, 10 oz. troy; distilled water, a sufficient quantity. Mix 4½ oz. troy of the nitric acid with 4 fl. oz. of distilled water in a capacious glass vessel, and, having added the bismuth, set the whole aside for twenty-four hours, dilute the resulting solution with 10 fl. oz. of distilled water, stir it thoroughly, and, after twenty-four hours, filter through paper. To the filtered liquid, previously diluted with 4 pints of distilled water, slowly add the ammonia water, constantly stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with two pints of distilled water, and drain it again. Then place the precipitate in a proper vessel, add the remainder of the nitric acid, and afterwards 4 fl. oz. of distilled water, and set the solution aside. At the end of twenty-four hours, filter through paper. Dissolve the sodium carbonate in 12 fl. oz. of distilled water, with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless. Lastly, press and dry it on bibulous paper with a gentle heat, and rub it into a powder.

Metallic bismuth generally contains arsenic but by this process any arsenic, if present, will be eliminated. The chemical formula is approximately $[(BiO)_2\,CO_3]_2 + H_2O$.

Description and Physical Properties—A white or pale yellowish-white powder. It is odorless and tasteless, and is stable in the air.

Bismuth Subcarbonate is insoluble in water and in alcohol. It is completely dissolved by nitric and hydrochloric acids with copious effervescence.

Test for Identity—Bismuth Subcarbonate responds to the reactions for bismuth (page 770), and for carbonates (page 589).

Tests for Purity—One Gm. of Bismuth Subcarbonate shows no more *chloride* than corresponds to 1 cc. of fiftieth-normal hydrochloric acid, page 1520.

Dissolve 3 Gm. of the salt in a sufficient quantity (about 4 cc.) of warm nitric acid, and pour the solution into 100 cc. of distilled water: a white precipitate is produced. Filter, evaporate the filtrate on a water bath to 30 cc., again filter the liquid, divide the latter filtrate into portions of 5 cc. each, and subject these several portions to the following tests:

Mix one portion with an equal volume of diluted sulphuric acid: the liquid does not become cloudy (*lead*).

Precipitate another portion with a slight excess of ammonia T.S.: the supernatant liquid does not exhibit a bluish tint (*copper*).

Another portion is not immediately affected by barium nitrate T.S. (*sulphate*).

In another portion, hydrochloric acid produces no precipitate which is insoluble in a slight excess of hydrochloric acid, but soluble in ammonia T.S. (*silver*).

Boil 1 Gm. of Bismuth Subcarbonate with 20 cc. of a mixture of equal volumes of acetic acid and distilled water, cool the solution, and filter. Add 2 cc. of diluted hydrochloric acid, remove the bismuth by the addition of hydrogen sulphide, boil the mixture, and again filter: the latter filtrate leaves not more than 0.005 Gm. of residue on evaporation and gentle ignition (*alkalies or alkali earths*).

Agitate about 0.05 Gm. of Bismuth Subcarbonate with 5 cc. of a solution of equal volumes of distilled water and ferrous sulphate T.S. and cautiously superimpose the mixture upon 5 cc. of concentrated sulphuric acid: no brownish-red zone forms at the line of contact of the two liquids (*nitrate*).

The residue resulting from the ignition of 2 Gm. of Bismuth Subcarbonate does not respond to Bettendorf's test for *arsenic*, page 1512.

Assay—Dry about 1 Gm. of Bismuth Subcarbonate to constant weight at 100° C., weigh accurately in a tared porcelain crucible, ignite at a red heat, and weigh the resulting bismuth oxide. The residue of bismuth oxide (Bi_2O_3) corresponds to not less than 90 per cent of the original weight of Bismuth Subcarbonate taken.

This assay is explained on page 1477.

Preserve protected from light.

Uses—Bismuth Subcarbonate is used for its protective and antacid effect in inflammations of the stomach and bowels. It is also given in large doses (two ounces) for rendering the alimentary canal opaque to X-ray. It is employed for the same purposes as the subnitrate, but is to be preferred to the subnitrate in mixtures containing carbonates, as the acidity, often noticed in the subnitrate, frequently causes decomposition or explosion in capsules, pills, etc.; the latter, however, is much more frequently used.

The dose is from five to fifteen grains (0.3 to 1 Gm.).

BISMUTHI SUBGALLAS. U.S. Bismuth Subgallate

[**Bism. Subgal.**—Basic Bismuth Gallate, Bismuth Oxygallate, Dermatol]

Bismuth Subgallate is a basic salt of varying chemical composition, which, when dried to constant weight at 100° C., yields upon ignition not less than 52 per cent and not more than 57 per cent of bismuth oxide [$Bi_2O_3 = 466.00$].

Preparation—Bismuth subgallate may be made by dissolving bismuth subnitrate in diluted acetic acid and precipitating the solution with gallic acid, but a more convenient and rapid method is that of Thibault, which is as follows: Bismuth trioxide is triturated with water, and an excess of pure gallic acid added, continuing the trituration until the color of the mixture has changed to a greenish-yellow. It is allowed to stand twenty-four hours, washed and dried. The chemical formula is approximately $Bi(OH)_2C_7H_5O_5$.

Description and Physical Properties—An amorphous, bright yellow powder. It is odorless and tasteless, and is stable in the air.

Bismuth Subgallate is practically insoluble in water, alcohol, and ether. It is readily dissolved with decomposition by warm, moderately dilute hydrochloric, nitric, or sulphuric acid: insoluble in very dilute mineral acids. It is readily dissolved by solutions of alkali hydroxides, forming a clear, yellow liquid, which rapidly changes to a deep red.

Tests for Identity—When heated to redness, Bismuth Subgallate at first chars, leaving finally a yellow residue, which is blackened by hydrogen sulphide T.S. A solution of this residue in a slight excess of warm nitric or hydrochloric acid produces a white turbidity when added to twenty-five volumes of distilled water.

Agitate thoroughly about 0.1 Gm. of Bismuth Subgallate with an excess of hydrogen sulphide T.S., filter, boil the filtrate to remove the dissolved gas, cool, and add one drop of ferric chloride T.S.: a blue-black color is produced.

Tests for Purity—Shake 1 Gm. of Bismuth Subgallate with 20 cc. of alcohol for one minute filter, and evaporate the filtrate to dryness on a water bath: not more than 0.005 Gm. of residue remains (*free gallic acid*).

Boil 1 Gm. of Bismuth Subgallate with 20 cc. of a mixture of equal parts of acetic acid and distilled water, cool the solution, and filter. Free the filtrate from bismuth by the addition of hydrogen sulphide, boil the mixture, and again filter: the latter filtrate leaves not more than 0.005 Gm. of residue on evaporation and gentle ignition (*alkalies or alkali earths*).

Mix thoroughly about 0.05 Gm. of Bismuth Subgallate with 5 cc. of diluted sulphuric acid and 5 cc. of ferrous sulphate T.S., filter the mixture, and carefully superimpose the filtrate, without mixing, on 5 cc. of concentrated sulphuric acid, page 1542, in a test tube: no brownish-red zone forms immediately (*nitrate*).

Ignite 3 Gm. of Bismuth Subgallate in a porcelain crucible, cool, and cautiously add, drop by drop, just sufficient nitric acid to dissolve the residue when it is warmed. Evaporate the solution

to dryness, again ignite, and cool. Cautiously dissolve this residue in just sufficient nitric acid by the aid of gentle heat, concentrate the solution to about 4 cc., pour it into 100 cc. of distilled water, filter, evaporate the filtrate on a water bath to 20 cc., again filter, and divide this filtrate into portions of 5 cc. each. These portions do not respond to the tests for *lead, copper or silver* under *Bismuthi Subcarbonas.*

The residue resulting from the ignition and subsequent treatment of 2 Gm. of Bismuth Subgallate, as described in the following test, meets the requirements of Bettendorf's test for *arsenic*, page 1512.

Assay—Ignite in a porcelain crucible about 1 Gm. of Bismuth Subgallate, previously dried to constant weight at 100° C. and accurately weighed, allow it to cool, and add nitric acid to the residue, drop by drop, warming until complete solution has been effected. Evaporate this solution to dryness, carefully ignite at red heat, and weigh the resulting bismuth oxide. The residue of bismuth oxide (Bi_2O_3) corresponds to not less than 52 per cent and not more than 57 per cent of the original weight of Bismuth Subgallate taken.

This assay is explained on page 1477.

Preserve protected from light.

Uses—Bismuth subgallate has been used internally in diarrhea, in doses of eight to fifteen grains (0.5 to 1 Gm.); externally as an application to wounds and ulcerations and in the treatment of eczema.

BISMUTHI SUBNITRAS. U. S. Bismuth Subnitrate

[**Bism. Subnit.**—Basic Bismuth Nitrate, Bismuth Oxynitrate]

Bismuth Subnitrate is a basic salt of varying chemical composition, which, when dried for twenty-four hours over sulphuric acid, yields upon ignition not less than 79 per cent of bismuth oxide [$Bi_2O_3 = 466.00$].

Preparation—This important salt may be made by the former official process, as follows:

Take the bismuth, in pieces, 2 oz. troy; nitric acid, 8½ oz. troy; sodium carbonate, 10 oz. troy; ammonia water, 5 fl. oz.; distilled water, a sufficient quantity. Mix 4½ oz. troy of the nitric acid with 4 fl. oz. of distilled water, in a capacious glass vessel, and, having added the bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with 10 fl. oz. of distilled water, stir it thoroughly, and, after twenty-four hours, filter through paper. Dissolve the sodium carbonate in 20 fl. oz. of distilled water with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of bismuth nitrate, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless, and drain as completely as possible. Then place the moist precipitate in a capacious vessel, gradually add the remainder of the nitric acid, and afterwards 4 fl. oz. of distilled water, and set the solution aside. At the end of twenty-four hours, filter through paper, and to the filtered liquid, previously diluted with 4 pints of distilled water, slowly add the ammonia water, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with 2 pints of distilled water, drain it again, and press out as much of the liquid as possible. Lastly, dry it upon bibulous paper with a gentle heat, and rub it into powder.

The formation of bismuth subnitrate may be explained by the following equations:

$$\underset{\text{bismuth}}{Bi_2} + \underset{\text{nitric acid}}{8HNO_3} = \underset{\text{bismuth nitrate}}{2Bi(NO_3)_3} + \underset{\text{water}}{4H_2O} + \underset{\text{nitrogen dioxide}}{N_2O_2}$$

then

$$\underset{\text{bismuth nitrate}}{5Bi(NO_3)_3} + \underset{\text{water}}{8H_2O} = \underset{\text{bismuth subnitrate}}{4BiONO_3.H_2O} + \underset{\text{bismuth nitrate}}{Bi(NO_3)_3} + \underset{\text{nitric acid}}{8HNO_3}$$

The chemical formula is approximately $Bi(OH)_2NO_3$.

Description and Physical Properties—A white, slightly hygroscopic powder.

Bismuth Subnitrate is practically insoluble in water, insoluble in alcohol, but is readily dissolved by hydrochloric or nitric acid.

Tests for Identity—Bismuth Subnitrate responds to the reactions for bismuth (page 770), and for nitrates (page 551).

When heated to redness, it evolves brown vapors of nitrogen oxides, leaving a yellow residue.

When brought in contact with moistened blue litmus paper, Bismuth Subnitrate shows a slightly acid reaction.

Tests for Purity—Boil 1 Gm. of Bismuth Subnitrate with 20 cc. of a mixture of equal volumes of acetic acid and distilled water. Cool and filter. Add 2 cc. of hydrochloric acid, remove the bismuth by the addition of hydrogen sulphide, boil the mixture, and filter: the filtrate leaves not more than 0.005 Gm. of residue on evaporation and gentle ignition (*zinc, alkali earths or alkalies*).

Boil about 0.1 Gm. of the salt with 5 cc. of sodium hydroxide T.S.: no odor of ammonia is perceptible nor does the vapor turn moistened red litmus paper blue.

One Gm. of the salt shows no more *chloride* than corresponds to 0.5 cc. of fiftieth-normal hydrochloric acid, page 1520.

The residue resulting from the ignition of 2 Gm. of the salt meets the requirements of Bettendorf's test for *arsenic*, page 1512.

Add 3 Gm. of Bismuth Subnitrate to 3 cc. of warm nitric acid: no effervescence occurs (*carbonate*), and no residue remains (*insoluble foreign salts*). A white precipitate is produced when this solution is poured into 100 cc. of distilled water. Now filter, evaporate the filtrate on a water bath to 30 cc., again filter the liquid, and divide the new filtrate into portions of 5 cc. each. These portions do not respond to the tests for *lead, copper, sulphate or silver* under *Bismuthi Subcarbonas*.

Assay—Dry about 1 Gm. of Bismuth Subnitrate over sulphuric acid for twenty-four hours, weigh accurately in a tared porcelain crucible, ignite at red heat, and weigh the resulting bismuth oxide. The residue of bismuth oxide (Bi_2O_3) corresponds to not less than 79 per cent of the original weight of Bismuth Subnitrate taken.

This assay is explained on page 1477.

Preserve protected from light.

N. F. Preparations—Glyceritum Bismuthi; Magma Bismuthi; Unguentum Resorcinolis Compositum.

Uses—Bismuth subnitrate is largely used in intestinal disorders; less frequently as a dusting powder. The dose is from three to ten grains (0.2 to 0.6 Gm.).

BISMUTHI SUBSALICYLAS. U.S. Bismuth Subsalicylate

[**Bism. Subsalicyl.**—Basic Bismuth Salicylate, Bismuth Oxysalicylate]

Bismuth Subsalicylate is a basic salt of varying chemical composition, which, when dried to constant weight at 100° C., yields upon ignition not less than 62 per cent and not more than 66 per cent of bismuth oxide [$Bi_2O_3 = 466.00$].

Preparation—Bismuth Subsalicylate is apt to be an unstable salt. It may be made by Thibault's process, as follows: 15 Gm. of crystallized bismuth nitrate dissolved in nitric acid are precipitated by an excess of solution of sodium hydroxide. After boiling, the whole of the amorphous, white, hydrated oxide is transformed into yellow crystallized anhydrous oxide; it is then thoroughly washed, and 10 Gm. of salicylic acid, rubbed up with 200 cc. of water, are added. The whole is then left on the water bath, and when there are no more opaque, yellow needles of anhydrous oxide left, it is thoroughly washed with cold alcohol, and dried in an oven. The chemical formula is approximately $Bi(OH)_2C_7H_5O_3$.

Description and Physical Properties—A white, or nearly white, amorphous or crystalline powder. It is odorless, and is stable in the air.

Bismuth Subsalicylate is practically insoluble in cold water. Upon prolonged boiling with water, a portion of the salicylic acid passes into solution with the formation of a more basic bismuth salicylate. When treated with a slight excess of warm nitric or hydrochloric acid, it is decomposed, a flocculent white precipitate of salicylic acid separating.

Tests for Identity—When heated, Bismuth Subsalicylate at first chars, and above 300° C. leaves a yellow residue, which is blackened by hydrogen sulphide. This residue responds to the reactions for bismuth, page 770.

Agitate about 0.1 Gm. of Bismuth Subsalicylate with a solution of five drops of ferric chloride T.S. in 10 cc. of distilled water: a deep violet-blue coloration is produced.

Tests for Purity—Agitate 1 Gm. of Bismuth Subsalicylate with 20 cc. of chloroform, filter the liquid, and evaporate the filtrate to dryness: not more than 0.005 Gm. of residue remains (*free salicylic acid*).

Ignite 3 Gm. of Bismuth Subsalicylate in a porcelain crucible, cool, and cautiously add, drop by drop, just sufficient nitric acid to dissolve the residue when it is warmed. Pour the acid solution into 100 cc. of distilled water, filter, evaporate the filtrate on a water bath to 30 cc., again filter, and divide the filtrate into portions of 5 cc. each. These portions do not respond to the tests for *lead, copper, sulphate, or silver* under *Bismuthi Subcarbonas*.

Boil 1 Gm. of Bismuth Subsalicylate with 20 cc. of a mixture of equal parts of acetic acid and distilled water, cool the solution, and filter. Free the filtrate from bismuth by the addition of hydrogen sulphide, boil the mixture, and again filter: the latter filtrate on evaporation and ignition leaves not more than 0.005 Gm. of residue (*alkalies or alkali earths*).

Triturate about 0.05 Gm. of Bismuth Subsalicylate with 0.1 Gm. of sodium salicylate and 5 cc. of distilled water, and superimpose the mixture upon 5 cc. of concentrated sulphuric acid, page 1542: no pink or brownish-red zone is observed at the line of contact (*nitrate*).

The residue resulting from the ignition and subsequent treatment of 2 Gm. of Bismuth Subsalicylate as described in the test below, meets the requirements of Bettendorf's test for *arsenic*, page 1512.

Assay—Dry about 1 Gm. of Bismuth Subsalicylate to constant weight at 100° C. and weigh accurately. Ignite in a porcelain crucible, and, after cooling, add 5 cc. of nitric acid, drop by drop, to the residue, warming until solution has been effected. Evaporate this solution to dryness, and carefully ignite it at red heat and weigh the resulting bismuth oxide. The residue of bismuth oxide (Bi_2O_3) corresponds to not less than 62 per cent and not more than 66 per cent of the original weight of Bismuth Subsalicylate taken.

This assay is explained on page 1477.

Preserve protected from light.

Uses—This salt is used as an intestinal antiseptic and protective in doses of from five to fifteen grains (0.3 to 1 Gm.).

MAGMA BISMUTHI. N.F. Bismuth Magma

(U. S. P. IX)

[**Magma Bism.**—Milk of Bismuth, Cream of Bismuth]

Bismuth Magma yields not less than 5.6 Gm. and not more than 6.2 Gm of Bi_2O_3 (466.00), in each 100 cc., corresponding to not less than 7 Gm. of bismuth subnitrate in each 100 cc.

	Metric	Alternative
Bismuth Subnitrate	**80 Gm.**	2 oz. av. 293 gr.
Nitric Acid	**120 cc.**	3 fl. oz. 403 min.
Ammonium Carbonate	**10 Gm.**	146 gr.
Ammonia Water,		
Distilled Water, each, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the bismuth subnitrate with 60 cc. [1 fl. oz. 442 min.] of distilled water and 60 cc. [1 fl. oz. 442 min.] of nitric acid in a flask and agitate, warming gently until solution is effected. Pour this solution, with constant stirring, into 5000 cc. [10 pints] of distilled water containing 60 cc. [1 fl. oz. 442 min.] of nitric acid. Dilute 480 cc. [15 fl. oz. 173 min.] of ammonia water with 4000 cc. [8 pints] of distilled water in a glazed or glass vessel of at least 12,000 cc. [3 gallons] capacity. Dissolve the ammonium carbonate in this solution and then quickly pour the bismuth solution into it with constant stirring. If the mixture is not distinctly alkaline, add sufficient ammonia water to make it so and allow it to stand until the precipitate has subsided, then pour or siphon off the supernatant liquid and wash the precipitate twice with distilled water, by decantation. Afterwards transfer the magma to a strainer of close texture, arranged in a percolator so as to provide continuous washing with distilled water, the outlet tube being elevated to prevent the surface of the magma from becoming dry, and allow the operation to proceed until the washings cease to react with phenolphthalein T.S. Then drain the moist magma, transfer it to a graduated vessel and add sufficient distilled water to make the product measure 1000 cc. [2 pints]. Mix thoroughly, transfer to bottles and stopper tightly.

Official Description—A thick, white, opaque liquid containing bismuth hydroxide and bismuth subcarbonate in suspension in water.

Reaction—Neutral to litmus paper and phenolphthalein, T.S.

Test for Identity—One cc. of hydrochloric acid added to 1 cc. of Bismuth Magma produces a clear solution. Pour the clear solution into 10 volumes of distilled water: a white precipitate is produced.

Assay—Evaporate to dryness 10 cc. of Bismuth Magma, accurately measured, and ignite the residue to constant weight: the residue of Bi_2O_3 weighs not less than 0.56 Gm. and not more than 0.62 Gm.

This assay is explained on page 1477.

Uses—It is used for the same purposes as bismuth subnitrate in doses of one fluidrachm (4 cc.).

GLYCERITUM BISMUTHI. N. F. Glycerite of Bismuth

The formula, tests, and uses will be found on page 302.

LIQUOR BISMUTHI. N. F. Solution of Bismuth

[Liq. Bism.]

	Metric	Alternative
Glycerite of Bismuth	125 cc.	4 fl. oz.
Alcohol	125 cc.	4 fl. oz.
Distilled Water, a sufficient quantity, To make	1000 cc.	2 pints

Mix the glycerite of bismuth with 700 cc. [22 fl. oz. 192 min.] of distilled water, then add the alcohol and finally sufficient distilled water to make the product measure 1000 cc. [2 pints].

Description and Tests—Solution of Bismuth is a clear, colorless liquid, almost odorless, having a slightly acidulous, sweetish, saline taste, and an acid reaction.

Add to 5 cc. of the Solution, two or three drops of diluted hydrochloric acid: a gelatinous, white precipitate is formed. This precipitate is immediately soluble in an excess of diluted hydrochloric acid.

No precipitate of basic bismuth salt is formed on the addition of ammonia T.S.

A dark brown precipitate is formed in the presence of an excess of diluted hydrochloric acid upon the addition of 5 cc. of hydrogen sulphide T.S. to 5 cc. of the Solution.

Uses—This is an astringent and is used in diarrhea but should never be given when acute inflammation is present. The dose is about one fluidrachm (4 cc.).

Unofficial Salts of Bismuth

Bismuthi Betanaphtholas (U. S. P. IX) Bismuth Betanaphthol	A buff-colored to grayish-brown, amorphous powder; odorless and tasteless. Nearly insoluble in water and alcohol. Used as an intestinal antiseptic in doses of 8 to 15 grains (0.5 to 1 Gm.)
Bismuthi Bromidum, $BiBr_3$ Bismuth Bromide	A yellowish-white, crystalline powder, decomposed by water, yielding an insoluble basic salt. It should be kept in a dry place
Bismuthi Chromas, $3Bi_2O_3.2CrO_3$ Bismuth Chromate	An orange-yellow, amorphous powder; insoluble in water. It is used as a pigment
Bismuthi Citras, $BiC_6H_5O_7$ Bismuth Citrate	Bismuth citrate, rendered soluble by the presence of ammonium citrate. Shining, pearly, or translucent scales or a white powder, becoming opaque with loss of ammonia upon exposure to air. It is very soluble in water and is used as an astringent, being generally prescribed in solution. The dose is from 1 to 3 grains (0.06 to 0.2 Gm.)
Bismuthi et Ammonii Citras (U. S. P. IX) Bismuth and Ammonium Citrate	
Bismuthi et Ferri Citras Bismuth and Iron Citrate	A soluble compound of variable composition but containing about forty per cent each of bismuth and iron citrates. It is used for dyspepsia
Bismuthi et Potassii Tartras Bismuth and Potassium Tartrate	A fine, granular, white powder; soluble in water. This compound is being used in the treatment of syphilis. The dose is from 1½ to 3 grains (0.1 to 0.2 Gm.). *Potassium Bismuth Tartrate* is more fully described, in the New and Non-official Remedies of 1925
Bismuthi Iodosubgallas Bismuth Oxyiodogallate Airol	A grayish-green, bulky powder; decomposed by water. It is used externally as a dusting powder for wounds and ulcers, also in ointments
Bismuthi Lactas Bismuth Lactate	A white, crystalline powder; slowly soluble in water. Its uses in medicine are similar to those of bismuth subnitrate
Bismuthi Methylene Digallas Bismal	A grayish-blue, bulky powder; insoluble in water. It is used as an intestinal astringent in doses of from 1½ to 5 grains
Bismuthi Oleas, $Bi(C_{17}H_{33}COO)_3$ Bismuth Oleate	A yellowish-brown, soft, granular mass, composed of bismuthous oxide and oleic acid. An olive-oil suspension of this compound called *Oleo-Bi-Roche* is described in the New and Non-official Remedies of 1925
Bismuthi Oxalas, $Bi_2(C_2O_4)_3.15H_2O$ Bismuth Oxalate	A white, granular powder; insoluble in water. It is dissolved by acids
Bismuthi Oxidum, Bi_2O_3 Bismuth Oxide	A heavy, yellow powder; insoluble in water. Its uses and dose are similar to those of bismuth subnitrate
Bismuthi Oxychloridum, $BiOCl$ Bismuth Oxychloride	Also called bismuthyl chloride and pearl white. It is a white, lustrous, crystalline powder; insoluble in water. It is used in face powders and pigments
Bismuthi Phosphas, $BiPO_4$ Bismuth Phosphate	A white powder; insoluble in water. It is used as an intestinal antiseptic and astringent. Dose, 3 to 8 grains

Unofficial Salts of Bismuth—*Continued*

Bismuthi Tannas Bismuth Tannate	A yellow powder; insoluble in water. It is used as an intestinal astringent and antiseptic.
Bismuthi Tribromphenas, N. N. R. Bismuth Tribromphenol Xeroform	A basic bismuth tribromphenate, of variable composition. An amorphous, yellow, nearly tasteless and odorless powder; slightly soluble in water, alcohol, chloroform, liquid petrolatum, and vegetable oils. A non-irritating, non-toxic, antiseptic, a substitute for iodoform. Internally for gastro-intestinal catarrh. Dose, 15 to 45 grains (1 to 3 Gm.) for adults. Marketed by Schering and Glatz, Inc.
Bismuthi Valeras Bismuth Valerate	A white powder having the disagreeable odor of valeric acid. It is insoluble in water and is used as a sedative and antispasmodic.

BISMOSOL, N. N. R.—A sterilized solution of potassium sodium bismuthotartrate (containing 35 per cent bismuth [Bi]) 10 Gm.; piperazine, 0.3 Gm., in an aqueous solution of glucose, to make 100 cc. A pale yellow, syrupy liquid.

Uses—Bismosol is proposed as a means of obtaining the systemic effects of bismuth in the treatment of syphilis.

Dose, administered intramuscularly in doses of 1 cc. every two to seven days until twenty doses have been given. After an intermission of one month, a second course may be given.

Manufactured by Powers-Weightman-Rosengarten Company.

CHAPTER LVI

GOLD AND PLATINUM

Au; 197.2 Pt; 195.2

Salts of these precious metals are not in the primary official lists, but bromauric acid is recognized in the N. F. Several gold salts enter the unofficial materia medica, and platinum salts are employed as test solutions. The name *gold* means yellow in several languages. The name *platinum* is from "platina", the diminutive form in the Spanish for silver, referring to its white color resembling silver. Gold and platinum are both found native in the free state, but not abundantly in many places. Gold is usually found alloyed with silver or copper while platinum is generally found in the same ore with metals of the palladium—platinum group. Latin names for these metals are Aurum and Platinum.

Tests for Gold Salts

Solutions of gold salts yield a purple coloration or precipitate with stannous chloride T.S.

Tests for Platinum Salts

1. If hydrogen sulphide or ammonium sulphide is added to a solution of platinic chloride, a brown precipitate of platinic sulphide will be produced, soluble in excess of ammonium sulphide.

2. If a solution of potassium chloride is added to a solution of platinic chloride acidulated with hydrochloric acid, a yellow precipitate (double chloride) will be formed.

ACIDUM BROMAURICUM. N. F. Bromauric Acid

[Acid. Bromaur.]

It contains $HAuBr_4.5H_2O$ (607.97) corresponding to not less than 32 per cent of gold, Au.

Description and Physical Properties—Bromauric Acid occurs as dark red-brown, flat, needle-shaped crystals, or as irregular, coarse, granular masses; odorless, and having a metallic and acid taste. Permanent in the air when pure; when chloride is present the salt is deliquescent.

Bromauric Acid melts at about 27° C.

It is very soluble in water and in alcohol.

Its aqueous solution is strongly acid to litmus, and yields with silver nitrate T.S. a yellowish-white precipitate, insoluble in nitric acid and but slightly soluble in ammonia water.

Tests for Purity—Ignite 0.1 Gm. of Bromauric Acid, heat the resulting residue of gold with 5 cc. of nitric acid, add 15 cc. of distilled water and filter; no weighable residue remains on evaporating the filtrate and igniting.

Dissolve 0.2 Gm. of Bromauric Acid in 10 cc. of distilled water, add 16 cc. of tenth-normal silver nitrate V.S. and 12 cc. of ammonium carbonate T.S., digest the mixture for ten minutes on a water bath, then cool and filter. The filtrate, on supersaturating with nitric acid, does not become more than slightly opalescent (*chloride*).

Bromauric Acid is decomposed on exposure to red heat and leaves a residue of metallic gold equivalent to not less than 32 per cent of the weight taken.

Preserve it in glass-stoppered, amber-colored bottles.

N. F. Preparation—Liquor Auri et Arseni Bromidi.

Uses—It is used in the preparation of the N.F. solution. The dose is one-tenth grain (0.006 Gm.).

Unofficial Salts of Gold

Auri Bromidum, $AuBr_3$ Gold Bromide	An unstable dark powder; very soluble in water. It should be kept from light. It is used in medicine as an anti-epileptic, anodyne, and nervine
Auri Chloridum, $AuCl_3$ Gold Chloride	A yellow, crystalline powder; readily soluble in water. It is used in photography and in electro-plating, and should be kept dry and unexposed to light
Auri et Sodii Chloridum Gold and Sodium Chloride	A mixture of equal parts of anhydrous gold chloride and anhydrous sodium chloride. An orange-yellow powder, very hygroscopic when exposed to damp air. It is readily soluble in water. It is used in photography, in decorating porcelain, and in staining glass. It is also used in medicine as an alterative and nervine. Dose, $\frac{1}{12}$ to $\frac{1}{4}$ grain (0.005 to 0.015 Gm.). Because of its instability it should be kept in well-stoppered, amber-colored vials
Auri Iodidum, AuI_3 Gold Iodide	A greenish-yellow powder; soluble in water and easily decomposed by heat, yielding iodine vapors and a residue of gold. It is used in tubercular diseases. Dose, $\frac{1}{60}$ to $\frac{1}{8}$ grain (0.001 to 0.008 Gm.)

PART V

ORGANIC CHEMISTRY AND ORGANIC CHEMICAL SUBSTANCES

CHAPTER LVII

THEORY OF ORGANIC CHEMISTRY

ORGANIC chemistry was for a long time considered to be the chemistry of substances produced or evolved by living tissues or organs. In the early days of scientific chemistry it was believed that the chemical compounds which are distinctive of organic chemistry could only be produced by vital action. In 1828 Wöhler, a German chemist, succeeded in transforming the inorganic compound ammonium cyanate, NH_4CNO, into the organic compound urea, NH_2CONH_2, by the simple process of heating.

This broke down the artificial barrier that had existed between the subdivisions of inorganic and organic substances. Since that time there have been produced thousands of syntheses of organic compounds first discovered in natural sources, and thousands of other organic compounds exist of which no counterparts whatever have been found in nature. The line of demarcation between the two is not very distinct, but since practically all of the so-called organic compounds contain carbon, and the great majority of them carbon and hydrogen, organic chemistry is frequently called the chemistry of the carbon compounds, or the chemistry of the hydrocarbons and their derivatives.

The chemistry of vital processes has never been solved, although much light has been thrown upon it in recent years by researches in plant chemistry and in physiological chemistry.

Carbon, hydrogen, oxygen, and nitrogen are the elements most frequently found in organic compounds; sulphur and phosphorus are present in complex protein compounds found in animal tissues particularly. Iron is found in hemoglobin, an essential constituent of the blood, iodine in thyroxin, the active principle of the thyroid gland. Potassium, calcium, magnesium, and fluorine are found in certain vital tissues and fluids.

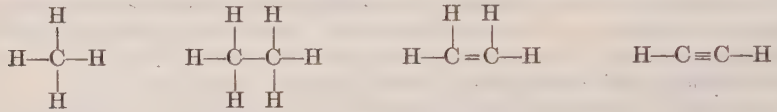
These few elements are apparently the ones essential to vital action. In addition to these, certain other elements have been introduced in preparing organic substances that are of purely synthetic origin. The complexity of organic compounds may be appreciated by a glance at a few empirical formulas of typical organic compounds:

$C_{10}H_{16}$ terpene, from essential oils.
$C_{16}H_{16}O$ camphor.
$C_{10}H_{14}N_2$ nicotine, from tobacco.
$C_{20}H_{24}O_2N_2$ quinine, from cinchona.
$C_{26}H_{45}NSO_7$ taurocholic acid, from bile.
$C_{42}H_{84}NPO_9$ lecithin, from eggs.
$C_{34}H_{34}FeN_4O_5$ hæmatin, from blood.
$C_{54}H_{64}MgN_4O_6$ chlorophyll, from green vegetable tissues.
$C_{11}H_{10}NO_3I_3$ thyroxin, from the thyroid gland.

Proximate principles are organic compounds which exist in natural sources, as morphine in opium, sugars in the juices of fruits and in other vegetable

tissues, and olein in oils and fats. The separation of these principles in a state of purity is called proximate analysis. The *ultimate principles* or constituents composing a substance are the elements themselves and the determination of elemental composition is called *ultimate analysis.* Both proximate and ultimate analyses are highly specialized branches of chemical research, requiring knowledge of fundamental chemical principles, skill in the technic of carrying out chemical reactions, and apparatus adapted to the particular line of investigation.

The formulas of organic compounds are written according to the same principles of valence as those of inorganic compounds previously discussed. The great number of carbon compounds, many having identical empiric formulas but differing in structural relationships, is explained by the fact that the carbon atom, whose valence is invariably four, as in CH_4, can, by single, double, or treble linkings with other carbon atoms in the same molecule, apparently show a valence of three as in C_2H_6, two as in C_2H_4, or even one as in C_2H_2. It requires a study of the graphic or structural formulas of these respective compounds to appreciate their exact character as shown by the following:



methane, CH_4 ethane, C_2H_6 ethylene, C_2H_4 acetylene, C_2H_2

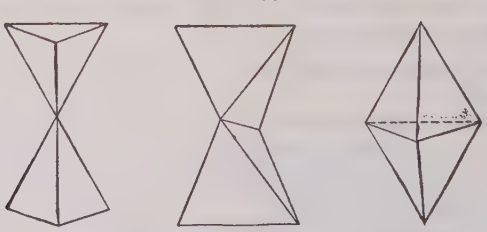
The fact that these linkings or common bonds of attachment may be produced in two or three directions at once, and may be extended in open formation, or in a closed series, as in a chain, makes it apparent that there are almost infinite possibilities of variation.

The ordinary structural formula which has thus far been used represents the atoms as arranged upon the same plane. This form of representing a compound conserves practically all of the requirements for an understanding of the composition of substances and is the one generally used. Inasmuch as molecules unquestionably occupy space, it is sometimes desirable to formulate them on a three dimensional system in order to illustrate certain differences of structure that would not otherwise be easily shown.

In order to do this the carbon atom is assumed to have the shape of a tetrahedron.

The four apexes of this distinctively shaped solid correspond to the four valences manifested by carbon. By placing two of these tetrahedral forms to-

FIG. 433

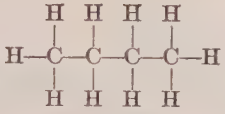


Stereochemic formulas

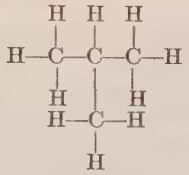
gether in the three possible ways in which apexes may be connected, we see illustrations of the four compounds previously shown, from a slightly different viewpoint (see Fig. 433). These are called stereochemic formulas.

In the compounds of carbon, as has previously been stated, combinations are frequently encountered in which the empiric formula is almost meaningless because of the existence of from two to sometimes nearly a dozen compounds which have exactly the same ultimate composition. Where two or more compounds have the same empiric formula but differ in certain properties they are called *isomers*, and the condition is called *isomerism*. True isomerism is where the compounds belong to the same class or group. The names of such compounds as show a close structural relationship to one or more others is prefixed by the Greek syllable *iso* meaning *the same*.

Thus in the hydrocarbon butane, C_4H_{10}, we have two possibilities as shown by the following graphic formulas:



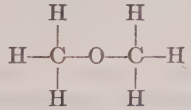
normal butane



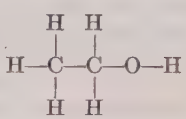
isobutane

Such differences give rise to distinctive usages in writing formulas and to the nomenclatural possibilities of defining them. Thus normal propane is written $CH_3CH_2CH_3$, and is called di-methyl methane, while isopropane is written $CH_3CHCH_3CH_3$ and is also called tri-methyl methane, for reasons which will be appreciated later.

Another form of isomerism is *metameric isomerism* or *metamerism*. This term is used to express the relationship between compounds which have the same empiric composition but which do not belong to the same class. This is illustrated by the formula C_2H_6O, which is applicable to either methyl oxide or ethyl alcohol, as illustrated by the following graphic and structural formulas:



methyl oxide—condensed structural formula $(CH_3)_2O$



ethyl alcohol—condensed structural formula C_2H_5OH

In this kind of isomerism the compounds are simply referred to as isomeric, but the prefix *iso* is not attached to either as in the preceding instance.

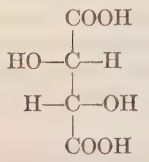
A kind of isomerism which differs from both of the preceding is where one compound is related to the other in having a formula which is a simple multiple of that of the original compound. This is called *polymeric isomerism*, and the compounds of the higher molecular weight are called *polymers*. They are sometimes distinguished from the original compound by the prefix *para*, which, however, has another distinctive meaning in the majority of cases and will be explained under the cyclic compounds to be considered later.

Thus CH_3CHO, often written C_2H_4O, is acetaldehyde, sometimes called simply *aldehyde*. Its polymeric isomer is $(CH_3CHO)_3$, often written $C_6H_{12}O_3$, and is called *paraldehyde*.

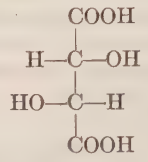
Where isomerism is dependent upon the spatial relation of the constituent atoms in complex molecules, it can only be properly represented by the stereochemic formulas recently discussed. This is called *stereoisomerism*, and

stereoisomers are of common occurrence, as, for example, in the optically active and inactive varieties of lactic and tartaric acids.

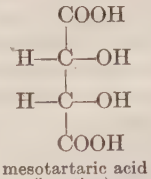
Thus tartaric acid is known in the forms illustrated below:



levotartaric acid



dextrotartaric acid



mesotartaric acid (inactive)

The racemic variety is also optically inactive, since it is made up of equal parts of dextro- and levotartaric acid molecules.

Stereoisomers are of opposite effect upon polarized light, *i. e.*, where one is dextrorotatory, the other is levorotatory. Where, as is frequently the case, the two stereoisomeric forms are combined, an optically inactive form of the compound results, which is known as the *racemic* form.

In organic chemistry even more than in inorganic chemistry, it is necessary to deal with radicles or groups of atoms which confer distinctive properties upon molecules containing them.

Some of these occur so frequently that it is desirable to describe them here, and illustrate some of the compounds in which they are found.

Hydroxyl (OH). This radicle is found in both organic and inorganic compounds. The presence of one or more hydroxyl groups in a compound is indicated in the correct nomenclature by the termination "ol," *e. g.*, phenol, C_6H_5OH; methanol, CH_3OH; glycerol, $C_3H_5(OH)_3$.

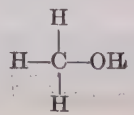
The hydrogen of the OH group in organic compounds of this class is replaceable by positive elements as K and Na.

Carboxyl (COOH). This group is characteristic of organic acids. The hydrogen of this group is replaceable by positive elements and radicles to form salts and esters. The basicity of an organic acid is dependent upon the number of such groups present. As examples may be cited acetic acid, CH_3COOH, which is monobasic; tartaric acid, $(CHOH)_2$ $(COOH)_2$ which is dibasic, and citric acid, $(CH_2)_2COH(COOH)_3$, which is tribasic.

Aldehyde (CHO). This group is found in a large number of organic compounds. The hydrogen is joined to the carbon atom and is not replaceable by positive elements or groups. Example: formaldehyde, HCHO and acetaldehyde, CH_3CHO. Aldehydes are sometimes written with the distinctive group, as COH. This is incorrect, because such an arrangement of the atoms is characteristic of the formula of a tertiary alcohol.

Aldehydes stand midway as oxidation products between alcohols and the organic acids. The name comes from the initial syllable of the term *al*cohol and the first two syllables of the word *dehyd*rogenatum, because aldehydes are produced by the removal of hydrogen from alcohols. A study of the reactions that are involved in the formation of a series of such related compounds will serve to illustrate the foregoing points and will also serve to show how fascinatingly interesting the possibilities of organic chemistry become to one who takes the trouble to thoroughly understand the underlying principles.

The graphic structural formula of methyl alcohol is:



The structural formula generally used for such a molecule would be HCH_2OH. The ordinary method of writing the formula, which has become a matter of custom, is CH_3OH. When this compound is oxidized, it does not take up oxygen, but instead it loses hydrogen, as shown by the following equation:

$$\underset{\text{methyl alcohol}}{HCH_2OH} + \underset{\text{oxygen}}{O} = \underset{\text{formaldehyde}}{HCHO} + \underset{\text{water}}{H_2O}$$

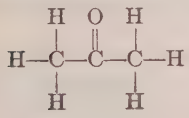
When formaldehyde in turn undergoes oxidation, it does so by the addition of an atom of oxygen which converts the aldehydic group into the carboxyl group as follows:

$$\underset{\text{formaldehyde}}{HCHO} + \underset{\text{oxygen}}{O} = \underset{\text{formic acid}}{HCOOH}$$

These reactions illustrate the intermediate position which aldehydes occupy between alcohols and acids.

Aldehydic groups confer certain distinctive reacting powers upon the molecules in which they occur, particularly in the carbohydrates.

Ketonic Group—This is a distinctive method of linking rather than a radicle such as we have been considering. It is characterized by having a carbon atom united to oxygen by two of its bonds and to two other carbon atoms by the remaining bonds, thus:



Example, acetone, CH_3COCH_3 (dimethylketone). This group, like the aldehyde group, gives to the molecule containing it certain distinctive reacting properties.

Amino (NH_2)—This group is characteristic of the simplest primary amines and confers basic properties, the basicity being in proportion to the number of such groups present. When the amino group is associated with a positive group, the compound is basic and is known as an *amine* (sometimes shortened to *amin*). When the amino is associated with a negative group the resulting compound may be neutral or acid and is called an *amide* (sometimes shortened to *amid*).

Examples: $C_2H_5NH_2$—ethylamine.
CH_3CONH_2—acetamide.

Both amines and amides are derived ammonias in which the hydrogen of NH_3 has been partly or wholly replaced by hydrocarbon or acid groups, respectively. In a *primary amine* one may conceive of one atom of hydrogen of NH_3 having been substituted, as in ethylamine. In a *secondary amine*, two thirds of the NH_3 are substituted, as in diethylamine $(C_2H_5)_2NH$. Such compounds are sometimes called *imines* or *imides* having the characteristic group known as *imido* (NH). *Tertiary amines* are also known in which all three of the hydrogen atoms of NH_3 are substituted. The disagreeable smelling compound found in herring brine known as trimethylamine $(CH_3)_3N$, is an example of this group.

The *open chain, fatty* or *aliphatic* hydrocarbons and their derivatives are the simplest of the organic compounds and will be the first to be considered. A hydrocarbon is a compound containing only carbon and hydrogen and the compounds of this type are very numerous.

The *open chain hydrocarbons* are sometimes called the *aliphatic* or *fatty* hydrocarbons, because many of their derivatives are found in the vegetable and

animal fats and oils. At the same time there are many open chain compounds that do not show any resemblance to the fats or oils in their properties.

The closed chain hydrocarbons are derivatives of coal-tar benzene (benzol), C_6H_6, and will be considered later.

The simplest open chain hydrocarbon is methane, CH_4, in which a single atom of carbon has each of its four valence bonds satisfied with an atom of hydrogen. This is known as a saturated compound. If all or part of the hydrogen in CH_4 is substituted by an element or group of elements having the proper equivalence, the saturation will not be disturbed. Hence, CH_3Cl, CH_2Cl_2, $CHCl_3$ and CCl_4 are all saturated organic compounds referable to CH_4 as the starting point. By successive subtractions of H from CH_4 a series of radicles is obtained which are not fully saturated and in which the valence is equivalent to the number of hydrogen atoms removed. CH_3 is therefore a monad radicle, CH_2 is a dyad and CH a triad. These are called unsatisfied hydrocarbon radicles and from each of these may be obtained derivatives and compounds comparable to analogous compounds in inorganic chemistry. Chlorides, bromides, hydroxides, sulphates, sulphides, oxides, etc., may be produced from these radicles or the radicles themselves may act as substituting groups.

Each of these hydrocarbons and each of the derived radicles may constitute a member of what is known as a homologous series. A homologous series is a series of compounds in which each member differs from the members on either side of it by the constant factor, CH_2.

Examples are given in the following table:

Saturated hydrocarbons	Unsatisfied radicles			Unsaturated hydrocarbons
1.	2.	3.	4.	5.
General Formula	General Formula	General Formula	General Formula	General Formula
$C_nH_{2n} + 2$	$C_nH_{2n} + 1$	C_nH_{2n}	$C_nH_{2n} - 1$	$C_nH_{2n} - 2$

3. This column also applies to a series of unsaturated hydrocarbons known as the olefines, with names ending in -ylene in place of *-ene*.

Valence O	Valence I	Valence II	Valence III	Valence O
Methane, CH_4	Methyl, CH_3	Methene, CH_2	Methenyl, CH	Acetylene or Ethine, C_2H_2
Ethane, C_2H_6	Ethyl, C_2H_5	Ethene, C_2H_4	Ethenyl, C_2H_3	Propine, C_3H_4
Propane, C_3H_8	Propyl, C_3H_7	Propene, C_3H_6	Propenyl, C_3H_5	Butine, C_4H_6
Butane, C_4H_{10}	Butyl, C_4H_9	Butene, C_4H_8	Butenyl, C_4H_7	Pentine, C_5H_8
Pentane, C_5H_{12}	[1]Pentyl, C_5H_{11}	Pentene, C_5H_{10}	Pentenyl, C_5H_9	Hexine, C_6H_{10}
Hexane, C_6H_{14}	Hexyl, C_6H_{13}	Hexene, C_6H_{12}	Hexenyl, C_6H_{11}	

[1] NOTE—Pentyl is usually called *amyl* in organic compounds.

The foregoing table stops with *hexane* of the paraffin series. It might be continued at great length, as members are known as far up in the series as *dimyricyl* ($C_{60}H_{122}$).

It will be noticed upon studying the above table that the groups with odd valences end in "yl" and that in the terminations of the hydrocarbons the vowels a, e, and i, are utilized in their regular order.

It is not to be understood that all of the members of these fundamental series are of common occurrence or even that all of them have been prepared, but most of them are known and the others could doubtless be prepared if necessity arose. They are of importance to the student as starting points of derivatives, many of which are of great economic value and importance in pharmacy.

A brief consideration of some of them will serve to emphasize this fact.

Paraffins, from *parvum affinis* (little affinity). The members of this series are saturated molecules not easily affected by chemical agents. Many of them have been found in natural gas and petroleum.

Methane—CH_4, the first member of the paraffin series, is a colorless, odorless gas occurring in natural gas, which, in some instances is nearly pure methane. It is also produced by the slow decomposition of cellulose, and is the gas which forms in the bottom of marshes and stagnant pools, whence the name *marsh gas*. When mixed with air, as is sometimes observed in coal mines, it constitutes the deadly *fire damp*, which is the frequent cause of explosions in such mines. The invention by Sir Humphrey Davy of the safety lamp which bears his name was for the purpose of minimizing this danger.

Ethane, C_2H_6; *propane*, C_3H_8; *butane*, C_4H_{10}; *pentane*, C_5H_{12}; *hexane*, C_6H_{14}; and *heptane*, C_7H_{16} are all found in petroleum, and some of them occur in nearly pure form in *cymogene*, *rhigolene*, *petroleum benzin*, *gasolene*, and *kerosene*. The hydrocarbons from C_8H_{18} to $C_{15}H_{32}$ are present in lubricating oils, and from $C_{16}H_{34}$ to $C_{20}H_{42}$ in *petrolatums* and in the so-called *paraffin waxes*.

There is a mathematical gradation of specific gravities, boiling points, and other physical properties from the lowest to the highest member of the series. The derivatives of the paraffin hydrocarbons are frequently produced by the direct action of chlorine or bromine, the halogen derivatives then being taken as the starting point for derivatives of other types.

The halogen derivatives themselves are frequently compounds of considerable importance. The chlorine substitution products of methane may be taken to illustrate this fact and also the possibilities of nomenclature of organic compounds which is a very important branch of their study.

Methane CH_4.
Monochlormethane (*methyl chloride*) CH_3Cl.
Dichlormethane (*methene chloride*) CH_2Cl_2.
Trichlormethane (*methenyl chloride*) $CHCl_3$.
(chloroform)
Tetrachlormethane (*carbon tetrachloride*) CCl_4.

If the italicized names in the above list are carefully studied and the principle of their formation thoroughly understood, the student will be able to appreciate the scientific basis of the nomenclature of the simpler organic compounds and will realize its possibilities.

Alkyls or monohydric alcohol series—This series consists of monad radicles. It is sometimes called the *methyl* series because *methyl* is the simplest member.

This series yields oxides called ethers, halogen derivatives called alkyl halides, salts that are called esters, hydroxides called alcohols, carbonyl derivatives called ketones, etc.

The relationship of these to each other may be appreciated by studying the following possibilities of modification and transformation along these lines. The alkyl radicles, ethyl and methyl, have been selected as yielding examples of importance in the following group.

Ethers—*Ethyl oxide*, $(C_2H_5)_2O$, commonly called *"ether"*, a member of the important generic group of *ethers* which may consist of simple ethers, as

illustrated above, or of mixed ethers, as $(CH_3)(C_2H_5)O$, which is called methyl-ethyl ether.

Alkyl Halides—*Ethyl chloride*, C_2H_5Cl. (This is really a type of an ester in which an inorganic acid unites with the radicle.)

Esters—*Ethyl acetate*, $C_2H_5C_2H_3O_2$. (This is sometimes incorrectly called "acetic ether".) The esters correspond to the "salts" of inorganic chemistry. Many are of official importance.

Hydroxides—*Ethyl hydroxide*, C_2H_5OH, commonly called *"alcohol"*, and a member of the important generic group of alcohols. It is also called *ethanol.*

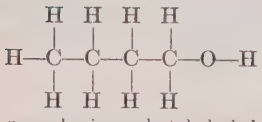
Ketones—*Dimethyl ketone*, CH_3COCH_3, commonly called *acetone* and a member of the important generic group of ketones. It is also called *propanone.*

Aldehydes—*Methyl formaldehyde*, or *ethyl aldehyde*, CH_3CHO, commonly called *aldehyde* and a member of the important generic group of *aldehydes.* It is also called *acetaldehyde* because upon oxidation it yields acetic acid.

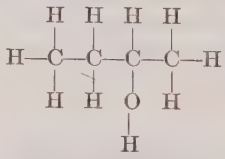
Acids—*Methyl formic acid*, CH_3COOH, commonly called *acetic acid.* This is also called *ethanoic acid.*

The lower members of the alcohol series are capable of existing in only one form. There are no isomers of methyl or ethyl alcohol. There are two possible isomers of propyl alcohol, three of butyl alcohol and the complexity increases upon ascending the scale. In order to distinguish certain types of the isomeric alcohols they are designated as *primary*, *secondary*, or *tertiary.* In primary alcohols the CH_2OH group is joined to only one other carbon atom. In secondary alcohols the group CHOH is joined to two carbon atoms. In tertiary alcohols the group COH is joined to three carbon atoms.

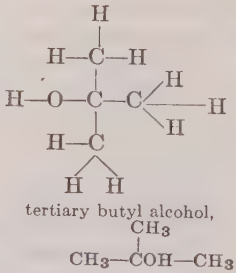
Illustrations of all three of these forms are found in the structural formulas of three of the butyl alcohols.



normal primary butyl alcohol, $CH_2CH_2CH_2CH_2OH$



secondary butyl alcohol, $CH_3CH_2CHOHCH_3$



tertiary butyl alcohol, $(CH_3)_3COH$

The COH group of the tertiary alcohols is trivalent and has the structure $\equiv C-(OH)$; it must not be confused with the aldehyde group CHO, which is monovalent and in which the hydrogen is united directly with the carbon, as in

$$-\underset{\displaystyle H}{\overset{|}{C}}=O.$$

The alcohols containing two OH groups are known as *dihydric alcohols* or *glycols.* Each of these alcohols yields *two* acids upon oxidation. Thus ethene glycol gives the following acids:

$$C_2H_4(OH)_2 + O_2 = \underset{\text{glycolic acid}}{CH_2OHCOOH} + H_2O$$

$$C_2H_4(OH)_2 + O_4 = \underset{\text{oxalic acid}}{(COOH)_2} + H_2O$$

Other derivatives of the dihydric alcohols of importance in pharmacy are *lactic acid* which is an oxidation product of the 1:2 *propene glycol*, and *succinic*

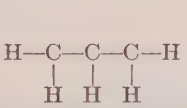
acid which is an oxidation product of 1:4 *butene glycol*. The first named acid is monobasic and the second is dibasic.

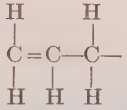
The oxygen of the alcohols may be replaced by other elements, as sulphur. For instance, ethyl alcohol, C_2H_5OH, has a corresponding sulphur compound, C_2H_5SH, which is really *ethyl hydrosulphide* or *ethyl sulphydrate*, but which is called *ethyl mercaptan*, the term being used in the generic sense also as in the case with the terms alcohol and aldehyde. The mercaptans when oxidized form sulphonic acids. Sulphur compounds corresponding to ethers are known, such as $(C_2H_5)_2S$, ethyl sulphide. The essential oils of garlic, mustard, horse radish, asafetida, etc., contain organic sulphides which are usually strongly odorous or irritating compounds. The *mustard gas* of the World War was the halogenated organic sulphide, dichlordiethyl sulphide $(C_2H_4Cl)_2S$.

Olefins—The olefin series of hydrocarbons of the table on page 784, is capable of yielding the same corresponding series of derivatives, such as alcohols, esters, aldehydes, acids, etc., that have been discussed under the paraffin series.

Malic acid, $CH_2CHOH(COOH)_2$, *tartaric acid*, $CHOHCHOH(COOH)_2$, and *citric acid*, $(CH_2)_2COH(COOH)_3$, are all regarded as types of the hydroxy or alcohol acids of this series.

The Methenyl series is composed of triad radicles. The most important member of this group is propenyl, C_3H_5, also called *glyceryl*. The hydroxide of this radicle, $C_3H_5(OH)_3$, is *glycerol* (*glycerin*). Most of the common fats and oils are esters of *glyceryl*, with one or more of the higher fatty acids, as oleic, palmitic, or stearic. *Allyl*, C_3H_5, is isomeric with *glyceryl*, but differs in the fact that it has a valence of one, due to a variation in structure as shown by the following:


glyceryl


allyl

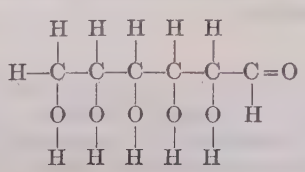
The Acetylene series of hydrocarbons is of little pharmaceutical importance.

Among the important of the more complex derivatives of the open chain hydrocarbons are the *carbohydrates*, which derive their name from the fact that they contain the three elements carbon, hydrogen, and oxygen, the latter two being in the same proportion in which they exist in water, namely, two atoms of hydrogen to one atom of oxygen. The limitation of composition, however, is no longer strictly applicable, as some true carbohydrates are known, in which this ratio of hydrogen to oxygen does not exist. The term, however, is too well fixed in the nomenclature of chemistry to be displaced.

Starch and cellulose $(C_6H_{10}O_5)_n$, dextrose $C_6H_{12}O_6$, and sucrose $C_{12}H_{22}O_{11}$, are typical carbohydrates.

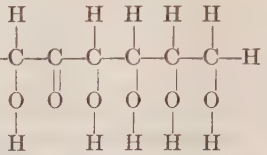
The carbohydrate molecules are very complex. They contain hydroxyl groups as the predominating factor, although aldehyde and ketone groups are frequently present.

The structural formulas of *dextrose* and *levulose* will serve for illustration of these facts:

Dextrose 

This is written in graphic form $CH_2OHCHOHCHOHCHOHCHOHCHO$ and the aldehydic group CHO is clearly apparent.

Levulose



This is written in graphic form $CH_2OHCOCHOHCHOHCHOHCH_2OH$ and the ketonic group CO is equally evident.

The *closed chain, cyclic,* or *aromatic hydrocarbons* are connected into one or more closed series or chains. Three atoms of carbon, of course, is the smallest number that can form such a chain. When all of the atoms composing the chain are of one kind the structure is known as *isocyclic.* When the chain includes elements of different kinds it is called *heterocyclic.* The closed chain hydrocarbons having the same number of carbon atoms as those of the open chain series are generally distinguished in name by adding the prefix "cyclo".

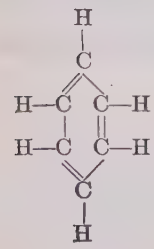
Thus the simplest isocyclic hydrocarbon is *trimethene,*

which is isomeric with the olefin hydrocarbon, propylene C_3H_6, and the former is called *cyclopropane.*

The most important and interesting of the isocyclic compounds is the series of hydrocarbon compounds containing six carbon atoms commonly known as the *benzene* series from the name of its fundamental member.

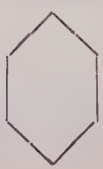
Benzene, C_6H_6, was first prepared in 1825 by Faraday from coal gas, later by Mitscherlich in 1834 by the destructive distillation of a benzoate (whence the name benzene) and subsequently in 1845 by Hofmann from coal tar, which has since been the principal source of its supply.

The chemical nature of benzene was not comprehended until 1865 when Kekule suggested its cyclic structure and its six latent valences, as illustrated by the following structural formula, which is generally accepted as satisfying the requirements from both theoretical and practical standpoints.



The double linkings between alternate carbon atoms are latent valences which increase the possibilities of preparing derivatives.

For the sake of convenience the cumbersome detailed structural formula as given above is usually replaced by a simple oblong hexagon which is understood to mean C_6H_6.

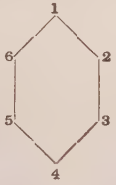


When any ordinary substitution of the hydrogen atoms occurs, such as by the OH group in the formation of phenol from benzene, it is simply represented as

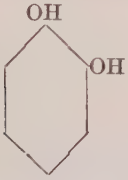
which means C_6H_5OH.

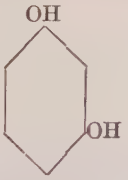
The position of the substituting element or group is immaterial in the case of a single substitution, but for the sake of uniformity it is usually placed at the upper angle of the hexagon as just shown.

When two of the hydrogen atoms of benzene are replaced, however, three isomeric compounds are possible. To assist in indicating the possible differences, the angles of the benzene ring, as it is called, are distinguished by imaginary numbers starting with one at the top and going around in clockwise order, thus:



Substitution of two of the hydrogen atoms of benzene can take place in three different ways, as shown by the following structural formulas.

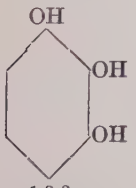




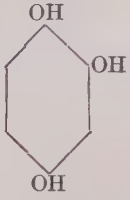
Each of these three compounds is entitled to the name dihydroxybenzene, but to distinguish them further the figures of substitution positions are added to the name, or the respective prefixes "ortho", "meta", and "para" are employed.

Thus the first of the three compounds given above is either called orthodihydroxybenzene or 1-2 dihydroxybenzene. The second is called metadihydroxybenzene or 1-3 dihydroxybenzene. The third is called paradihydroxybenzene or 1-4 dihydroxybenzene. The second of the isomers in the foregoing case is the well known resorcinol.

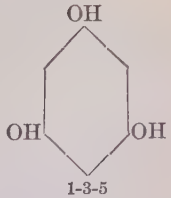
Substitution of three hydrogen atoms of benzene by three similar atoms or groups also gives rise to three isomers which are distinguished as follows:



1-2-3
consecutive or adjacent



1-2-4
unsymmetric



1-3-5
symmetric

The first of the foregoing isomers is 1-2-3 trihydroxybenzene (commonly known as pyrogallol), the second is 1-2-4 trihydroxybenzene, and the third is 1-3-5 trihydroxybenzene (commonly known as phloroglucin).

The isomeric forms are often designated by placing the letters v, a, or s before the name, these letters coming from the words vicinal, asymmetrical and symmetrical, respectively.

In order that the student may familiarize himself with the use of the ring symbols as they are called, and to afford an opportunity to become acquainted with the nomenclature of the cyclic compounds, a number of illustrations are given most of which are of compounds of importance in pharmacy.

C_6H_5OH

hydroxybenzene, phenylhydroxide, phenol

$C_6H_5NO_2$

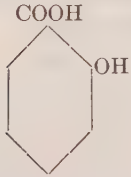
nitrobenzene, oil of mirbane

C_6H_5COOH

carboxybenzene, benzoic acid

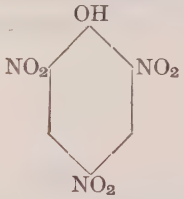
C_6H_5CHO

benzaldehyde



$C_6H_4OHCOOH$

1-2 hydroxybenzoic acid, orthohydroxybenzoic acid, salicylic acid



$C_6H_2OH(NO_2)_3$

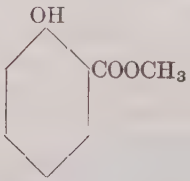
2-4-6 trinitrohydroxybenzene, trinitrophenol, picric acid

$C_6H_5CH_3$

methyl benzene, toluene

1–4 $C_6H_4OHHSO_3$

1-4 hydroxybenzene sulphonic acid, paraphenolsulphonic acid

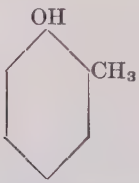


$C_6H_4OHCOOCH_3$

1-2 hydroxymethylbenzoate, methyl salicylate

$C_6H_5NH_2$

aminobenzene, aniline



$C_6H_4OHCH_3$

orthohydroxymethylbenzene, orthocresol

$C_6H_5CH_2OH$

phenylcarbinol, benzyl alcohol

A careful study of the foregoing formulas will show that the classes of compounds, and the nomenclatural possibilities are exactly analogous to those discussed under the open chain hydrocarbons.

So far as homologous series are concerned there is exact parallelism. Benzene is considered as the first member of a series of the general formula C_nH_{2n-6} of which the following are the lower members of the series.

C_6H_6—*Benzene.*

C_7H_8—*Methylbenzene,* $C_6H_5CH_3$ *Toluene.*

C_8H_{10}—*Dimethylbenzene,* $C_6H_4(CH_3)_2$ *Xylene.*

C_9H_{12}—*Trimethylbenzene,* $C_6H_3(CH_3)_3$.

$C_{10}H_{14}$—*Tetramethylbenzene,* $C_6H_2(CH_3)_4$.

These homologues of benzene are all associated with it in the more volatile fractions of coal tar.

For convenience in naming compounds, C_6H_5 is sometimes referred to as *phenyl,* and the OH group is sometimes referred to as "oxy", or "hydroxy". Thus C_6H_5OH is either *phenyl hydroxide, hydroxybenzene,* or *oxybenzene* or *phenol.* Phenol is a generic as well as a specific name. The *phenols* are nucleus hydroxy derivatives of benzene and are distinguished by the terms *mono-di-* or *tri-* hydric *phenols,* depending upon the number of hydroxyl groups present.

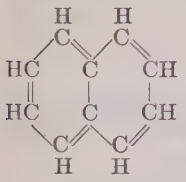
Phenol, C_6H_5OH, is *monohydric; resorcinol,* $C_6H_4(OH)_2$ 1:2, is *dihydric;* and *pyrogallol,* $C_6H_3(OH)_3$ 1:2:3, is *trihydric.*

The phenols must not be confused with the *aromatic alcohols* in which the hydroxyl substitution occurs not in the nucleus but in the side chain, as a substituting group is called. Thus C_6H_5OH is a phenol and $C_6H_5CH_2OH$ is an alcohol.

The *terpenes* are cyclic hydrocarbons having the general formula $(C_5H_8)_n$. They carry one or more latent valences. They are classified as *hemiterpenes,* C_5H_8; *terpenes,* $C_{10}H_{16}$; *sesquiterpenes,* $C_{15}H_{24}$; *diterpenes,* $C_{20}H_{32}$; *polyterpenes,* $(C_{10}H_{16})_n$.

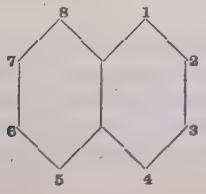
Camphors are oxygenated terpene derivatives. Ordinary camphor, $C_{10}H_{16}O$, and borneol, $C_{10}H_{18}O$, are examples.

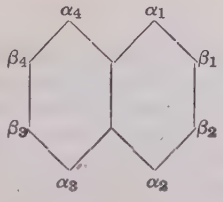
Naphthalene, $C_{10}H_8$, consists of a double ring in which two benzene nuclei are held together by two common carbon atoms. All but the linking atoms are saturated with hydrogen, as shown by the following graphic formula.



It is usually expressed in a manner comparable to that used for benzene, as

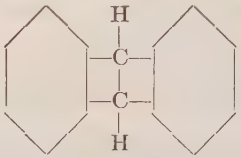
The *naphthalene ring* is oriented or numbered in the same manner as the benzene ring and certain positions are given Greek letter designations as shown by the following two diagrams:





The *naphthols* are hydroxy derivatives of naphthalene, just as the phenols are hydroxy derivatives of benzene. The empiric formula of the simplest naphthol is $C_{10}H_7OH$. There are two isomers known. They are called *alpha naphthol* and *beta naphthol*. Both are important in pharmacy. Their structural formulas may be deduced from the foregoing explanation of the positions in the naphthalene ring.

Anthracene $C_{14}H_{10}$ is an important coal tar fraction having a distinctive structure as follows:



Diphenyl $(C_6H_5)_2$ consists of independent rings joined at one point, as in the following example.

Many of its derivatives, through *benzidin*, which is diamidodiphenyl, are valuable dyes.

When two atoms of nitrogen are joined by two bonds and the remaining bonds are joined to hydrocarbon radicles, the compound so formed is called an *azo compound*. Example, $C_6H_5-N=N-C_6H_5$, *azobenzene*.

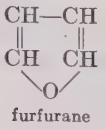
When the N_2 group is attached by one bond to a hydrocarbon radicle and by the other to an acid radicle, or to hydroxyl, there is formed a *diazo compound*. Example, $C_6H_5-N=N\,HSO_3$, *diazobenzenesulphonic acid*.

When an atom of oxygen occurs between the nitrogen atoms of an azo compound as in *azobenzene*, an *azoxy compound* results. Example, $C_6H_5NON\,C_6H_5$, *azoxybenzene*.

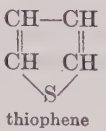
When one of the bonds of each nitrogen atom in an azo compound is united to a hydrogen atom, a *hydrazo compound* results. Example, $C_6H_5NHNHC_6H_5$, *hydrazobenzene*.

The hydrazines are related to the diazo compounds except that the union between the nitrogens is by one bond and that one of the nitrogen atoms is attached to hydrogen, only, by its remaining two bonds. Example, $C_6H_5HN\text{-}NH_2$, phenylhydrazine.

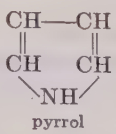
Heterocyclic compounds are ring compounds in which other elements are present in addition to the carbon and the hydrogen. The most commonly occurring and best known examples of this type are as follows:



furfurane



thiophene



pyrrol

The principal example of the six-membered heterocyclic rings is *pyridine*, C_5H_5N, in which the ring nucleus contains 5 carbon atoms and 1 nitrogen atom. A heterocyclic double linked ring compound is found in *quinoline*, which bears the same relationship to pyridine that naphthalene does to benzene. Both pyridine and quinoline are the starting point of homologous series, in which are found members of importance.

This condensed presentation of the principles of organic chemistry is introduced as a fitting preface to the detailed consideration of the many important therapeutic agents belonging to this class. In the following pages, however, the compounds are considered in the usual groups only when the substances composing them have similar chemical and physical properties. The opening chapters are devoted to *cellulose* and its derivatives; then *benzoic acid and its compounds and derivatives*; next *coloring principles*; followed by *organometallic compounds*; then *starch*, and the allied products, gums, mucilages, etc.; then the *sugars* and the products derived from them as the result of decomposition and fermentation, *alcohol*, *ether*, etc., including the various synthetic products which are derived from organic bases or acids. Following these the *acid saccharine fruits*, with the important acids which they contain, are considered, and then the products obtained from them and from other plants; *i. e.*, the *volatile oils*, *oleo-resins*, *resins*, *gum-resins*, and *balsams* naturally following each other, the classification being based upon the character of prominent constituents found in the drugs; *astringents*, *cathartics*, etc., being grouped together. Drugs containing *alkaloids* are among the last organic compounds to be considered. The alkaloids are very complex, and most of them are powerful poisons. The plan thus begins with elementary substances, like cellulose, starch, and gum, and leads by regular progression to the most powerful compounds in the materia medica, the alkaloids.

Following the alkaloids the subject of *vitamines* and afterwards medicinal products from animal source are given due consideration.

A sharp distinction is made between the U. S. P. and N. F. drugs and preparations, the latter usually following the former. Full botanical descriptions have not been included for vegetable or animal drugs, the reader being referred to the U. S. P. or N. F. monographs for the details of plant structure, microscopic descriptions, etc.

Many unofficial drugs and preparations are also included, and the arrangement enables the student to distinguish the more important compounds at a glance, and they can be studied together or separately, at will.

CHAPTER LVIII

THE CELLULOSE GROUP

Cellulose—$(C_6H_{10}O_5)_n$[1]

Cellulose—The woody fiber of plants, which forms the skeleton or framework for the vegetable tissues, is termed *cellulose*, or *cellulin*. During the natural growth of the plant, the cells become filled with coloring matter, starch, gums, organic acids, fixed oils, volatile oils, glucosides, alkaloids, and other active principles peculiar to the particular plant, and these give to the plant physical properties which render it useful in medicine. Pharmacy teaches the various methods of extracting the *valuable principles* from plants and leaving behind or eliminating by appropriate methods those which are inert. Cellulose constitutes the greater part of the inert residues (see Percolation).

The term *lignin* was formerly applied to cellulose; indeed, three words, *lignin*, *cellulin*, and *cellulose*, were used synonymously; a distinction, however, is sometimes made, the substances which are found adhering to the cellulose skeleton of plants and vegetable tissues being called *lignin* so that lignin may be considered an alteration product of cellulose. The latter is less digestible than cellulose, and it is believed by Payen and others to vary from it somewhat in chemical composition. *Fungin*, from fungi, *hordein*, from barley, *medullin*, from the pith of various plants, *pollenin*, from pollen granules, are special forms of cellulose. The lignin in plant chemistry is estimated and calculated as "*crude fiber*".

Cellulose is seen in a pure form in raw cotton, the hairs of the seed of various species of Gossypium, and in many other vegetable products. It is the most useful and valuable substance obtained from plants; fabrics like cotton, linen, or hemp goods are made on an immense scale from cellulose. Ashless filter paper is a prepared form of practically pure cellulose. When pure, cellulose is white, translucent, unalterable in the air, and has the specific gravity of 1.5. It is insoluble in water, alcohol, ether, petroleum benzin, and oils, but is dissolved by concentrated zinc chloride solution, and in an ammoniacal solution of copper oxide, and this latter fact has been taken advantage of to form many useful articles by partially dissolving a woven cotton material and rolling or pressing it into any desired shape. Artificial silk is produced from cellulose by various methods. It is now called *rayon*, *celamese*, or *lustron*. In one method for preparing *artificial silk*, a gelatinous *hydrocellulose* is precipitated from an ammoniacal copper oxide solution by acid, alkali salts or sugar solutions, this hydrocellulose is then redissolved in a mixture of caustic soda and carbon disulphide, and reprecipitated, in a gelatinous state, by salts, the precipitate being forced through minute perforations to form filaments which are spun into thread. By another method a substance known as *viscose*, which is *sodium-cellulose dithiocarbonate*, is prepared by treating cellulose with strong alkali, macerating the *mercerized cellulose* so produced in carbon disulphide and then treating with an acid solution of sodium sulphate. The resulting gelatinous mass is then formed into threads which are washed, dried, treated

[1] The formula for cellulose is given with an unknown factor, $(C_6H_{10}O_5)n$, because its molecular weight has never been determined. For the *determination of a molecular weight* a substance must be capable of being vaporized, melted, or dissolved without decomposition. As cellulose is one of the few organic bodies which cannot be changed in its physical form in this way, its molecular weight (or a multiple of the same) is deduced from its decomposition and hydrolysis.

to remove excess of sulphur, bleached, and subsequently wound into skeins from which are woven the viscose fabrics. When cellulose is treated with strong sulphuric acid or phosphoric acid, it is converted into dextrin. If the mixture is diluted with water and heated, dextrose is produced. If cellulose in the form of unsized paper is passed through a mixture made from two parts of sulphuric acid of specific gravity 1.840 and one part of water (*both by measure*), and the whole *cooled to* 15° C. (59° F.), the valuable product known as *parchment paper* is produced, amyloid being formed. The strips of paper should be well washed after parchmentizing by passing them through a dilute solution of ammonia and water. This paper is useful as a dialyzing medium; it forms, when perfect, an excellent septum (see Dialysis).

When cellulose is treated with acetic anhydride in the presence of sulphuric acid, esters called *cellulose acetates* are produced. Cellulose acetate is soluble in chloroform and also in a number of other organic solvents. The solutions may be utilized for the production of threads to form fabrics (*cellulose acetate silk*) or *sheets*, known as *cellophane*, which may be used for bottle caps or for wrapping packages to make a transparent, damp-proof wrapper. Cellulose acetate sheets are used for the non-inflammable films of the moving picture industry.

Cellulose is employed in the form of filtering paper, in muslin and cotton cloth strainers, for surgical bandages, paper, lint, etc. When cellulose is treated with a mixture of nitric and sulphuric acids, pyroxylin, or guncotton, is produced.

GOSSYPIUM PURIFICATUM. U.S. Purified Cotton

[Gossyp. Purif.—Absorbent Cotton]

The hairs of the seed of cultivated varieties of *Gossypium herbaceum* Linné, or of other species of *Gossypium* (Fam. *Malvaceæ*), freed from adhering impurities and linters, and deprived of fatty matter.

Purified cotton constitutes cellulose in one of its purest forms. For a long time one of the most important uses of this valuable staple, that of an absorbent and substitute for sponge, was neglected, because a trace of fatty matter was permitted to remain, which coated the filaments and prevented the cotton from absorbing liquids freely and uniformly. The so-called absorbent cotton of commerce was introduced, and it soon became an important product. This is cotton freed from the trace of fatty matter by boiling it in a weak alkaline solution to remove fat, rinsing it in a weak solution of chlorinated lime to bleach it, dipping it into a very dilute solution of hydrochloric acid, and then thoroughly rinsing it with pure water; the cotton, having been thoroughly dried, is then carded. The loss is about 10 per cent.

A form of cotton which has been purified but from which the oil has not been removed is known as *non-absorbent cotton*. This is of special value for stoppering flasks or test tubes containing liquids to be sterilized by live steam, as it does not readily absorb moisture.

Description and Physical Properties—White, soft, fine filaments, appearing under the microscope as hollow, flattened and twisted bands, spirally striate and slightly thickened at the edges. It is odorless and almost tasteless.

Purified Cotton is insoluble in ordinary solvents, but is soluble in ammoniated cupric oxide T.S.

Tests for Purity—Purified Cotton, previously compressed in the hand, when thrown on the surface of water at about 25° C., readily absorbs it and sinks.

Ash: not more than 0.2 per cent.

Thoroughly saturate about 10 Gm. of Purified Cotton with 100 cc. of distilled water, then with the aid of a glass rod press out two 25 cc. portions of the water into white porcelain dishes. Add to one portion three drops of phenolphthalein T.S. and to the other portion one drop of methyl orange T.S.: no pink color develops in either portion (*alkali or acid*).

Pack 10 Gm. of Purified Cotton in a narrow percolator, extract with ether, until the percolate measures 200 cc. and evaporate to dryness: the residue does not exceed 0.6 per cent (*fatty matter*).

Pack 10 Gm. of Purified Cotton in a narrow percolator, and extract with alcohol until the percolate measures 50 cc.: when observed downward through a column 20 cm. in depth, the percolate may show a yellowish color, but no blue or green tint (*dyes*).

Place 10 Gm. of Purified Cotton in 200 cc. of boiling distilled water in a porcelain dish; keep the water at about 100° C. for five minutes, holding the cotton under the surface with the aid of a glass rod. Then press out with the assistance of the rod, and decant 100 cc. of the water, filtering it if not clear. Now add 50 cc. of cold distilled water to the Purified Cotton, thoroughly working it through the Cotton with the glass rod, for ten minutes, and again decant 50 cc. of the water. Twice again wash the Cotton with 50 cc. portions of cold distilled water, in the manner described, and evaporate to dryness the combined washings so obtained in a porcelain or platinum dish on a water bath. The residue, dried to constant weight at 100° C., does not exceed 0.025 Gm. (*water-soluble substances*).

N. F. Preparation—Gossypium Stypticum.

Uses—Purified cotton is used in funnels for straining, in percolators for controlling the flow of the percolate, and for many other purposes besides its main use in surgery.

GOSSYPIUM STYPTICUM. N. F. Styptic Cotton

[Gossyp. Stypt.]

	Metric	Alternative
Purified Cotton	**100 Gm.**	3 oz. av. 231 gr.
Solution of Ferric Chloride	**80 cc.**	3 fl. oz. 38 min.
Glycerin	**16 cc.**	295 min.
Water	**225 cc.**	10 fl. oz.

Mix the solution of ferric chloride, glycerin and water, immerse the purified cotton in this solution, and allow it to remain one hour. Then remove it, press it until it has been brought to a weight of 300 Gm. [12 oz. av.] and spread it out in thin layers, in a warm place protected from dust and light. When dry transfer it to well-closed glass containers.

Uses—It is used as a hemostatic, being applied to wounds.

Products Resulting from the Decomposition of Cellulose

Under this head will be included—1. The preparations made by decomposing cellulose or lignin by the action of acids or alkalies. 2. Those made by destructive distillation.

Pyroxylin is placed in the first class, primarily because of its importance in pharmacy, medicine, and the arts.

PYROXYLINUM. U. S. Pyroxylin

[Pyroxylin.—Soluble Guncotton]

Pyroxylin is a product obtained by the action of a mixture of nitric and sulphuric acids on cotton, and consists chiefly of cellulose tetranitrate $[C_{12}H_{16}O_6(NO_3)_4 = 504.22]$.

Preparation—The process official in the U. S. P. 1890 was as follows:

	Metric	Alternative
Purified Cotton	**100 Gm.**	½ oz. av.
Nitric Acid	**1400 cc.**	7 fl. oz.
Sulphuric Acid	**2200 cc.**	11 fl. oz.
Alcohol,		
Ether,		
Water, each, a sufficient quantity.		

Mix the acids gradually in a glass or porcelain vessel, and, when the temperature of the mixture has fallen to 32° C., add the purified cotton. Using a glass rod imbue the cotton thoroughly with the acids, and allow it to macerate, until a sample of it, taken out, thoroughly washed with a large quantity of water, and subsequently with alcohol, and pressed, is found to be soluble in a mixture

of 1 volume of alcohol and 3 volumes of ether. Then remove the cotton from the acids, transfer it to a larger vessel, and wash it, first, with cold water, until the washings cease to have an acid taste, and then with boiling water, until they cease to redden blue litmus paper. Finally, drain the Pyroxylin on filter paper, and dry it in small, detached pellets, by means of a water bath or steam bath at a temperature not exceeding 60° C.

Shönbein, in 1846, first pointed out the fact that nitric acid acts on cotton and produces a soluble compound. It was subsequently proved that this substance, pyroxylin, or guncotton, belongs to a series of closely related nitro-compounds in which the nitric acid radicle replaces the hydroxyl of the cellulose formula. This is usually indicated as taking the double formula for cellulose $C_{12}H_{20}O_{10}$ with the displacement of the HO, thus:

$$\underset{\text{nitric acid}}{6HNO_3} + \underset{\text{cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{cellulose hexanitrate}}{C_{12}H_{14}O_4(NO_3)_6} + \underset{\text{water}}{6H_2O}$$

$$\underset{\text{nitric acid}}{5HNO_3} + \underset{\text{cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{cellulose pentanitrate}}{C_{12}H_{15}O_5(NO_3)_5} + \underset{\text{water}}{5H_2O}$$

$$\underset{\text{nitric acid}}{4HNO_3} + \underset{\text{cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{cellulose tetranitrate}}{C_{12}H_{16}O_6(NO_3)_4} + \underset{\text{water}}{4H_2O}$$

$$\underset{\text{nitric acid}}{3HNO_3} + \underset{\text{cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{cellulose trinitrate}}{C_{12}H_{17}O_7(NO_3)_3} + \underset{\text{water}}{3H_2O}$$

$$\underset{\text{nitric acid}}{2HNO_3} + \underset{\text{cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{cellulose dinitrate}}{C_{12}H_{18}O_8(NO_3)_2} + \underset{\text{water}}{2H_2O}$$

Intermediate nitro-celluloses have also been prepared, Vieille having made at least eight different forms which suggested the possibility of double the cellulose formula shown above, but today it is thought that these differences are due to mechanical mixtures of the various nitro-celluloses.

The soluble pyroxylin used in preparing collodion is a varying mixture of the di-, tri-, tetra-, and pentanitrates, but is mainly tetranitrate. The hexanitrate is the true explosive guncotton, and is insoluble in ether, alcohol, acetone, or water.

Description and Physical Properties—A yellowish-white, matted mass of filaments, resembling raw cotton in appearance but harsh to the touch. It is exceedingly inflammable, burning, when unconfined, very rapidly and with a luminous flame. When kept in well-closed bottles and exposed to light, it is decomposed with the evolution of nitrous vapors, leaving a carbonaceous residue.

Tests for Identity—Pyroxylin is slowly but completely soluble in 25 parts of a mixture of three volumes of ether and one volume of alcohol. It is soluble in acetone and in glacial acetic acid and is precipitated from these solutions on the addition of water.

Tests for Purity—Saturate 0.5 Gm. of Pyroxylin with alcohol in a dish placed in cold water and ignite the Pyroxylin at the top. When combustion is complete and the dish heated to redness, not more than 0.3 per cent of ash remains.

Stir 1 Gm. of Pyroxylin with 20 cc. of distilled water for ten minutes and filter: the filtrate does not acquire an acid reaction. Evaporate 10 cc. of the filtrate from the preceding test to dryness on a water bath: not more than 0.0015 Gm. of residue remains (*soluble substances*).

Preserve in cartons, packed loosely, and protected from light and moisture.

Preparations—Collodium, Collodium Flexile.

U. S. P. and N. F. Preparations—Collodium, and, from Collodion, the several medicated Collodions are prepared (see pages 343 and 344).

Uses—Pyroxylin has been used very largely by photographers for producing the basis of the sensitized film upon which impressions are made. It is now replaced to a great extent by gelatin. The composition known as *celluloid*, which is employed so largely for useful and ornamental articles, is made from pyroxylin and camphor, heated together under pressure. The camphor, which acts as a plasticising medium has been replaced to some extent by other organic compounds, such as triphenyl phosphate and allied compounds.

Unofficial

ACIDUM OXALICUM. Oxalic Acid

$H_2C_2O_4.2H_2O = 126.06$

This acid was omitted from the alphabetical list of chemical substances in the U. S. Pharmacopœia; it is found, however, among the official reagents.

Preparation—Oxalic acid, also known as *dicarboxyl*, is dibasic, and is frequently found in plants in the form of crystals of calcium oxalate of distinctive forms. It may be made by acting on cellulose, sugar, or starch with nitric acid, with the aid of heat, and is prepared on a commercial scale by heating dried sawdust with a mixture of two molecules of caustic soda and one molecule of caustic potash. The mixture of caustic alkalies and sawdust is made in a thick paste and then heated for several hours to a temperature of about 240° C. The greenish-yellow mass is then washed with sodium carbonate, whereby the potassium is removed as carbonate, the less soluble sodium oxalate remaining. This is converted into calcium oxalate by milk of lime, and the calcium salt is then decomposed with sulphuric acid. The impure oxalic acid is finally purified by recrystallization.

It is also prepared on a large scale by heating a mixture of potassium formate with a little potassium oxalate and a slight excess of alkali. The oxalate so obtained is liberated by the addition of sulphuric acid.

It has also been produced directly from CO_2 and metallic sodium.

It occurs in small, colorless clino-rhombic crystals, which are odorless and have a very sour taste; it is slightly efflorescent in dry air, fusible at 98° C., and entirely volatile at a red heat.

The crystals should dissolve in ten parts of distilled water at 25° C. It is soluble in 4.5 parts of absolute alcohol, and in 2.5 parts of alcohol, and is almost insoluble in ether, chloroform, benzene, and petroleum benzin. It fuses in its water of hydration at 98° C., although continued exposure to a heat of 60° to 70° C., will render it perfectly anhydrous. Solutions of oxalic acid at 100° C. lose acid by sublimation and at 157° C. it sublimes rapidly. If the heat rises to 160° C. much loss of acid occurs. (See Reagents, Chapter XCII.)

It combines with salifiable bases, and forms salts called oxalates. The most important of these are the three *potassium salts—oxalate*, *binoxalate*, and *quadroxalate* (acid potassium oxalate plus free oxalic acid), *ammonium oxalate* (used as a test), and *calcium oxalate*. The binoxalate and quadroxalate, popularly called *salt of sorrel* or *essential salt of lemons*, are employed for removing iron stains from linen, and act by their excess of acid, which forms a soluble salt with the ferric oxide constituting the stain. The name "essential salts of lemon" is a particularly dangerous one as citric acid is also known by the same synonym. Oxalates should always bear a poison label when dispensed.

Oxalic acid in solution combines readily with calcium compounds forming an insoluble white precipitate consisting of calcium oxalate, which is insoluble in an excess of oxalic or acetic acid, but is dissolved by dilute hydrochloric acid.

Uses—This acid was used in the U. S. P. VIII as a reagent for establishing a standard for volumetric solutions, since a pure acid may be easily obtained and a definite quantity weighed. It is used in the test solutions and volumetric solutions of the U. S. Pharmacopœia. It is not, however, as frequently directed as in former Pharmacopœias, due to the tendency of the solution to crystallize at the delivery point of the burette, causing errors through the crystals falling into the solution which is being tested.

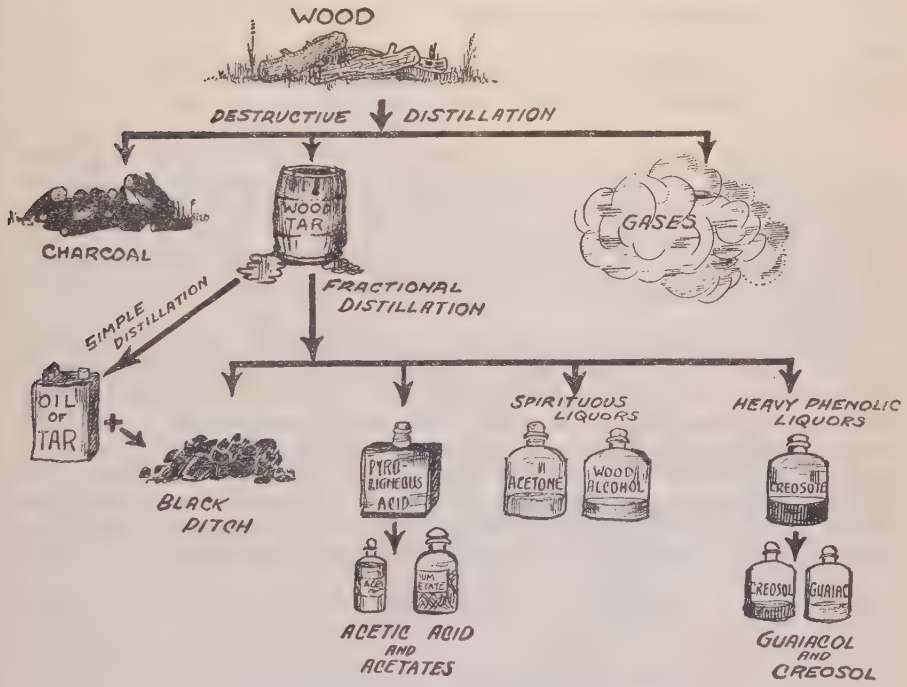
The best antidote to poisoning by oxalic acid is a paste made by mixing prepared chalk or powdered chalk with water or lime water; it must be

administered promptly and freely. Calcium chloride or any non-toxic salt of calcium may be used; magnesia has some antidotal effect although it is less valuable than lime.

Products Resulting from the Destructive Distillation of Cellulose and Lignin

When wood is distilled in a closed vessel, many products are obtained. These vary with the kind of wood used, the care used in the distillation, and the temperature at which the distillation is effected. When dry hard woods (oak, walnut, or beech) are distilled, about 25 per cent of charcoal is obtained; the

Fig. 434



Products from the destructive distillation of wood.

liquid portion amounts to about 53 per cent, while the remainder, 22 per cent, is represented by waste products, principally uncondensible gases, carbon dioxide, carbon monoxide, etc. The principal solid, liquid, and gaseous products are shown by Fig. 434, and by the following list:

Solids—Charcoal, inorganic salts, etc. **Liquids**—1. Aqueous liquid, containing *acetic, formic, butyric, crotonic, capronic,* and *propionic acids; acetone, methyl alcohol, furfurol, methylamine, pyrocatechin,* and some small quantities of *empyreumatic oils* and *resins.* 2. Tarry liquid, containing *toluol, xylol, cumol, methol, mesitylene, pseudocumol, phenol, cresol, guaiacol, creosol, phlorol, methylcreosol, naphthalene, paraffin, pyrene, chrysene, retene, mesit.* **Gases**—*Carbon dioxide, carbon monoxide, methane, acetylene, ethylene, propene,* and others. The most important products are *charcoal, tar, acetic acid, acetone, methyl alcohol,* and *creosote.* Of these, charcoal has been considered on page 589.

ACIDUM ACETICUM. U.S. Acetic Acid

[Acid. Acet.]

Acetic Acid is an aqueous solution containing not less than 36 per cent and not more than 37 per cent of $CH_3.COOH = (60.04)$.

Preparation—Acetic acid is an important product of the hard wood destructive distillation industry. It is obtained commercially by neutralizing the crude wood distillate called *pyroligneous acid* with milk of lime, decomposing the calcium acetate with sulphuric acid, and distilling off the liberated acetic acid. The reactions that take place in this separation are shown in the following equations:

$$\underset{\text{acetic acid(crude)}}{2CH_3COOH} + \underset{\substack{\text{calcium hydroxide}\\\text{(milk of lime)}}}{Ca(OH)_2} = \underset{\text{calcium acetate}}{(CH_3COO)_2Ca} + \underset{\text{water}}{2H_2O}$$

then

$$\underset{\text{calcium acetate}}{(CH_3COO)_2Ca} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{calcium sulphate}}{CaSO_4} + \underset{\text{acetic acid}}{2CH_3COOH}$$

The temperature used for distilling wood may be much less than that necessary to produce charcoal. The advantages of this process are that the production of the empyreumatic substances, which constitute the most objectionable impurities in the commercial acid, is largely curtailed, the process being at the same time more economical, as the residue of slightly darkened wood is more valuable than the completely charred carbon left by the ordinary process.

Acetic acid is also made by distilling *vinegar*, a liquid made by the oxidation of dilute alcoholic liquids, such as cider, wine, etc. In Germany acetic acid is made by mixing alcohol with water in the proportion of eight parts of the former to ninety-two parts of the latter, and then pouring it upon beech wood shavings which have been impregnated with cultures of *Mycoderma aceti*. As the alcoholic liquid trickles through it is oxidized by the action of the air, through the agency of the microörganisms. Aldehyde is an intermediate product. This " quick vinegar " process is now extensively used in the United States, being also employed for the acetification of "hard cider".

$$\underset{\text{alcohol}}{C_2H_6O} + \underset{\text{oxygen}}{O} = \underset{\text{aldehyde}}{C_2H_4O} + \underset{\text{water}}{H_2O}$$

$$\underset{\text{aldehyde}}{C_2H_4O} + \underset{\text{oxygen}}{O} = \underset{\text{acetic acid}}{C_2H_4O_2}$$

Various strengths of acetic acid are found in commerce—the official acid (36 to 37 per cent), which has the sp. gr. 1.045 at 25° C., stronger acids of 60 or 80 per cent strength, which may be used economically for making the weaker acid, and also the *No. 8 acid*, as it is called (30 per cent), which is still used; the latter has the sp. gr. 1.038 at 25° C. and is weaker than the official acid. It is termed " No. 8 " because it was formerly used in the proportion of one part in eight to make the ordinary diluted acetic acid, equivalent in strength to distilled vinegar.

Tests for Acetates

Acetates—When warmed with concentrated sulphuric acid, acetates evolve acetic acid. If acetic acid or an acetate is warmed with sulphuric acid and alcohol, the characteristic fragrant odor of ethyl acetate is evolved. With neutral solutions of acetates, ferric chloride T.S. produces a deep red color which is destroyed by the addition of mineral acids.

Description and Physical Properties—A clear, colorless liquid, having a strong, characteristic odor, and a sharply acid taste.

Acetic acid is miscible with water, alcohol, and glycerin.

Specific gravity: about 1.045 at 25° C.

Tests for Identity—Acetic Acid is strongly acid to litmus paper and responds to the reactions for acetates, page 800.

Tests for Purity—Evaporate 20 cc. of Acetic Acid on a water bath, and dry to constant weight at 100° C.: the weight of the residue does not exceed 0.002 Gm.

Mix 5 cc. of the Acid with 10 cc. of ammonia T.S., add 5 cc. of silver nitrate T.S., and boil the solution for one minute: the color of the solution is not changed (*formic or sulphurous acid*).

Dilute 4 cc. of the Acid in a glass-stoppered bottle with 20 cc. of distilled water, and add 0.5 cc. of tenth-normal potassium permanganate: the pink color is not changed to brown at once, and the liquid does not become entirely brown or free from a pink tint in less than one-half minute (*empyreumatic substances*).

Separate portions of 1 cc. each of Acetic Acid diluted with 10 volumes of distilled water show no turbidity on the addition of 5 drops of barium chloride T.S. (*sulphate*), and no opalescence with 5 drops of silver nitrate T.S. (*chloride*).

Acetic Acid diluted with 20 volumes of distilled water meets the requirements of the test for *heavy metals*, page 1519.

Assay—Proceed as directed under the assay for acids, page 1514, using about 6 cc. of the Acid, accurately weighed and phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.06004 Gm. of $CH_3.COOH$.

This assay is explained on page 1453.

Preserve in glass-stoppered bottles.

U. S. P. Preparations—Acidum Aceticum Dilutum; Extractum Nucis Vomicæ.

N. F. Preparations—Acetum Aromaticum; Linimentum Terebinthinæ Aceticum; Liquor Alumini Subacetatis.

Uses—Acetic acid is used in pharmacy as a solvent and menstruum, and for making the diluted acetic acid. The crude acetic acid called pyroligneous acid is sometimes put up under the name of "liquid smoke" and sold for the purpose of preserving meat, fish, etc., which are dipped therein and then dried, instead of subjecting them to the customary smoking process. This use of pyroligneous acid is prohibited by most food laws.

ACIDUM ACETICUM DILUTUM. U.S. Diluted Acetic Acid

[Acid. Acet. Dil.]

Diluted Acetic Acid is an aqueous solution containing not less than 5.7 per cent and not more than 6.3 per cent of $CH_3.COOH$ (60.04).

	Metric	Alternative
Acetic Acid	**165 Gm.**	5 fl. oz. 35 min.
Distilled Water	**835 Gm.**	26 fl. oz. 445 min.
To make	**1000 Gm.**	2 pints

Mix them.

Description and Physical Properties—A clear, colorless liquid, having a characteristic odor.

Diluted Acetic Acid is miscible with water and with alcohol.

Specific gravity: about 1.008 at 25° C.

Tests for Identity and Purity—Diluted Acetic Acid is acid to litmus paper and responds to the reactions for acetates, page 800.

It conforms to the tests for purity under *Acidum Aceticum*, allowance being made for the difference in strength.

Assay—Proceed as directed under the assay for acids, page 1514, using about 25 cc. of the Acid, accurately weighed, and phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.06004 Gm. of $CH_3.COOH$.

This assay is explained on page 1453.

Preserve in glass-stoppered bottles.

U. S. P. Preparations—Acetum Scillæ; Liquor Ammonii Acetatis; Liquor Ferri et Ammonii Acetatis.

N. F. Preparations—Mistura Adstringens; Syrupus Allii.

Uses—Diluted acetic acid is superior to vinegar as a menstruum, and is used officially because of its greater purity, more uniform strength, and freedom from color. It is of service as an astringent, as in sunburn, and as a styptic. The dose is thirty minims (2 cc.).

ACIDUM ACETICUM GLACIALE. U.S. Glacial Acetic Acid

[Acid. Acet. Glac.]

Glacial Acetic Acid contains not less than 99 per cent of $CH_3.COOH$(60.04).

Preparation—This acid (which is termed "glacial" because of its solid glassy appearance when congealed) is made by fusing carefully fifty-four parts of pure crystallized sodium acetate; the residue is coarsely powdered, placed in a retort, mixed with forty parts of pure concentrated sulphuric acid, and distilled; the distillate is glacial acetic acid.

$$\underset{\text{sodium acetate}}{NaC_2H_3O_2} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\substack{\text{glacial acetic}\\\text{acid}}}{HC_2H_3O_2} + \underset{\substack{\text{acid sodium}\\\text{sulphate}}}{NaHSO_4}$$

The specific gravity of glacial acetic acid (100 per cent) is 1.0471 at 25° C. and the specific gravity of 39 per cent acetic acid is nearly the same, 1.0474, while 79, 80, 77, and 76 per cent acids have exactly the same density. It will thus be seen that specific gravity cannot be relied upon as a criterion for strength. The glacial acid may, however, be distinguished from the 39 per cent acid by adding 10 per cent of water, when, if the density increases, the specimen is the stronger acid. (See Acetic Acid table, U. S. P. X.)

Description and Physical Properties—A clear, colorless liquid, having a strong, characteristic odor, and a very pungent, acid taste.

Glacial Acetic Acid is miscible with water, alcohol, and glycerin.

Specific gravity: from 1.047 to 1.050 at 25° C.

Tests for Identity and Purity—Congealing point: not below 14.5° C. It boils between 117° and 118° C.

Glacial Acetic Acid responds to the reactions for acetates, page 800.

It conforms to the tests for purity under *Acidum Aceticum* when diluted to that strength, except in the following respects:

The pink color produced by the addition of 0.1 cc. of tenth-normal potassium permanganate to 2 cc. of Glacial Acetic Acid, which has been diluted with 10 cc. of distilled water and is contained in a glass-stoppered bottle, is not changed to brown within two hours (*readily oxidizable impurities*).

Evaporate 20 cc. of Glacial Acetic Acid to dryness on a water bath, and dry to constant weight at 100° C.: the weight of the residue does not exceed 0.002 Gm.

Assay—Proceed as directed under the assay for acids, page 1514, using about 2.5 Gm. of the Acid, accurately weighed, and phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.06004 Gm. of $CH_3.COOH$.

This assay is explained on page 1453.

Preserve in glass stoppered bottles.

U. S. P. Preparations—Ceratum Cantharidis; Tinctura Cantharidis.

Uses—Glacial acetic acid is a solvent for fixed and volatile oils. Medicinally, it is a caustic and vesicant when applied externally. It is often sold under various disguises as a corn solvent.

ACIDUM TRICHLORACETICUM. U.S. Trichloracetic Acid

[Acid. Trichloracet.]

Trichloracetic Acid, dried to constant weight over sulphuric acid, contains not less than 99 per cent of $CCl_3.COOH$ (163.40).

Preparation—This acid, discovered by Dumas in 1838, may be made by oxidizing 165.5 Gm. of chloral hydrate, previously fused at 58° C. with 63 Gm. of fuming nitric acid, and placing the mixture aside for an hour or until the red fumes have disappeared; the liquid is then distilled, and the portion coming over above 190° C. is trichloracetic acid, which is then crystallized.

Description and Physical Properties—Colorless, deliquescent crystals having a slight, characteristic odor.

One Gm. of Trichloracetic Acid is soluble in about 0.1 cc. of water at 25° C. It is very soluble in alcohol and in ether.

Tests for Identity—Trichloracetic Acid heated with a solution of an alkali hydroxide is decomposed with the formation of alkali carbonate and chloroform, the latter being recognizable by the odor of phenylisocyanide (a poisonous substance), when a few drops of a saturated, aqueous solution of aniline are added to the heated mixture.

Tests for Purity—Ash: not more than 0.05 per cent.

Dissolve about 0.5 Gm. of ferrous sulphate in 5 cc. of an aqueous solution of Trichloracetic Acid (1 in 20) and superimpose it upon 5 cc. of sulphuric acid: no brownish-red color develops at the zone of contact (*nitric acid*).

One Gm. of Trichloracetic Acid shows no more *chloride* than corresponds to 0.5 cc. of fiftieth-normal hydrochloric acid, page 1520.

Assay—Proceed as directed under the assay for acids, page 1514, using about 4 Gm. of the Acid, previously dried to constant weight over sulphuric acid, and phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.1634 Gm. of CCl_3COOH.

Each Gm. of Trichloracetic Acid, previously dried to constant weight over sulphuric acid, corresponds to not less than 6.06 cc. and to not more than 6.12 cc. of normal sodium hydroxide.

This assay is explained on page 1453.

Preserve in well-stoppered bottles, in a cool place, protected from light.

Uses—This acid was first introduced into the U. S. P. VIII; it is used as a caustic in solution or in crystals.

ACETONUM. U. S. Acetone

[Aceton.—Dimethyl-ketone]

Acetone contains not less than 99 per cent of $CH_3.CO.CH_3$ (58.06).

Preparation—This liquid may be made by the distillation of dry calcium acetate, obtained by neutralizing crude wood spirit with milk of lime, at 290° C. The reaction involved is expressed as follows:

$$\underset{\text{calcium acetate}}{CH_3COO\diagdown \atop CH_3COO\diagup Ca} = \underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{acetone}}{\begin{matrix} CH_3 \\ | \\ CO \\ | \\ CH_3 \end{matrix}}$$

It is also found in crude wood spirit in varying proportions but it is separated, with difficulty, from methyl alcohol, which constitutes the principal bulk in the wood spirit, because methyl alcohol boils at 55° C. and acetone at about 56.5° C., the difference being too slight to use fractional distillation with success.

Description and Physical Properties—A transparent, colorless, mobile and volatile liquid, having a characteristic odor. It is inflammable.

Acetone is miscible without cloudiness with water, alcohol, ether, chloroform, and most volatile oils.

Tests for Identity—Specific gravity: about 0.790 at 25° C.

It boils between 56° and 58° C., but volatilizes even at low temperatures.

Add 1 cc. of sodium hydroxide T.S. to 1 cc. of an aqueous dilution of Acetone (1 in 200), warm the mixture, and add a few cc. of iodine T.S.: a yellow precipitate of iodoform is formed at once.

Mix 1 cc. of the same Acetone dilution with five drops of sodium nitroprusside T.S. and 2 cc. of sodium hydroxide T.S. and add a slight excess of acetic acid: a deep red liquid is produced which develops a violet tint when diluted with several volumes of water.

Tests for Purity—Acetone diluted with an equal volume of distilled water does not affect the color of blue or red litmus paper previously moistened with water.

Evaporate 50 cc. of Acetone in a dish on a water bath, and dry to constant weight at 100° C.: the weight of the residue does not exceed 0.002 Gm.

Mix 20 cc. of Acetone with 0.1 cc. of tenth-normal potassium permanganate in a clean glass-stoppered bottle: the pink tint produced does not wholly disappear in less than fifteen minutes (*empyreumatic substances*).

Assay—Determine the exact weight of a glass-stoppered weighing bottle containing 15 cc. of distilled water, add about 1 cc. of Acetone, and again weigh accurately. Transfer the contents of the bottle to a 1000 cc. graduated flask, rinse the weighing bottle with several portions of distilled water, and add the rinsings to the flask. Fill to the mark with distilled water, and mix thoroughly. Place 25 cc. of normal sodium hydroxide in a 250 cc. glass-stoppered flask, add exactly 25 cc. of the Acetone solution and 35 cc. of tenth-normal iodine, with constant agitation of the flask, and

allow the mixture to stand for fifteen minutes. Add 26 cc. of normal hydrochloric acid, and at once titrate the residual iodine with tenth-normal sodium thiosulphate, adding starch T.S. as indicator when the liquid is nearly decolorized. Conduct a blank test with the same quantities of the reagents, and subtract the quantity of tenth-normal iodine consumed in the blank test from that consumed in the assay. Each cc. of the difference, which represents the iodine consumed by the reaction with the Acetone, corresponds to 0.0009677 Gm. of $CH_3.CO.CH_3$.

This assay is explained on page 1469.

Preserve in well-closed containers, in a cool place, remote from fire.

Uses—Acetone was formerly used as the menstruum in the preparation of oleoresins but is now replaced by ether. It is used as a solvent for dissolving fatty bodies, resins, pyroxylin, etc. It is at present largely used in the manufacture of chloroform.

PIX PINI. U.S. Pine Tar

[**Pix Pin.**—Pix Liquida U.S.P. IX]

A product obtained by the destructive distillation of the wood of *Pinus palustris* Miller, or of other species of *Pinus* (Fam. *Pinaceæ*).

Preparation—Tar is usually obtained as a by-product in the manufacture of charcoal or acetic acid (see page 800). It is a complex mixture of phenolic bodies for the most part insoluble in water. Among these are *creosol*, *phlorol*, *guaiacol*, *pyrocatechol*, *cœrulignol* and *pyrogallol* esters. Traces of *phenol* and *cresols* are also present as well as hydrocarbons of the paraffin and benzene series.

Description and Physical Properties—A very viscid, blackish-brown, non-crystalline liquid. It is translucent in thin layers, becoming granular and opaque with age. It has an empyreumatic, terebinthinate odor and a sharp, empyreumatic taste.

Pine Tar is heavier than water and is slightly soluble in it, the solution being pale yellowish to yellowish-brown and acid to litmus paper.

Pine Tar is miscible with alcohol, ether, chloroform, glacial acetic acid, and fixed and volatile oils.

Tests for Identity and Purity—Shake about 1 cc. of Pine Tar with 10 cc. of water for ten minutes, filter, and add 1 drop of ferric chloride T.S. to the filtrate. A green color is produced, rapidly changing to brown.

Ash: not more than 0.25 per cent.

Preserve in well-closed containers.

U. S. P. Preparation—Unguentum Picis Pini.
N. F. Preparation—Glyceritum Picis Pini.

History—An aqueous extract of tar was claimed by George Berkeley, Bishop of Cloyne, in the early part of the eighteenth century to be a panacea for all human ills and he wrote a book upon "*Tar Water*" which makes very interesting reading as an example of misbelief and credulity.

Uses—The volatile products of tar are expectorant, and tar inhalations are often used. The dose of tar is 8 grains (0.5 Gm.). Externally, tar is stimulating and antiseptic and is used in skin diseases.

Unofficial Preparation

LIQUOR PICIS ALKALINUS. N.F.IV. Alkaline Solution of Tar

Dissolve 125 Gm. of potassium hydroxide in 625 cc. of water, add 250 Gm. of pine tar, and agitate until solution is effected. Allow it to stand twenty-four hours, then strain the solution through purified cotton, and pass sufficient water through the strainer to make the product measure 1000 cc.

Uses—Used externally as an antiseptic in dermatologic practice.

OLEUM PICIS RECTIFICATUM. U.S. Rectified Oil of Tar

[Ol. Pic. Rect.—Oleum Picis Liquidæ Rectificatum U.S.P. IX]

The volatile oil from pine tar rectified by steam distillation.

Description and Physical Properties—A thin liquid, having a dark reddish-brown color, and a strong, empyreumatic odor and taste.

Tests for Identity and Purity—The Oil is soluble in all proportions in alcohol.

Specific gravity: 0.960 to 0.990 at 25° C.

An alcoholic solution of the Oil is acid to moistened blue litmus paper.

U.S.P. Preparation—Syrupus Picis Pini.

N.F. Preparation—Unguentum Picis Compositum.

Uses—The constituents of oil of tar are complex and numerous; the residue left after the distillation of tar is *black pitch*. The oil is preferred to tar for most medicinal uses, because the insoluble and inert substances have been separated. The dose is three minims (0.2 cc.).

OLEUM CADINUM. U.S. Oil of Cade

[Ol. Cadin.—Cade Oil, Oil of Juniper Tar, Oleum Juniperi Empyreumaticum]

The empyreumatic volatile oil obtained from the wood of *Juniperus Oxycedrus* Linné (Fam. *Pinaceæ*).

Description and Physical Properties—A dark brown, clear, thick liquid, having a tarry odor, and a warm, faintly aromatic, bitter taste.

The Oil is very slightly soluble in water, but imparts to it an acid reaction shown by moistened blue litmus paper. It is only partially soluble in alcohol and in petroleum benzin, but completely soluble in three volumes of ether and soluble in all proportions in amyl alcohol, chloroform, glacial acetic acid, and in oil of turpentine.

Tests for Identity and Purity—Specific gravity: 0.980 to 1.055 at 25° C.

Shake 1 part of Oil of Cade with 20 parts of warm distilled water, and filter: separate portions of 5 cc. each of the aqueous filtrate give a red coloration with three drops of ferric chloride solution (1 in 1000), blacken silver ammonium nitrate T.S. in the cold, and give a red precipitate with alkaline cupric tartrate T.S. on heating.

Agitate 1 cc. of Oil of Cade with 15 cc. of purified petroleum benzin, filter the solution, add an equal volume of copper acetate solution (1 in 100), shake the mixture, and allow it to separate. Decant the benzin layer into a test tube, and add to it an equal volume of ether: no intensely green coloration is produced, nor does the liquid become more than light yellow to brown (*rosin or rosin oils*).

N.F. Preparations—Linimentum Saponis Mollis Compositum; Petroxolinum Cadini; Petroxolinum Sulphuratum Compositum; Unguentum Sulphuris Compositum.

Uses—It is used as a local application in skin diseases.

OLEUM BETULÆ EMPYREUMATICUM RECTIFICATUM. N.F. Rectified Oil of Birch Tar

[Ol. Bet. Empyr. Rect.—Rectified Pyroligneous Oil of Birch, Oleum Rusci Rectificatum, Russian Leather Oil]

The pyroligneous oil obtained by the dry distillation of the bark and wood of *Betula alba* Linné (Fam. *Betulaceæ*), rectified by steam distillation.

It contains guaiacol, cresol, and pyrocatechol.

Official Description—A limpid, dark brown liquid.

Odor and Taste—A penetrating, empyreumatic odor resembling that of Russia leather.

Solubility—It yields clear solutions with three volumes of dehydrated alcohol, and with ether chloroform, glacial acetic acid, amyl alcohol, oil of turpentine, benzene, or carbon disulphide. When mixed with three volumes of alcohol or purified petroleum benzin, the solution is not more than slightly turbid, but a decided turbidity is produced when mixed with the same volume of methanol.

Specific gravity: 0.886 to 0.950 at 25° C.

Tests for Identity and Purity—Warm 2 cc. of the Oil with 10 cc. of distilled water, agitate and allow the mixture to cool; separate and filter the aqueous liquid. The filtrate is colorless, has a strong, empyreumatic odor and an acid reaction. Add two drops of potassium dichromate T.S.

to 4 cc. of the aqueous filtrate: a bright yellow solution is produced which soon becomes darker and turbid. Add one drop of dilute ferric chloride solution (1 in 100) to 4 cc. of the filtrate: it produces a green coloration which changes to brown and becomes turbid (distinction from *oil of cade*).

N.F. Preparation—Unguentum Resorcinolis Compositum.

Uses—It is similar to oil of cade, being used externally in the form of an ointment for eczema and other skin affections.

CREOSOTUM. U.S. Creosote

[**Creosot.**—CREASOTE]

A mixture of phenols, principally guaiacol [$C_6H_4(OH)(OCH_3)$ 1:2 = 124.10] and creosol [$C_6H_3(CH_3)(OH)(OCH_3)$ 1:2:3 = 138.12] obtained from wood tar.

Preparation—This is a product of the distillation of wood tar, consisting mainly of the following phenols: *guaiacol*, or *oxycresol*, $C_7H_8O_2$, boiling at 200° C.; *creosol*, $C_8H_{10}O_2$, boiling at 217° C.; *methyl-creosol*, $C_9H_{12}O_2$, boiling at 214° C. to 218° C.; *phlorol*, $C_8H_{10}O$, boiling at 219° C.

Wood tar, preferably that from beechwood, is distilled until about one-half passes over and the dense vapors of higher boiling constituents appear. The distillate separates into three strata, the lower of heavy, the upper of lighter oily liquid, with an aqueous acid layer between. The oil contains *eupion*, which is a liquid consisting chiefly of pentane. The heavy oil is then shaken with a concentrated solution of sodium carbonate, to neutralize the acetic acid, the separated oily liquid is again distilled, and only the portion heavier than water collected. The distillate is now treated with potassium hydroxide, in which the creosote dissolves, the hydrocarbons separating. Sulphuric acid is now added to neutralize the potassium hydroxide and the separated creosote is well washed with water and redistilled, the portion coming over between 200° and 220° C. being collected. Formerly much of the liquid sold for and labeled "creosote" in the market was impure phenol (carbolic acid), or so called "coal-tar creosote". In view of the extensive use of wood creosote in large doses internally in phthisis, the liability of administering a large dose of phenol and causing death through this substitution is very great. Phenol may be distinguished from true wood creosote by the tests given below. The odor of each is distinctive and characteristic.

Description and Physical Properties—An almost colorless or yellowish, highly refractive, oily liquid, having a penetrating, smoky odor, and a burning, caustic taste. It does not readily become brown on exposure to light. Creosote is inflammable, burning with a luminous, smoky flame.

Creosote is slightly soluble in water, but is miscible with alcohol, ether, and with fixed or volatile oils.

Tests for Identity—Add 1 drop of ferric chloride T.S. to 10 cc. of a saturated aqueous solution of Creosote: a violet-blue color, which is very transient, develops. The liquid becomes cloudy almost instantly, the color changing rapidly from grayish-green to muddy brown, with the formation, finally, of a brown precipitate.

Tests for Purity—Specific gravity: not below 1.076 at 25° C.

It begins to distil at about 200° C. and not less than 90 per cent, by volume, distils between 200° and 220° C. when determined by Method II, page 121.

Creosote is neutral or faintly acid to moistened litmus paper.

Mix equal volumes of Creosote and collodion in a dry test tube: no permanent coagulum is produced (*phenol* and so-called "*coal-tar creosote*").

Mix 4 cc. of Creosote and 4 cc. of glycerin, add 1 cc. of water, shake the mixture gently, and allow it to stand: a creosote layer separates equal to or greater in volume than the Creosote taken (so-called "*coal-tar creosote*").

A 2 cc. portion of Creosote requires not less than 10 cc. and not more than 18 cc. of normal sodium hydroxide to produce a clear liquid. This liquid remains unclouded on diluting with 50 cc. of distilled water (*hydrocarbons and bases*).

Shake gently 1 cc. of Creosote with 2 cc. of petroleum benzin and 2 cc. of freshly prepared barium hydroxide T.S. until a uniform mixture results: upon complete separation three distinct layers are visible, the upper layer being neither blue nor muddy (*cærulignol*).

Preserve in tightly-stoppered, dark amber-colored bottles.

N. F. Preparations—Elixir Terpini Hydratis et Creosoti Compositum; Mulla Creosoti Salicylata.

Uses—Creosote is used internally as an expectorant in bronchitis and phthisis and as a gastro-intestinal antiseptic. It is occasionally employed externally for its disinfectant action. It is applied upon cotton to exposed nerve tissue in teeth, when it acts as a local anesthetic. It is also hemostatic when applied to bleeding surfaces. When taken internally, undiluted, and in large doses, it is a powerful poison. The administration of mucilaginous drinks, and the prompt evacuation of the stomach by the stomach pump, would be the best treatment, no antidote to poisoning by creosote being known. Dose: four minims (0.25 cc.).

CREOSOTI CARBONAS. U. S. Creosote Carbonate

[Creosot. Carb.]

Creosote Carbonate is a mixture of the carbonates of various constituents of creosote, chiefly guaiacol and creosol.

Preparation—It is prepared by passing a current of carbonyl chloride, or phosgene, into a solution of creosote in sodium hydroxide and washing the product with weak soda solution and water.

The local action and toxicity of creosote is minimized by masking the active OH group, through the replacement of the H group by an acid radicle as in this official product. These compounds are insoluble in water and inactive but are saponified in the intestines and gradually liberate their active constituents.

Description and Physical Properties—A clear, colorless or yellowish, viscid liquid. It is odorless and tasteless, or has a slight odor and taste of creosote. On prolonged exposure to a low temperature, crystals of guaiacol carbonate may separate, which redissolve on warming.

Creosote Carbonate is insoluble in water, but is freely soluble in alcohol. It is soluble in petroleum benzin and in fixed oils, and is miscible with chloroform and with benzene.

Tests for Identity—Heat about 0.5 cc. of Creosote Carbonate for a few minutes with 10 cc. of alcoholic potassium hydroxide T.S. and cool the mixture: a crystalline precipitate forms, which effervesces with acids.

Tests for Purity—Specific gravity: not below 1.145 at 25° C.

Ash: not more than 0.1 per cent.

An alcoholic solution of Creosote Carbonate (1 in 5) is neutral to moistened litmus paper, and acquires only a yellow color on the addition of a drop of ferric chloride T.S. (*free creosote*).

Heat 25 cc. of Creosote Carbonate in a water bath for half an hour with a solution of 15 Gm. of potassium hydroxide in 100 cc. of alcohol, add about 50 cc. of water, and evaporate the alcohol. Treat the residue with an excess of hydrochloric acid, and allow the liquid to separate into two layers. Separate the creosote layer, wash it by shaking at first with 15 cc. of a 20 per cent aqueous solution of sodium chloride, then with 10 cc. of water, and distil: eighty-five per cent of the creosote thus obtained, allowance being made for adhering moisture, distils between 200° and 220° C. when determined by Method II, page 121. The distillate, after the separation of adhering water, does not respond to the test for *hydrocarbons and "coal-tar creosote"* under *Creosotum.*

Uses—Creosote Carbonate (also sold under the name *creosotal*) is claimed to be non-toxic and devoid of irritating properties. It is employed as an expectorant in doses of five to fifteen grains (0.3 to 1 Gm.).

GUAIACOL. U. S. Guaiacol

A liquid consisting principally of $C_6H_4(OH)(OCH_3)$ 1:2 (124.10), usually obtained from wood creosote, or a solid, consisting almost entirely of $C_6H_4(OH)(OCH_3)$ 1:2, usually prepared synthetically.

Preparation—It may be obtained from wood creosote by fractional distillation and purification or be produced synthetically by heating a mixture of equal molecules of pyrocatechin, potassium hydroxide, and potassium methyl-

sulphate, in a closed vessel at a temperature of 170° to 180° C., resulting in the following reaction:

$$\underset{\text{pyrocatechin}}{C_6H_4(OH)_2} + \underset{\text{potassium hydroxide}}{KOH} + \underset{\text{potassium methylsulphate}}{KCH_3SO_4} = \underset{\text{guaiacol}}{C_6H_4.OH.OCH_3} + \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{water}}{H_2O}$$

The resulting guaiacol is removed by solution in alcohol or benzin and purified by recrystallizing.

Description and Physical Properties—Liquid Guaiacol is colorless or yellowish; solid Guaiacol is crystalline and is colorless or yellowish. Guaiacol becomes darker on exposure to light. When liquefied, the solid form may remain liquid for a long time even at a low temperature. Guaiacol has an agreeable, aromatic odor.

One Gm. of Guaiacol is soluble in from 60 to 70 cc. of water and in 1 cc. of glycerin, at 25° C., but separates from the glycerin on the addition of water. It is miscible with alcohol, chloroform, ether, and with glacial acetic acid.

Tests for Identity—Solid Guaiacol melts at about 28° C.

The addition of a drop of ferric chloride T.S. to 10 cc. of an alcoholic solution of Guaiacol (1 in 100) immediately produces a blue color, changing to emerald-green, and finally becoming yellowish.

Tests for Purity—Specific gravity: liquid Guaiacol, not below 1.112 at 25° C., melted solid Guaiacol, about 1.132 at 25° C.

Not less than 85 per cent of liquid Guaiacol distils between 200° and 210° C. when determined by Method II, page 121. Solid Guaiacol boils between 204° and 206° C.

Ash: not more than 0.1 per cent.

Shake 2 cc. of liquefied Guaiacol with 4 cc. of purified petroleum benzin: the mixture separates into two distinct, clear layers on standing. Permanent turbidity, or failure to separate into layers indicates the presence of impurities.

One cc. of liquefied Guaiacol dissolves in 2 cc. of 15 per cent potassium hydroxide solution when heated for one minute in boiling water; on cooling, the solution congeals to a nearly white mass. Much coloration or failure to congeal indicates the presence of impurities. The mass thus obtained forms a clear solution with 25 cc. of distilled water (*hydrocarbons*).

Preserve in well-closed containers, protected from light.

N. F. Preparation—Petroxolinum Guaiacolis.

Uses—Guaiacol is employed internally as an expectorant in bronchitis and in tuberculosis. It is occasionally used by endermic application in fevers. Dose: five to ten minims (0.3 to 0.6 cc.).

GUAIACOLIS CARBONAS. U.S. Guaiacol Carbonate
[Guaiacol. Carb.]

The guaiacol ester $[(C_6H_4(OCH_3)O)_2.CO = 274.19]$ of carbonic acid.

Preparation—It may be prepared by slowly passing carbonyl chloride into guaiacol, in sodium hydroxide solution, washing the resulting precipitate and crystallizing it from alcohol. The reaction is expressed by the following equation:

$$\underset{\text{guaiacol}}{C_6H_4\begin{cases}OCH_3\\OH\end{cases}C_6H_4\begin{cases}OH\\OCH_3\end{cases}} + \underset{\text{carbonyl chloride}}{Cl_2CO} = \underset{\text{guaiacol carbonate}}{C_6H_4\begin{cases}OCH_3\\O\end{cases}CO\begin{cases}O\\C_6H_4\end{cases}\begin{matrix}\\OCH_3\end{matrix}} + \underset{\text{hydrochloric acid}}{2HCl}$$

Description and Physical Properties—Small, colorless crystals, or a white, crystalline powder. It is odorless and tasteless, or has a slight, aromatic odor and taste.

Guaiacol Carbonate is insoluble in water. One Gm. is soluble in 60 cc. of alcohol, 1 cc. of chloroform, and in 18 cc. of ether, at 25° C. It is freely soluble in boiling alcohol and benzene, and is slightly soluble in glycerin and in fixed oils.

Tests for Identity—Guaiacol Carbonate melts between 85° and 88° C.

Heat about 0.5 Gm. of Guaiacol Carbonate for a few minutes with 10 cc. of alcoholic potassium hydroxide T.S., cool, and decant the liquid from the precipitate: the addition of an acid to the precipitate produces effervescence. Evaporate the alcohol from the decanted liquid, strongly acidulate the residue with diluted sulphuric acid, and shake with chloroform: the separated chloroform layer upon evaporation leaves a residue which responds to the ferric chloride test for identity under *Guaiacol*.

Tests for Purity—Ash: not more than 0.1 per cent.

A saturated alcoholic solution of Guaiacol Carbonate is neutral to litmus paper, previously moistened with distilled water, and yields no bluish-green color on the addition of ferric chloride T.S. (*free guaiacol*).

Dissolve 0.1 Gm. of Guaiacol Carbonate in 2 cc. of sulphuric acid: the solution is not darker than faint yellow (*readily carbonizable substances*).

Uses—Guaiacol Carbonate, known also as *duotal*, is given as an expectorant in doses of eight to fifteen grains (0.5 to 1 Gm.).

Unofficial Creosote and Guaiacol Compounds

Calcreose, N. N. R.—Calcium Creosotate—A mixture containing in loose chemical combination approximately equal weights of creosote and lime.

A dark brown powder, having an empyreumatic odor and a sharp phenolic taste. It is partially soluble in water; the alkaline solution containing calcium compounds of the phenolic bodies of creosote, while the insoluble portion consists largely of calcium hydroxide and calcium carbonate.

Actions and Uses—Calcreose, when administered internally, is claimed to have the same actions and uses as creosote. It is claimed that calcreose does not readily produce gastric distress, nausea and vomiting. Dose: 4 to 15 grains (0.25 to 1 Gm.).

Manufactured by The Maltbie Chemical Company, Newark, N. J.

Guaiacol Benzoate, N. N. R—Guaiacolis Benzoas—Benzosol. $C_6H_5COO.C_6H_4.OCH_3$. The benzoic acid ester of guaiacol.

In minute colorless crystals; odorless or having a faint, aromatic odor; tasteless or nearly so. Guaiacol benzoate is almost insoluble in water; soluble in ether and in chloroform; also soluble in hot alcohol.

Actions and Uses—Guaiacol benzoate is decomposed slowly in the intestinal tract into guaiacol and benzoic acid, which exert their usual actions. The liberated constituents are absorbed and exereted in the urine. It is claimed to be non-irritating. Dose: 3 to 10 grains (0.2 to 0.6 Gm.) in capsules, pills or as an emulsion.

Distributed by the H. A. Metz Laboratories, New York, and the Seydel Chemical Company, Jersey City, N. J.

With sulphuric acid guaiacol benzoate forms a permanent yellow coloration. Ferric chloride produces in the guaiacol benzoate-sulphuric acid mixture a violet color, changing to green and blue, and on the further addition of nitric acid, to orange and green, or of potassium nitrite to green, violet and yellow.

On heating with alcoholic potassium hydroxide, guaiacol benzoate is saponified and the odor of guaiacol is developed.

Guaiacol benzoate is incompatible with the alkalies, which split it into guaiacol and benzoic acid.

Incinerate about 1 Gm. of guaiacol benzoate, accurately weighed: the ash does not exceed 0.1 per cent.

Proposote, N. N. R—Creosote Phenylpropionate—A condensation product of creosote and phenylpropionic acid. Proposote contains the equivalent of 50 per cent of creosote.

An amber-colored oily liquid, having a characteristic odor, resembling creosote and a slightly bitter taste. It is insoluble in water, soluble in alcohol, ether, and fatty oils. The boiling point of proposote is above 360° C.; its specific gravity at 25° C. is 1.10.

Actions and Uses—Proposote is not decomposed by the gastric fluids and passes the stomach practically unabsorbed. It is decomposed in the intestines and the components are chiefly eliminated through the kidneys; but it is claimed that a part of the liberated creosote is eliminated through the respiratory tract. Claimed to be of value in bronchitis and in coughs due to bronchial infection. Dose: for adults 10 minims (0.6 cc.) in capsules.

Manufactured by Parke, Davis and Company, Detroit.

Thiocol, N. N. R.—Potassium Guaiacol-Sulphonate—$C_6H_3(OH)(OCH_3)(SO_3K)$, 1:2:6—The potassium salt of orthoguaiacol sulphonic acid, $C_6H_3(OH)(OCH_3)(SO_3H)$ 1:2:6.

A colorless, crystalline powder, neutral or faintly alkaline, odorless, and having a faintly bitter taste; soluble in water, slightly soluble in ordinary alcohol, but insoluble in absolute alcohol and in ether or oils.

Actions and Uses—Thiocol-Roche acts as a sedative expectorant. It has the advantage over guaiacol in that it is comparatively tasteless, does not disturb digestion and is non-toxic.

Claimed to be useful in the treatment of diseases of the respiratory tract, incipient tuberculosis and certain diarrheas. Dose: 5 to 20 grains (0.3 to 1.3 Gm.) in solution or tablets.

Manufactured by Hoffmann-La Roche Chemical Works, New York.

Unofficial Product of the Destructive Distillation of Cellulose

Methanol, CH_3OH
Methyl Alcohol
Methylic Alcohol
Wood Naphtha
Wood Alcohol
Pyroxylic Spirit
Columbian Spirit
Colonial Spirit

It occurs among the products of the dry distillation of wood. The watery liquid is separated from the tar and distilled; then the first portion of the distillate is rectified over slaked lime, so as to remove acid, etc., and the product treated with sulphuric acid to remove tar and neutralize ammonia and methylamine, and, lastly, redistilled.

Immense quantities of methanol are now being made in Germany by interaction between water gas and steam, under the influence of a catalyst said to be zinc oxide. The old method of chopping the hard wood, distilling it, and refining the product is much more costly and cannot compete with methanol prepared by this synthetic process in which water and coke are the raw materials. It is a colorless, limpid liquid, of a peculiar odor, resembling alcohol and acetic ether, and of a warm taste. Its specific gravity is about 0.7984 at 15° C. and its boiling point about 66° C. It is a good solvent for volatile oils, fats, and many resins. When purified it is sold under such names as Columbian Spirit, Colonial Spirit, etc.

It is extensively employed as a denaturing agent for ethyl alcohol and as such is an ingredient in several of the special formulas authorized by the Internal Revenue Department of the U. S. Government (see page 1227).

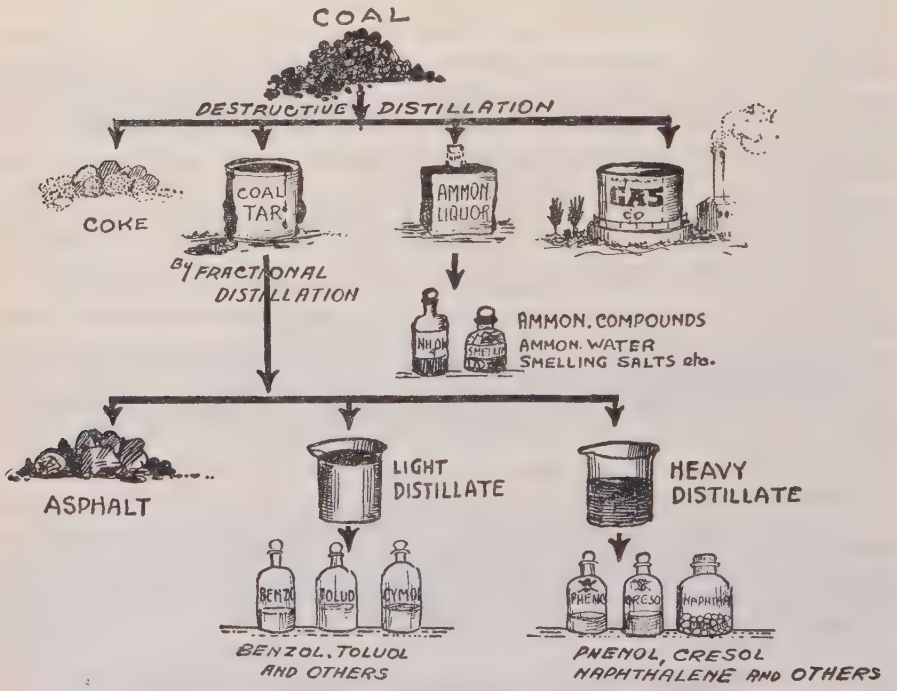
Methanol is very poisonous. It should never be used internally; death and permanent blindness have been produced through the administration of as small quantities as several fluidrachms. The practice of substituting any form of this liquid for ethyl alcohol in pharmaceutical preparations in which it will remain in the finished product is criminal and indefensible.

Products Resulting from the Natural Decomposition of Cellulose and Lignin and Their Derivatives

Coal is fossil fuel, which is found in the earth at various depths, and which has been formed by the decomposition of prehistoric cellulose, and lignin, under the changing influences of moisture, temperature, and pressure to which it has been subjected. The differences in the structure and composition of coal are undoubtedly due to the variations in these influences, as well as to the variations in the character of the vegetable tissues.

When bituminous coal is destructively distilled an exceedingly important group of fractions and products is obtained as explained by the accompanying illustration (Fig. 435), and in the following paragraph under coal tar.

FIG. 435



Products from the destructive distillation of coal

Coal tar is a by-product of the illuminating gas industry. At one time it was considered as worthless and large sums were spent in getting rid of it. Organic chemists had experimented with it because of its complex character and the interesting compounds obtainable from it. In 1856, the English chemist, W. H. Perkin, while making an ineffectual attempt to synthesize quinine, accidentally discovered the first coal-tar color while experimenting with one of the derivatives of coal tar. The value of coal tar became evident and at present it is so necessary to organic chemical manufacture that even if gas were no longer used for illuminating purposes, coal would be subjected to destructive distillation for the sake of the coal tar.

When coal tar is subjected to fractional distillation, a number of valuable commercial products are obtained directly from it. These are properly

termed *coal tar fractions*. The substances of value which are produced by chemical reactions using these coal tar fractions as the starting point, are called *coal tar derivatives* or *synthetics*. Some substances not actually existing in coal tar are so frequently used in the manufacture of synthetics that they are known as *coal tar intermediates*. The term *coal tar product* has been loosely and indefinitely applied to any member of these groups. The first fractions obtained in the distillation of coal tar are complex mixtures in themselves and are called *light oils, middle or carbolic oils, heavy or creosote oils, and anthracene oils*; a non-volatile residue called pitch remaining in the still.

Each of these fractions is subjected to redistillation and the simple products are separated from each other by various chemical and physical methods. Ammonium sulphate is obtained from the aqueous portions of the distillate from coal and a small additional amount is separated from the coal tar itself. Among the fractions of the light oils are *carbon disulphide, pentane, hexane, acetonitrile, benzene, toluene, xylene, cumene,* and other hydrocarbons of the paraffin and benzene series.

From the middle oils are obtained *naphthalene, phenols,* and *cresols*. The heavy oils yield *naphthalene, dinaphthalene, methyl-naphthalene, xylenol, naphthol,* and *paraffins*. The "heavy oil" finds its principal use as a timber preservative, as wood when impregnated with the material under pressure resists decay, and is known as *creosoted lumber*. It will be noted that no creosote, such as obtained from wood tar, is present in this fraction, so the term is a misnomer.

The anthracene oils contain a small amount of phenol, but the main constituent, *anthracene*, is one of the most valuable of all the coal tar fractions. There are also present small amounts of *methylanthracene, phenanthrene, diphenyl, naphthalene, pyrene, retene, carbazol, pyridine, quinoline,* and *aniline*.

Among the more important of the intermediates previously mentioned are *alphanaphthylamine, alphanitronaphthalene, aniline, benzidine, Cleve's acid, cresotinic acid* (also known as *cresotic, homosalicylic* or *toluic acid*), *diasinidine, dimethylaniline, dinitrobenzene, dinitrochlorobenzene, dinitrophenol, dinitrotoluene, diphenylamine, gamma acid, H acid, Laurent's acid, metanitraniline, metaphenylenediamine, metatoluenediamine, mixed mononitrotoluenes, mixed toluidenes, monochlorobenzene, Neville and Winter's acid, nitrobenzene, orthonitrotoluene, orthotoluidine, paraaminophenol, paranitraniline, paranitrochlorobenzene, paranitrotoluene, paratoluidine, picric acid, salicylic acid, sodium metanilate, sodium naphthionate, sodium picramate, sulphanilic acid,* and *toluidine*.

Some of these have valuable uses in medicine and pharmacy, and some are found as coal tar fractions, in amounts too small to be of value, and hence must be prepared synthetically to satisfy the commercial demands.

The coal-tar industry, meaning the industry in which coal tar is used as a starting point, is one of the most important of the chemical industries. It links together the production of synthetic medicines, of artificial dyes and colors, and of munitions.

PIX CARBONIS. N. F. Coal Tar

[**Pix Carbon.**—Pix Lithanthracis N. F. IV]

The tar obtained as a by-product in the destructive distillation of coal in the manufacture of illuminating gas.

Description and Physical Properties—A nearly black, thick liquid or semi-solid, heavier than water and possessing a characteristic, naphthalene-like odor and a sharp burning taste.

It is only slightly soluble in water, to which it imparts its characteristic odor and taste and a faintly alkaline reaction. It is but partially dissolved by alcohol, acetone, methyl alcohol, or

purified petroleum benzin; almost entirely dissolved by ether; entirely dissolved by benzene, carbon disulphide or chloroform.

On ignition it burns with a reddish, luminous and very sooty flame and upon strong heating is almost entirely consumed, leaving not more than 2 per cent of ash.

N. F. Preparation—Liquor Picis Carbonis.

Uses—Used pharmaceutically only in the preparation of the solution (see below).

LIQUOR PICIS CARBONIS. N. F. Coal Tar Solution

[**Liq. Pic. Carbon.**—Liquor Carbonis Detergens]

	Metric	Alternative
Coal Tar	**200 Gm.**	6 oz. av. 296 gr.
Quillaja, in moderately coarse powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the coal tar and quillaja with 700 cc. [about 22 fl. oz.] of alcohol and macerate the mixture during seven days in a closed vessel, with occasional agitation. Then filter and wash the contents of the filter with sufficient alcohol to make the product measure 1000 cc. [2 pints].

Coal Tar Solution is a yellowish-brown or amber-colored, alcoholic liquid with a characteristic, empyreumatic odor.

Mix 5 cc. of Coal Tar Solution with 100 cc. of water: an opalescent liquid results, which froths abundantly when shaken in a closed vessel. Neither the addition of small amounts of acids nor alkalies noticeably affects the frothing property.

Uses—This preparation is employed externally in the treatment of chronic skin diseases.

BETANAPHTHOL. U. S. Betanaphthol

[**Betanaph.**—Naphthol]

Beta-monohydroxy naphthalene [$C_{10}H_7OH = 144.11$].

Preparation—When naphthalene is digested with fuming sulphuric acid, two acids may be obtained; at a temperature of 80° to 90° C. alphanaphthalene sulphonic acid is chiefly formed, but at 200° C. the beta variety is the principal product, and when this latter acid is fused with an alkali hydroxide and hydrochloric acid added, the official compound, betanaphthol, is liberated.

The fusion of the betanaphthalene sulphonic acid with caustic alkali, and the subsequent liberation of the betanaphthol by treatment with mineral acid, involves reactions that are typical in the synthetic production of the phenols. They are illustrated by the following equations:

$$\underset{\text{betanaphthol sulphonic acid}}{\beta C_{10}H_7HSO_3} + \underset{\text{sodium hydroxide}}{3NaOH} = \underset{\text{sodium betanaphtholate}}{\beta C_{10}H_7ONa} + \underset{\text{sodium sulphite}}{Na_2SO_3} + \underset{\text{water}}{H_2O}$$

then

$$\underset{\text{sodium betanaphtholate}}{\beta C_{10}H_7ONa} + \underset{\text{hydrochloric acid}}{HCl} = \underset{\text{betanaphthol}}{\beta C_{10}H_7OH} + \underset{\text{sodium chloride}}{NaCl}$$

Description and Physical Properties—Colorless or pale buff-colored, shining, crystalline leaflets, or a white or yellowish-white, crystalline powder. It has a faint, phenol-like odor, and is stable in the air.

One Gm. of Betanaphthol is soluble in about 1000 cc. of water, 0.8 cc. of alcohol, 17 cc. of chloroform, and in 1.3 cc. of ether, at 25° C. One Gm. is soluble in 80 cc. of boiling water. It is soluble in glycerin and in olive oil and is readily dissolved by solutions of alkali hydroxides.

It sublimes readily when heated, and volatilizes with the vapors of alcohol and of water.

Tests for Identity—Betanaphthol melts between 120° and 122° C.

A cold, saturated, aqueous solution of Betanaphthol, when mixed with ammonia water, develops a faint, bluish fluorescence.

Add about 0.1 Gm. of Betanaphthol to 5 cc. of an aqueous solution of potassium hydroxide (1 in 4), then add 1 cc. of chloroform, and gently warm the mixture: the aqueous layer acquires a blue color, changing afterward, successively, to green and brown.

Ferric chloride T.S. produces a greenish color in a cold, saturated, aqueous solution of Betanaphthol, and after some time causes the separation of whitish flakes, which turn brown upon the application of heat.

Tests for Purity—Shake 1 Gm. of Betanaphthol with 100 cc. of distilled water at frequent intervals for fifteen minutes, and filter: the filtrate is neutral to litmus paper.

Ash: not more than 0.05 per cent.

Dissolve 0.5 Gm. of Betanaphthol in 25 cc. of ammonia water: no residue remains (*naphthalene*), and the solution does not have a deeper color than pale yellow (*other organic impurities*).

Boil 0.1 Gm. of Betanaphthol with 10 cc. of distilled water until dissolved, allow the solution to cool, and then filter: the addition to the filtrate of 0.3 cc. of normal sodium hydroxide, followed by 0.3 cc. of tenth-normal iodine, produces no violet color (*alphanaphthol*).

Preserve in well-closed containers, protected from light.

N. F. Preparations—Pasta Betanaphtholis; Petroxolinum Betanaphtholis.

Uses—Betanaphthol is used externally as an antiseptic in skin diseases. Internally it is a valuable agent in the treatment of various disorders of the digestive organs. Dose: three to five grains (0.2 to 0.3 Gm.).

CRESOL. U. S. Cresol

A mixture of isomeric cresols [$(C_6H_4.CH_3.OH) = 108.10$] obtained from coal tar.

Preparation—Soon after the introduction of phenol (carbolic acid) into use as an antiseptic it was discovered that some of the homologous constituents of *crude carbolic acid* were more active than the phenol which it contained. Cresol or *cresylic acid*, as it was then called, was the most important among these, and experience has developed its value. Official cresol consists of a mixture of three isomers, existing according to Schulze in coal tar approximately in the proportion of 40 per cent of *metacresol*, 35 per cent of *orthocresol*, and 25 per cent of *paracresol*. Cresol has a higher boiling point than phenol and is separated from it by fractional distillation.

Laws in some states require that preparations of this type shall state upon the label their germicidal activity as compared with phenol. This figure is known as the *Phenol Coefficient* (see *Phenol*).

The official cresol usually shows a phenol coefficient varying from 2 to 3, but higher boiling fractions, known as "tar acids" are also commercially available and these frequently show a phenol coefficient of from 12 to 25. This greatly increased germicidal activity, while indicated by the test organism, the typhoid bacillus, is not equally effective with other common organisms and is therefore misleading. The U. S. P. has intentionally retained a rather limited boiling point product, of uniform and dependable activity, so that when the official products are directed by physicians they may depend upon their efficiency. For the phenol coefficient methods. see page 818.

Description and Physical Properties—A colorless, or yellowish to brown-yellow, or a pinkish, highly refractive liquid, becoming darker with age and on exposure to light. It has a phenol-like, sometimes empyreumatic odor.

One cc. of Cresol is soluble in about 50 cc. of water, usually forming a cloudy solution. It is miscible with alcohol, ether, benzene, petroleum benzin, and with glycerin, and is dissolved by solutions of the fixed alkali hydroxides.

Tests for Identity and Purity—Specific gravity: 1.030 to 1.038 at 25° C.

Not less than 90 per cent by volume of Cresol distils between 195° and 205° C. when determined by Method II, page 121.

A saturated aqueous solution of Cresol is neutral or slightly acid to litmus paper, and becomes bluish-violet on the addition of ferric chloride T.S.

A solution of 1 cc. of Cresol in 60 cc. of distilled water shows no greater turbidity than that produced in 58 cc. of distilled water by the addition of 1.5 cc. of fiftieth-normal sulphuric acid and

1 cc. of barium chloride T.S., comparison being made after the control mixture has been well shaken and allowed to stand for five minutes (*hydrocarbons*).

Preserve in well-closed containers, protected from light.

U. S. P. Preparation—Liquor Cresolis Compositus.

Uses—Cresol is antiseptic and resembles phenol in its medicinal properties, but owing to its greater insolubility in water is nearly always employed in combination with alkalies associated with fatty bodies, or soaps. (See Liquor Cresolis Compositus below.) The dose is one minim (0.06 cc.).

LIQUOR CRESOLIS COMPOSITUS. U. S. **Compound Solution of Cresol**

[Liq. Cresol. Co.]

	Metric	Alternative
Cresol	**500 cc.**	16 fl. oz.
Linseed Oil	**350 cc.**	11 fl. oz. 96 min.
Dekanormal Solution of Potassium Hydroxide	**22 cc.**	338 min.
Dekanormal Solution of Sodium Hydroxide	**88 cc.**	2 fl. oz. 392 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the cresol and linseed oil, add the dekanormal solutions (see pages 1558 and 1561) and mix well. Heat the mixture to about 70° C. until a portion gives a clear solution when mixed with nine volumes of cold water, cool, and add sufficient water to make the product measure 1000 cc. [2 pints].

NOTE—The 22 cc. [338 min.] of dekanormal solution of potassium hydroxide directed above may be replaced by 14.52 Gm. [212 gr.] of 85 per cent potassium hydroxide and the 88 cc. [2 fl. oz. 392 min.] of dekanormal solution of sodium hydroxide may be replaced by 39.11 Gm. [1 oz. av. 134 gr.] of 90 per cent sodium hydroxide, dissolving the hydroxides in 50 cc. [1 fl. oz. 288 min.] of water. If upon assay the potassium and the sodium hydroxides are found to be of any other strength, a proportionately larger or smaller quantity should be taken.

This liquid was introduced into the Pharmacopœia to supply a need for an antiseptic solution, which will readily mix with water; it closely resembles *lysol, creolin, solveol,* and *solutol* in its medical uses. Some of these preparations produce a milky mixture when added to water, due to the presence of rosin soap instead of an olein soap. Creolin is a preparation of this type, usually employed in from 1 to 3 per cent aqueous solutions. Compound solution of cresol must be used with caution as it is about equal to phenol in its poisonous character.

The U. S. P. now uses a mixture of sodium hydroxide and potassium hydroxide in preparing the soap for this solution, although in the U. S. P. IX the use of only sodium hydroxide was allowed with a great saving in cost. It has been suggested that the pharmacist may readily prepare this solution by dissolving a corresponding weight of linseed-oil soft soap in the cresol and adding sufficient water to make the required quantity. This has been found to be satisfactory if the soap is of proper concentration.

Similar preparations are extensively used as a "*sheep dip*" for the destruction of parasitic organisms in the wool of sheep (see page 816).

The following assay has been added to insure the absence of "higher-boiling-point tar acids" which do not produce an official solution.

Assay—Mix in a 500 cc. distilling flask 50 cc. of Compound Solution of Cresol, accurately measured at 25° C., with 150 cc. of purified kerosene (page 1535). Add 3 Gm. of sodium bicarbonate and distil through an upright condenser, at the rate of not more than two drops per second, until the distillate comes over strongly yellow, receiving the distillate in a 250 cc. to 300 cc. separatory funnel. Run off the lower aqueous layer, shake the kerosene layer with 10 cc. of sulphuric acid (49 to 51 per cent), allow to stand for two hours, then draw off the acid layer completely, and discard it. Add to the kerosene layer 40 cc. of an aqueous sodium hydroxide solution (15 per cent),

accurately measured at 25° C., shake well for five minutes, then allow to stand until complete separation has taken place, and draw off the sodium hydroxide layer into a graduated cylinder. Shake the kerosene layer again with a fresh portion of 20 cc. of the 15 per cent sodium hydroxide solution, accurately measured at 25° C., allow the two layers to separate completely, and draw off the sodium hydroxide layer into the graduated cylinder. Adjust the sodium hydroxide solution in the graduated cylinder to a temperature of 25° C. and note the volume. The difference between the volume noted and the total volume of sodium hydroxide solution used represents the volume of cresol present in 50 cc. of Compound Solution of Cresol. This difference is not less than 23 cc. and not more than 26 cc.

Transfer the sodium hydroxide solution of the cresol obtained in the assay to a separatory funnel and add sufficient hydrochloric acid to render the solution distinctly acid. Allow the precipitated cresol to separate completely and draw off the lower aqueous layer. Wash the cresol with several successive portions of 20 cc. each of a saturated aqueous solution of sodium chloride until the washings are neutral or only slightly acid. Then add to the washed cresol about 5 Gm. of freshly ignited potassium carbonate, shake gently at frequent intervals during three hours, and allow to stand overnight. The cresol decanted from the potassium carbonate meets the distillation requirements for *Cresol*, when determined by Method II, page 121.

Uses—Compound solution of cresol is a valuable disinfectant solution; used chiefly for surgical purposes. It is sometimes used internally in doses of five to ten minims (0.3 to 0.6 cc.).

ORTHOCRESOL. N. F. Orthocresol

The ortho variety of cresol [1:2 $C_6H_4.CH_3OH = 108.10$], obtained from coal tar.

Orthocresol is being made directly from coal tar by fractional distillation and crystallization. The synthetic method for its production involves the sulphonating of toluene whereby the three isomeric toluene sulphonic acids are formed. After converting these into their sodium salts they are fused with caustic soda. This converts them into sodium cresolates which, upon treatment with acid, yield the three isomeric cresols. The orthocresol is then separated by fractional distillation.

Description and Physical Properties—Orthocresol occurs as white crystals or as a colorless or yellow to brown, highly refractive liquid, becoming darker with age and exposure, and having a phenol-like odor.

Slightly soluble in water; soluble in alcohol, ether and chloroform. Miscible with an equal volume of solution of formaldehyde with the production of a transparent solution.

Tests for Identity and Purity—Specific gravity about 1.05; melting point about 30° C.; boiling point about 190° C.

A saturated solution of Orthocresol is neutral or slightly acid to litmus and becomes blue-violet on the addition of ferric chloride T.S.

Preserve it in well-closed containers, protected from light.

N. F. Preparation—Formaldehydum Cresolatum.

Uses—A disinfectant and antiseptic similar in use to the official cresol of which it is a fraction. It was introduced into the N. F. because of its forming a clear solution with formaldehyde in cresolated formaldehyde.

FORMALDEHYDUM CRESOLATUM. N. F. Cresolated Formaldehyde [Formal. Cresol.]

	Metric	Alternative
Orthocresol	40 cc.	2 fl. oz.
Solution of Formaldehyde	60 cc.	3 fl. oz.

Mix them.

Uses—This preparation is used as a toothache remedy, being applied to the cavity on purified cotton.

The following unofficial formulas for preparations of this type may be of value to the pharmacist:

Compound Solution of Crude Cresol

Rosin	300 Gm.
Solution of Potassium Hydroxide (50 per cent)	4.5 cc.
Crude Carbolic Acid (or "Tar Acid", 30 per cent)	600 cc.
Water, a sufficient quantity,	
To make	1000 cc.

Melt the rosin without stirring, and add to it the warmed solution of potassium hydroxide, allow the effervescence to continue for a few minutes until all of the rosin has been saponified, and immediately dissolve the rosin soap in the crude carbolic acid, using as little heat as possible. Finally add water to make 1000 cc.

Sheep Dip

Soap	**1 lb. av.**
Crude Carbolic Acid (or "Tar Acid", 30 per cent)	**16 fl. oz.**
Water	**100 quarts**

Dissolve the soap in a gallon or more of boiling water, add the acid, and stir thoroughly. Any kind of laundry soap may be used. Keep the mixture well thinned in using, and do not let it get into the eyes, mouth, or nostrils of the sheep.

Cresol and Cresol Preparations Recognized by the N. N. R.

Purified Three Cresols, N. N. R.—A mixture of isomeric cresols, corresponding closely to cresol, U. S. P. The phenol coefficient is not less than 2.5 (the value is stated on each package). The phenol toxicity, determined by the method of Hale, is not greater than 150 per cent (the value is stated on each package).

Manufactured by the H. K. Mulford Company, Philadelphia.

Izal, N. N. R.—An albuminous emulsion containing not less than 50 per cent of a liquid, "*izal oil*", which is obtained in the destructive distillation of bituminous coal, and which consists essentially of monatomic phenols boiling between 205° and 300° C. Izal is, therefore, practically free from phenol and cresols.

Actions and Uses—Izal is a germicide and disinfectant. The germicidal efficiency of izal is claimed to have a phenol coefficient of 12, but it is stated to be less toxic than phenol.

Dose—For general use and as a gargle, douche, etc., dilutions of 1: 300 (1 fluidrachm to 1 quart of water) are used. For the disinfection of urine, feces, etc., dilutions of 1: 100 (1 fluidrachm to 1 pint of water) are advised. *Izal is not intended for internal use.*

Manufactured by The Abbott Laboratories, Chicago.

Izal Disinfectant Powder: Izal oil, 10 per cent; naphthalene, 5 per cent; inert, absorbent earth, 85 per cent.

Krelos, N. N. R.—Liquor Cresolis et Phenolis Comp.—A solution of cresols or higher phenol homologues and rosin soap. It is said to represent 60 to 67 per cent of phenols.

A dark brown, almost black, liquid, having a specific gravity of about 1.040 and a characteristic cresol-like odor. With water it forms an almost white, milk-like emulsion.

The phenol coefficient, ranges from 5 to 7, as stated on the label.

Actions and Uses—An antiseptic and germicide.

H. K. Mulford Company, Philadelphia, distributor.

Phenoco, N. N. R.—A mixture of coal-tar creosote and higher phenol homologues, in soap solution. It is said to contain coal-tar creosote, 20 per cent, phenol homologues, 50 per cent, and soap, 30 per cent.

A dark brown fluid of a characteristic odor like that of coal tar. It is miscible with water in all proportions, forming a white emulsion; it is soluble in alcohol, ether, acetone and in fixed oils, forming clear solutions. It is compatible with physiologic salt solution. When tested by the "phenol coefficient" method of the Hygienic Laboratory of the U. S. Public Health Service, it is said to be from twelve to fourteen times stronger, as a germicide, than pure phenol.

Actions and Uses—Phenoco is an antiseptic and germicide, being, in the latter respect, from fifteen to sixteen times stronger than phenol. It is stated to be non-caustic, non-irritant and, for mammals, about one-half as toxic as phenol.

It is used in minor surgery, obstetrics, gynecology, ophthalmology, otology, diseases of the skin, etc.

Dose—Dilutions of from 1 to 5 per cent, or higher, according to the severity of the case.

Manufactured by the West Disinfecting Company, New York.

Creasatin, Dr. N. Sulzberger, N. N. R.—Meta-Cresyl Acetate.—$CH_3C_6H_4.O(CH_3CO)$.—The acetic acid ester of meta-cresol, $CH_3C_6H_4.OH$.

A colorless, oily liquid, possessing a characteristic odor. It is practically insoluble in water, but soluble in the ordinary organic solvents, miscible with liquid petrolatum, fixed and volatile oils and is volatile with steam.

Actions and Uses—It is said to possess antiseptic and analgesic properties, and is apparently free from toxic effects. Useful in the treatment of affections of the nose, throat and ear. It may be employed either in the pure form, or in dilution with oils or alcohol by direct application or spray.

Manufactured by Sharp & Dohme, Baltimore, Md.

Cryogenine, N. N. R.—Phenylsemicarbazide—$C_6H_5.NH.NH.CO.NH_2$.

A white, crystalline powder; odorless; taste slightly bitter. It is soluble in about 100 parts of water at 20° C.; soluble in ether, acetone, chloroform, and benzene. It melts at 172° C.

Actions and Uses—An antipyretic in febrile conditions. An analgesic said to be of value in rheumatism, headache, sciatica, gout and in painful conditions generally. After administration, the urine is highly colored.

Dose—As an antipyretic, 4 to 30 grains (0.25 to 2 Gm.) per day. As an analgesic, from 15 to 45 grains (1 to 3 Gm.) per day.

Manufactured by A. Lumiere, Lyons, France.

PHENOL. U. S. Phenol

[Carbolic Acid]

Phenol (hydroxybenzene) contains not less than 98 per cent of C_6H_5OH (94.08).

Preparation—This valuable product belongs to a well-marked class of phenols of which it is the type. For many years it was made only by distilling crude carbolic acid, and separating and purifying the distillate by repeated

crystallizations, but it is now prepared synthetically by treating benzene or benzol with fuming sulphuric acid to produce benzene-sulphonic acid as follows:

$$\underset{\text{benzene}}{C_6H_6} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{benzene-sulphonic acid}}{C_6H_5SO_2OH} + \underset{\text{water}}{H_2O}$$

This acid is now neutralized with sodium carbonate, forming sodium benzene-sulphonate.

$$\underset{\text{benzene-sulphonic acid}}{2(C_6H_5SO_2OH)} + \underset{\text{sodium carbonate}}{Na_2CO_3} = \underset{\text{sodium benzene-sulphonate}}{2(C_6H_5SO_2ONa)} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

The sodium benzene-sulphonate is fused with caustic soda, whereby sodium phenolate and sodium sulphite are formed as follows:

$$\underset{\text{sodium benzene-sulphonate}}{2(C_6H_5SO_2ONa)} + \underset{\text{sodium hydroxide}}{4NaOH} = \underset{\text{water}}{2H_2O} + \underset{\text{sodium sulphite}}{2Na_2SO_3} + \underset{\text{sodium phenolate}}{2C_6H_5ONa}$$

Hydrochloric acid is finally added to the sodium phenolate, which liberates phenol, which is further purified by distillation. The last reaction is expressed as follows:

$$\underset{\text{sodium phenolate}}{C_6H_5ONa} + \underset{\text{hydrochloric acid}}{HCl} = \underset{\text{phenol}}{C_6H_5OH} + \underset{\text{sodium chloride}}{NaCl}$$

When perfectly pure, phenol is devoid of the odor of cresol, but it has a peculiar aromatic odor, which is not disagreeable. Crystallized phenol, as found commercially, is much purer than the liquid forms, and has the advantage that it may be transported in cans or bottles without risk of loss by leakage. (See Phenol Liquefactum, page 819.)

Description and Physical Properties—Colorless, interlaced, or separate needle-shaped crystals, or a white or light pink, crystalline mass. It has a characteristic, somewhat aromatic odor. When undiluted it cauterizes and whitens the skin and mucous membrane.

One Gm. of Phenol is soluble in about 15 cc. of water at 25° C. It is very soluble in alcohol glycerin, chloroform, ether, carbon disulphide, and in fixed or volatile oils. Soluble in petrolatum and in liquid petrolatum.

When gently heated, phenol melts, forming a highly refractive liquid. It is also liquefied by the addition of about 8 per cent of water. Its vapor is inflammable.

Tests for Identity—Congealing point: not below 39° C.

Its aqueous solution yields with bromine water a white precipitate of tribromphenol, which at first redissolves, but becomes permanent as more of the reagent is added.

Add 1 drop of ferric chloride T.S. to 10 cc. of an aqueous solution of Phenol (1 in 100): the liquid acquires a violet-blue color.

Tests for Purity—An aqueous solution of Phenol (1 in 15) is clear, and neutral or only faintly acid to litmus paper.

Heat about 5 Gm. of Phenol on a water bath: it is volatilized without leaving more than 0.05 per cent of residue.

Assay—Dissolve about 1.5 Gm. of Phenol, accurately weighed, in sufficient distilled water to make 1000 cc. Transfer an aliquot portion of this solution, containing from 0.038 to 0.041 Gm. of Phenol, to a 500 cc. glass-stoppered flask having a long, narrow neck, add 30 cc. of tenth-normal bromine, then 5 cc. of hydrochloric acid, and immediately insert the stopper. Shake the flask repeatedly during half an hour, allow it to stand for fifteen minutes, remove the stopper just sufficiently to introduce quickly 5 cc. of an aqueous solution of potassium iodide (1 in 5), being careful that no bromine vapor escapes, and at once stopper the flask. Shake the latter thoroughly, remove the stopper, and rinse it and the neck of the flask with a little distilled water, so that the washings may flow into the flask, then add 1 cc. of chloroform, shake the mixture well, and titrate with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal bromine corresponds to 0.001568 Gm. of C_6H_5OH.

This assay is explained on page 1468.

Preserve in well-closed containers, protected from light.

U. S. P. Preparations—Glyceritum Phenolis (from Liquefied Phenol); Phenol Liquefactum; Unguentum Phenolis.

N. F. Preparations—Aqua Phenolata (from Liquefied Phenol); Liquor Iodi Phenolatus (from Liquefied Phenol); Liquor Sodii Boratis Compositus (from Liquefied Phenol); Nebula Aromatica; Odontalgicum; Oleum Phenolatum; Petroxolinum Phenolis; Petroxolinum Phenolis Camphoratum; Phenolum Iodatum; Pulvis Antisepticus.

Phenol Coefficient—The disinfectant value of phenol and other germicides largely depends upon their ability to destroy bacteria and other organisms. For a comparison of values pure phenol has been generally adopted as the standard, and the "phenol coefficient" is the ratio of the germicidal power of a disinfectant to the germicidal power of phenol.

Two methods are in general use; the Rideal-Walker Test, largely used in England (published by H. K. Lewis and Company, Ltd., London, England), and the Hygienic Laboratory Method, given below. The U. S. P. has not yet adopted a phenol coefficient method and under the provisions of the Insecticide Act of 1910 it is not necessary for a manufacturer to state the phenol coefficient on the label of a disinfectant. However, if such a statement is made it must comply with the test; some state laws, however, require such statements.

The method recommended by the Hygienic Laboratory of the Public Health Service is published in the Report of July 8, 1921. The process is given below.[1]

Uses—Phenol is one of the most largely used disinfectants and because of this fact great caution must be observed in dispensing it, as it is employed frequently for suicidal purposes. (For treatment of poisoning, see Antidotes, Part XV.) When applied to the skin or mucous membrane, it cauterizes and produces blanching; alcohol applied at once to the cauterized part causes the disappearance of the white spots. When diluted with an equal volume of glycerin, it becomes miscible with water in any proportion (see Glyceritum Phenolis, page 301).

---

[1] **DISINFECTANT TESTING BY THE HYGIENIC LABORATORY METHOD**

The following method for determining the phenol coefficient of disinfectants supersedes the methods described in previous publications of the Public Health Service, and is the present Hygienic Laboratory Method.

No single method can serve as a means of comparing the value in practice of disinfectants of greatly diverse composition and destined for a variety of applications. However, disinfectants which are chemically related to phenol, which are to be used against organisms reacting similarly to the manner in which the typhoid bacillus reacts and which are destructive within the time and temperature limits of this test, may be compared as to their disinfecting properties within these limitations by means of this test. The results may be useful in the selection of a potent product, in making comparisons of cost in terms of service rendered, and in checking successive batches of the same product.

This method was submitted to several different laboratories for trial before its adoption, and the results seem to justify the belief that the personal equation in the performance of the tests does not play an inordinate rôle.

THE TEST CULTURE

The test culture is a culture of *Bacillus typhosus*, Hopkins strain. Between periods of testing it is maintained on nutrient agar stabs, transferred at monthly intervals.

For at least five days before the test the culture is transferred at 24-hour intervals to successive tubes of the meat extract broth described below and incubated at 37° C. Transfers are made with one standard loopful. The culture is filtered through sterile filter paper just before using. The test is performed with a 24-hour culture.

THE PHENOL

The phenol must comply with the requirements of the Eighth United States Pharmacopœia. Particularly the congealing point must not be below 40° C. The crystals are kept in tightly stoppered amber-colored bottles in a dark and relatively cool place.

A 5 per cent original solution is made by adding 1 part by weight of phenol, liquefied by warming the bottle, to 19 parts of distilled water. A fresh solution is made for each day's use.

THE CULTURE MEDIUM

Make meat extract medium as follows:

Beef extract (Liebig's)	3 Gm.
Peptone (Armour's for disinfectant testing)	10 Gm.
Sodium chloride	5 Gm.
Water, distilled	1,000 cc.

Boil for 15 minutes.
Make up to original weight by addition of water.
Filter through paper.
Tube, 10 cc. to each tube.
Sterilize.
The pH value of this medium should be between 6.0 and 7.0.

Phenol is used internally in the treatment of various digestive disorders and as a urinary antiseptic. The dose is one grain (0.06 Gm.). As an external remedy it is used for its anesthetic and antiseptic action in skin diseases. It is also largely used as a local application in nose and throat infections and as a surgical disinfectant.

Average dose—1 grain (0.06 Gm).

PHENOL LIQUEFACTUM. U.S. Liquefied Phenol

[**Phenol Liq.**—Liquefied Carbolic Acid]

Phenol liquefied by mixing with 10 per cent of water. It contains not less than 88 per cent of C_6H_5OH (94.08).

Phenol, a convenient quantity.
Distilled Water, a sufficient quantity.

Liquefy the phenol by placing the unstoppered container in a water bath and apply heat gradually until it is melted. Transfer the liquid to a tared vessel, weigh, and add 1 Gm. [1 oz. av.] of distilled water for each 9 Gm. [9 oz. av.] of phenol and mix thoroughly.

On standing, liquefied phenol becomes pink or red in color. It is claimed that the immersion of a few strands of wool yarn will remove the color, the wool becoming dyed, and the phenol restored to its original appearance.

Description and Physical Properties—A colorless liquid, which may develop a red tint upon keeping. It has a characteristic, somewhat aromatic odor. When undiluted it cauterizes and whitens the skin and mucous membrane.

Liquefied Phenol is miscible with alcohol, ether, and glycerin. When diluted with an equal volume of glycerin, the mixture is miscible with water.

Tests for Identity and Purity—Specific gravity: about 1.065 at 25° C.

When subjected to distillation, the boiling point does not rise above 182° C.

GLASSWARE AND APPARATUS

Glassware for measuring must be accurately graduated. It must be clean, dry, and sterile at the time of use. There will be needed—

1 cc. capacity pipettes.
5 cc. capacity pipettes.
1 cc. delivery pipettes, graduated in tenths.
5 cc. delivery pipettes.
100 cc. measuring cylinders, graduated in 1 cc., glass stoppered.
Seeding tubes, 1 x 3 inches, flared tops, round bottoms.

Racks consisting of blocks of wood with rows of holes for both the seeding tubes (before they are placed in the water bath) and the subculture tubes.

Wire loops must be carefully made and kept from damage. They are made as follows: A close cylindrical spiral is made by winding a piece of platinum wire, No. 23, B. & S. gauge, as tightly as possible about a piece of steel or other hard wire having a diameter of 0.072 inch (No. 13, B. & S. gauge) to complete a little more than four full turns. The long end of the wire is then bent sharply at right angles to the wound portion and parallel to the steel wire. The core is removed and the short end of the wire is clipped off so as to leave exactly four full turns to the coil. The successive turns of the spiral must touch one another continuously. The long end of the wire is attached to an aluminum handle.

A convenient support is provided on which to rest the loops so that a batwing Bunsen burner may be placed under each one successively.

A constant temperature bath is provided, capable of maintaining the seeding tubes at 20° C. during the time of the test. A well-insulated bath of large volume relative to the surface exposed is sufficient without thermo-regulating appliances.

Disinfectant Testing Machine—The use of a disinfectant testing machine is optional. One is described in Reprint No. 462 from the Public Health Reports. A few modifications have proved useful. For example, the use of platinum instead of nichrome loops, and the practice of sterilizing the subculture tubes covered with padded inverted troughs in the racks.

DILUTIONS

Dilutions of phenol and of disinfectants are made from the original liquid on the day of the test. For the dilutions of the disinfectant, a 5 per cent solution is made by adding 5 cc. of the disinfectant to 95 cc. of sterile distilled water. A standardized 5 cc. capacity pipette is used for this purpose. After filling the pipette, all excess of the disinfectant on the outside of the pipette is wiped off with sterile gauze. The contents of the pipette are then delivered into a cylinder containing 95 cc. of sterile distilled water and the pipette is washed out as clean as possible by aspiration and blowing out the contents into the cylinder. The contents of the cylinder are then thoroughly shaken and the dilutions up to 1 : 500 are made from it, using delivery pipettes for measuring. For those disinfectants which do not readily form a 5 per cent solution make a 1 per cent solution, and from this make the dilutions greater than 1 : 100 in accordance with the second table of dilutions. If greater dilutions than 1 : 500 are to be made, a 1 per cent solution is made from the 5 per cent solution and the higher dilutions are made from this.

In other respects Liquefied Phenol responds to the tests for identity and purity under *Phenol*, omitting the congealing point.

Assay—Proceed as directed under *Phenol*.

NOTE—When Phenol is to be mixed with fixed oils, liquid petrolatum, or petrolatum, use melted crystalline phenol instead of Liquefied Phenol.

Preserve in well-closed containers, protected from light.

U. S. P. Preparations—Glyceritum Phenolis; Unguentum Phenolis.

N. F. Preparations—Aqua Phenolata; Liquor Iodi Phenolatus; Liquor Sodii Boratis Compositus.

Uses—Liquefied phenol was introduced into the Pharmacopœia to furnish a uniform and convenient method of using phenol in a concentrated liquid form. The practice of adding 10 per cent of water to crystallized phenol has long been followed, this liquid being often more convenient for compounding prescriptions than the crystals. In using it, allowance must of course be made for the presence of 10 per cent of water. The dose is one minim (0.06 cc.).

PHENOL IODATUM. N.F. Iodized Phenol

[**Phenol Iodat.**—ACIDUM CARBOLICUM IODATUM]

	Metric	Alternative
Iodine, reduced to powder	**20 Gm.**	2 oz. av.
Phenol	**60 Gm.**	6 oz. av.
Glycerin	**20 Gm.**	2 oz. av.
To make	**100 Gm.**	10 oz. av.

Place the iodine in a flask, add the phenol, then the glycerin, and digest the mixture at a gentle heat, frequently agitating, until the iodine is dissolved.

Preserve the product in glass-stoppered bottles in a dark place.

Uses—It is used as an antiseptic and caustic.

For the higher dilutions, delivery pipettes may be used. The following scale is used for making dilutions:

For dilutions up to 1 : 70, increase or decrease by a difference of 5 (*i.e.*, 5 parts of water); from 1 : 70 to 1 : 160, by a difference of 10; from 1 : 160 to 1 : 200, by a difference of 20; from 1 : 200 to 1 : 400, by a difference of 25; from 1 : 400 to 1 : 900, by a difference of 50; from 1 : 900 to 1 : 1800, by a difference of 100; from 1 : 1800 to 1 : 3200, by a difference of 200; and so on if higher dilutions are necessary.

It is important that the cylinders used for making the dilutions be correctly graduated. It is preferable to use standardized cylinders and pipettes. For making the dilutions in accordance with the above scheme, the following tables are of service:

Tables useful in making dilutions

[5 cc. of disinfectant + 95 cc. of distilled water = Solution A]

Dilution	cc. of A	cc. of dist. water	cc. of A	cc. of dist. water	cc. of A	cc. of dist. water
1 : 20 =	20 +	0 or 10 +	0	or 4 +	0	
1 : 25 =	20 +	5 or 10 +	2½	or 4 +	1	
1 : 30 =	20 +	10 or 10 +	5	or 4 +	2	
1 : 35 =	20 +	15 or 10 +	7½	or 4 +	3	
1 : 40 =	20 +	20 or 10 +	10	or 4 +	4	
1 : 45 =	20 +	25 or 10 +	12½	or 4 +	5	
1 : 50 =	20 +	30 or 10 +	15	or 4 +	6	
1 : 55 =	20 +	35 or 10 +	17½	or 4 +	7	
1 : 60 =	20 +	40 or 10 +	20	or 4 +	8	
1 : 65 =	20 +	45 or 10 +	22½	or 4 +	9	
1 : 70 =	20 +	50 or 10 +	25	or 4 +	10	
1 : 70 =	20 +	50 or 10 +	25	or 4 +	10	
1 : 80 =	20 +	60 or 10 +	30	or 4 +	12	
1 : 90 =	20 +	70 or 10 +	35	or 4 +	14	
1 : 100 =	20 +	80 or 10 +	40	or 4 +	16	
1 : 110 =	20 +	90 or 10 +	45	or 4 +	18	
1 : 120 =	20 +	100 or 10 +	50	or 4 +	20	
1 : 130 =	20 +	110 or 10 +	55	or 4 +	22	

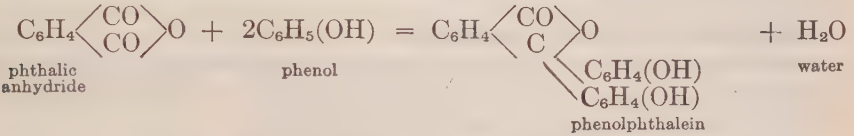
Dilution	cc. of A	cc. of dist. water	cc. of A	cc. of dist. water	cc. of A	cc. of dist. water
1 : 140 =	20 +	120 or 10 +	60	or 4 +	24	
1 : 150 =	20 +	130 or 10 +	65	or 4 +	26	
1 : 160 =	20 +	140 or 10 +	70	or 4 +	28	
1 : 170 =	20 +	150 or 10 +	75	or 4 +	30	
1 : 180 =	20 +	160 or 10 +	80	or 4 +	32	
1 : 200 =	20 +	180 or 10 +	90	or 4 +	36	
1 : 200 =	20 +	180 or 4 +	36	or 2 +	18	
1 : 225 =	20 +	205 or 4 +	41	or 2 +	20½	
1 : 250 =	20 +	230 or 4 +	46	or 2 +	23	
1 : 275 =	20 +	255 or 4 +	51	or 2 +	25½	
1 : 300 =	20 +	280 or 4 +	56	or 2 +	28	
1 : 325 =	20 +	305 or 4 +	61	or 2 +	30½	
1 : 350 =	20 +	330 or 4 +	66	or 2 +	33	
1 : 375 =	20 +	355 or 4 +	71	or 2 +	35½	
1 : 400 =	20 +	380 or 4 +	76	or 2 +	38	
1 : 450 =	20 +	430 or 4 +	86	or 2 +	43	
1 : 500 =	20 +	480 or 4 +	96	or 2 +	48	

PHENOLPHTHALEINUM. U.S. Phenolphthalein

[Phenolphthal.]

$(C_6H_4OH)_2CO.C_6H_4CO(318.21)$

A compound resulting from the condensation of phthalic anhydride with phenol, and with the elimination of water.



Preparation—It may be prepared by heating 10 parts of phenol with 5 parts of phthalic anhydride and 4 parts of sulphuric acid to 120° C. for ten or twelve hours, exhausting the product with boiling water, dissolving the residue in dilute sodium hydroxide solution, filtering, and precipitating with acetic acid. It is afterwards purified and crystallized.

Description and Physical Properties—A white or faintly yellowish-white, crystalline powder. It is odorless, and is stable in the air.

Phenolphthalein is almost insoluble in water. One Gm. is soluble in 13 cc. of alcohol, and in about 70 cc. of ether, at 25° C.

Test for Identity—Melting point not below 256° C.

It is readily dissolved by solutions of alkali hydroxides and by hot solutions of alkali carbonates, yielding a red liquid. These solutions are decolorized by the addition of an excess of acid.

Tests for Purity—Ash: not more than 0.05 per cent.

A solution of 0.5 Gm. of Phenolphthalein in 30 cc. of neutral alcohol is colorless.

One-half Gm. of Phenolphthalein dissolves completely in a mixture of 4 cc. of sodium hydroxide T.S. and 50 cc. of distilled water (*fluorane*).

A mixture of 250 cc. of cold, recently boiled, distilled water and 0.5 cc. of a solution of Phenolphthalein (1 in 100) in alcohol, requires not more than 0.25 cc. of fiftieth-normal sodium hydroxide to produce a pink color.

Heat 0.5 Gm. of Phenolphthalein with 10 cc. of diluted hydrochloric acid on a water bath for five minutes, filter, and evaporate the filtrate to dryness. The residue dissolved in 25 cc. of dis-

---

Tables useful in making dilutions—Continued

[1 cc. of disinfectant + 99 cc. of distilled water = Solution B]

Dilution	cc. of B	cc. of dist. water	cc. of B	cc. of dist. water	cc. of B	cc. of dist. water
1 : 100 =	100	+ 0	or 10	+ 0		
1 : 110 =	100	+ 10	or 10	+ 1		
1 : 120 =	100	+ 20	or 10	+ 2		
1 : 130 =	100	+ 30	or 10	+ 3		
1 : 140 =	100	+ 40	or 10	+ 4		
1 : 150 =	100	+ 50	or 10	+ 5		
1 : 160 =	100	+ 60	or 10	+ 6		
1 : 160 =	100	+ 60	or 10	+ 6		
1 : 180 =	100	+ 80	or 10	+ 8		
1 : 200 =	100	+ 100	or 10	+ 10		
1 : 200 =	100	+ 100	or 10	+ 10	or 4	+ 4
1 : 225 =	100	+ 125	or 10	+ 12½	or 4	+ 5
1 : 250 =	100	+ 150	or 10	+ 15	or 4	+ 6
1 : 275 =	100	+ 175	or 10	+ 17½	or 4	+ 7
1 : 300 =	100	+ 200	or 10	+ 20	or 4	+ 8
1 : 325 =	100	+ 225	or 10	+ 22½	or 4	+ 9
1 : 350 =	100	+ 250	or 10	+ 25	or 4	+ 10
1 : 375 =	100	+ 275	or 10	+ 27½	or 4	+ 11
1 : 400 =	100	+ 300	or 10	+ 30	or 4	+ 12
1 : 400 =	10	+ 30	or 4	+ 12	or 2	+ 6
1 : 450 =	10	+ 35	or 4	+ 14	or 2	+ 7
1 : 500 =	10	+ 40	or 4	+ 16	or 2	+ 8
1 : 550 =	10	+ 45	or 4	+ 18	or 2	+ 9
1 : 600 =	10	+ 50	or 4	+ 20	or 2	+ 10

Dilution	cc. of B	cc. of dist. water	cc. of B	cc. of dist. water	cc. of B	cc. of dist. water
1 : 650 =	10	+ 55	or 4	+ 22	or 2	+ 11
1 : 700 =	10	+ 60	or 4	+ 24	or 2	+ 12
1 : 750 =	10	+ 65	or 4	+ 26	or 2	+ 13
1 : 800 =	10	+ 70	or 4	+ 28	or 2	+ 14
1 : 850 =	10	+ 75	or 4	+ 30	or 2	+ 15
1 : 900 =	10	+ 80	or 4	+ 32	or 2	+ 16
1 : 900 =	5	+ 40	or 4	+ 32	or 2	+ 16
1 : 1,000 =	5	+ 45	or 4	+ 36	or 2	+ 18
1 : 1,100 =	5	+ 50	or 4	+ 40	or 2	+ 20
1 : 1,200 =	5	+ 55	or 4	+ 44	or 2	+ 22
1 : 1,300 =	5	+ 60	or 4	+ 48	or 2	+ 24
1 : 1,400 =	5	+ 65	or 4	+ 52	or 2	+ 26
1 : 1,500 =	5	+ 70	or 4	+ 56	or 2	+ 28
1 : 1,600 =	5	+ 75	or 4	+ 60	or 2	+ 30
1 : 1,700 =	5	+ 80	or 4	+ 64	or 2	+ 32
1 : 1,800 =	5	+ 85	or 4	+ 68	or 2	+ 34
1 : 1,800 =	5	+ 85	or 4	+ 68	or 2	+ 34
1 : 2,000 =	5	+ 95	or 4	+ 76	or 2	+ 38
1 : 2,200 =	5	+ 105	or 4	+ 84	or 2	+ 42
1 : 2,400 =	5	+ 115	or 4	+ 92	or 2	+ 46
1 : 2,600 =	5	+ 125	or 4	+ 100	or 2	+ 50
1 : 2,800 =	5	+ 135	or 4	+ 108	or 2	+ 54
1 : 3,000 =	5	+ 145	or 4	+ 116	or 2	+ 58
1 : 3,200 =	5	+ 155	or 4	+ 124	or 2	+ 62

METHOD

This description applies to the hand method. For the use of the machine, follow the procedure of Reprint No. 462 from the Public Health Reports.

The object is to add 0.1 cc. of typhoid culture to 5 cc. of successive dilutions of the disinfectant and of

tilled water, slightly acidulated with hydrochloric acid, meets the requirements of the test for *heavy metals*, page 1519.

Heat a crucible to redness, and introduce, in small portions, an intimate mixture of 0.2 Gm. of Phenolphthalein, 0.5 Gm. of potassium nitrate, and about 0.3 Gm. of anhydrous sodium carbonate. Maintain a red heat until the reaction ceases, then boil the cooled residue for five minutes with 10 cc. of diluted sulphuric acid, filter, and wash the undissolved residue with 10 cc. of distilled water. Evaporate the filtrate and washings until sulphuric acid vapors begin to evolve. The residue dissolved in 5 cc. of distilled water conforms to the requirements of the test for *arsenic*, page 1512.

N. F. Preparation—Tabellæ Phenolphthaleini.

Uses—Phenolphthalein has been used for a number of years as an indicator in volumetric analysis, but it is now largely employed internally as a purgative in doses of one-half to three grains (0.03 to 0.2 Gm.).

Average dose—1 grain (0.06 Gm.).

PHENOLSULPHONPHTHALEINUM. U. S. Phenolsulphonphthalein

(See Chapter on Coloring Principles, page 846.)

TRINITROPHENOL. U. S. Trinitrophenol

[**Trinitrophen.**—Picric Acid]

$C_6H_2(OH)(NO_2)_3$ 1 : 2 : 4 : 6 (229.08).

Caution—For safety in transportation it is usually mixed with about 20 per cent of water. Before applying the tests described below, dry the Trinitrophenol to constant weight in a desiccator over sulphuric acid.

Preparation—It is obtained by nitrating phenolsulphonic acid, which is made by the action of concentrated sulphuric acid on phenol.

Description and Physical Properties—Pale yellow, rhombic prisms or scales. It is odorless and has an intensely bitter taste.

Caution—Trinitrophenol explodes when heated rapidly or when subjected to percussion.

One Gm. of Trinitrophenol is soluble in 78 cc. of water, 12 cc. of alcohol, 35 cc. of chloroform, 65 cc. of ether, and in 10 cc. of benzene, at 25° C. One Gm. is soluble in 15 cc. of boiling water.

Tests for Identity—Trinitrophenol melts between 121° and 123° C.

An aqueous solution of Trinitrophenol is acid to litmus paper.

An aqueous solution of Trinitrophenol (1 in 100) has a yellow color, which becomes more intense on the addition of alkalies, and red on the addition of ammonium sulphide T.S. or a solution of an alkaline cyanide.

An aqueous solution of Trinitrophenol is precipitated by solutions of most alkaloidal salts.

Tests for Purity—Add 5 drops of barium chloride T.S. to 10 cc. of an aqueous solution of Trinitrophenol (1 in 100): the liquid does not at once become opalescent (*sulphate*).

---

phenol, and, after this addition, to transfer a loopful of each mixture to a separate subculture tube at periods of 5, 7½, 10, 12½, and 15 minutes. The subculture tubes are then incubated for 48 hours at 37° C., and readings of growth or no growth are made and recorded.

Dilutions are made to cover the expected range of the disinfectant, and 5 cc. of each dilution is placed in a seeding tube. Dilutions of phenol are made as follows: 1 : 80, 1 : 90, 1 : 100, 1 : 110, 1 : 120, and 1 : 130, and 5 cc. of each is placed in a seeding tube.

The seeding tubes are placed in the water bath at 20° C. and a few minutes are allowed for their contents to reach this temperature.

To each seeding tube 0.1 cc. of culture is then added seriatim, allowing 15 seconds for each addition. If there are 10 tubes of disinfectant dilutions, this will occupy 2½ minutes. At the end of five minutes from the time of adding the disinfectant to the first seeding tube, a loopful of the mixture is transferred from this tube to a subculture tube, and this is done from each successive seeding tube at 15-second intervals. This procedure is repeated after the lapse of 7½, 10, 12½, and 15 minutes from the time of the first addition of culture to the seeding tube. Each loop is placed on the support and flamed with the Bunsen burner immediately after use, and the use of several loops permits them to cool before they are needed again. The operator is therefore obliged to make a transfer every 15 seconds for 10 minutes.

The culture is best added to the seeding tube by holding the latter in a slanting position and touching the tip of the 1 cc. pipette to the wetted surface exposed on its upper side. One-tenth cc. is run in at the proper time and thorough admixture is assured by gentle shaking.

The dilutions of phenol are next treated in the same manner as those of the disinfectant.

The tubes are properly labeled and are placed in the incubator for 48 hours, at the end of which time readings of growth or no growth are made and entered in a table as + or − signs, respectively.

In the nature of the test it is unavoidable that discrepancies in the even oblique slant of the plus signs across the chart will occasionally be encountered; but if these are numerous, a faulty technic is indicated and the test should be discarded. The same applies to accidentally contaminated tubes.

Dissolve 2 Gm. of Trinitrophenol is 50 cc. of benzene, collect the insoluble residue, if any, on a small counterpoised filter, or in a Gooch crucible with an asbestos layer, which has been dried at 100° C. and weighed, and wash the residue and filter with benzene until the washings are colorless: the residue, dried at 100° C., does not exceed 0.2 per cent.

Preserve in well-stoppered bottles, in a cool place, remote from fire.

Uses—It is used as an antiseptic in the form of a 1 per cent aqueous solution for burns; also used for its astringent and antiseptic effect in skin diseases. In urinalysis it is employed as a reagent to detect and estimate albumin. It is very explosive when dry, therefore the above caution concerning transportation. It has been employed internally as an antipyretic; the dose is one-half grain (0.03 Gm.).

RESORCINOL. U.S. Resorcinol

[**Resorcin.**—Resorcin, Metadioxybenzene]

Resorcinol, when dried to constant weight over sulphuric acid, contains not less than 99.5 per cent of $C_6H_4(OH)_2$ 1:3 (110.08).

Preparation—Resorcinol is usually prepared by fusing sodium metabenzenedisulphonate with sodium hydroxide; it may be made in several other ways—by the destructive distillation of brazilin, or by the fusion of either galbanum, ammoniac, sagapenum, asafetida, or acroides with caustic potash. Resorcinol is a dihydric phenol isomeric with *pyrocatechin* and *hydroquinone*.

The first method of preparation referred to is a general one for the production of phenols and may be illustrated, as applied to resorcinol, by the following equations:

$$C_6H_4(NaSO_3\,①)(NaSO_3\,③) + 4NaOH = C_6H_4(ONa\,①)(ONa\,③) + 2Na_2SO_3 + 2H_2O$$

sodium metabenzenedisulphonate — sodium hydroxide — sodium resorcinolate — sodium sulphite — water

$$C_6H_4(ONa\,①)(ONa\,③) + 2HCl = C_6H_4(OH\,①)(OH\,③) + 2NaCl$$

sodium resorcinolate — hydrochloric acid — resorcinol — sodium chloride

Description and Physical Properties—Colorless, or nearly colorless, needle-shaped crystals, or powder. It has a faint, characteristic odor and a sweetish, followed by a bitter, taste. It acquires a pink tint on exposure to light and air.

One Gm. of Resorcinol is soluble in 0.9 cc. of water and in 0.9 cc. of alcohol, at 25° C. One Gm.

DETERMINATION OF COEFFICIENT

The coefficient is the arithmetical mean of the sum of three ratios, expressed decimally. These ratios are the denominator of the highest dilution of the disinfectant in whose subculture tube no growth occurs, divided by the corresponding figure for phenol, for the 5, 10, and 15 minute intervals, respectively.

Example:

Sample	Dilution	Time of exposure in minutes				
		5	7½	10	12½	15
Disinfectant	1 : 700	−	−	−	−	−
	1 : 800	+	−	−	−	−
	1 : 900	+	+	−	−	−
	1 : 1,000	+	+	+	+	−
	1 : 1,000	+	+	+	+	+
Phenol	1 : 80	−	−	−	−	−
	1 : 90	+	−	−	−	−
	1 : 100	+	+	+	+	−
	1 : 110	+	+	+	+	−
	1 : 120	+	+	+	+	+
	1 : 130	+	+	+	+	+

$$\text{Coefficient} = \frac{\frac{700}{80} + \frac{900}{90} + \frac{1000}{110}}{3} = \frac{8.7 + 10.0 + 9.0}{3} = 9.2$$

is soluble in about 0.2 cc. of water at 80° C. It is freely soluble in glycerin and in ether, and is slightly soluble in chloroform.

Tests for Identity—Resorcinol melts between 109° and 111° C.

The addition of three drops of ferric chloride T.S. to 10 cc. of an aqueous solution of Resorcinol (1 in 200) produces a bluish-violet color, changing to brownish-yellow on the addition of ammonia T.S. (*difference from catechol and quinol*).

Dissolve 0.1 Gm. of Resorcinol in 2 cc. of sodium hydroxide T.S., add a drop of chloroform, and heat the mixture: an intense crimson color is produced, which changes to pale yellow on the addition of a slight excess of hydrochloric acid.

Tests for Purity—Its aqueous solution (1 in 20) is neutral or only faintly acid to litmus paper.

Ash: not more than 0.05 per cent.

An aqueous solution of Resorcinol (1 in 20) does not emit the odor of phenol when gently warmed.

Lead acetate T.S. produces no precipitate in an aqueous solution of Resorcinol (1 in 20) (*catechol*).

Assay—Dissolve about 1.5 Gm. of Resorcinol, previously dried to constant weight over sulphuric acid and accurately weighed, in sufficient distilled water to make 500 cc. Transfer 25 cc. of this solution, representing one-twentieth of the weight of Resorcinol taken, to a 500 cc. glass-stoppered flask having a long, narrow neck, add 50 cc. of tenth-normal bromine, dilute with 50 cc. of distilled water, add 5 cc. of hydrochloric acid, and at once stopper the flask. Shake, allow it to stand for one minute, dilute with 20 cc. of distilled water, add 5 cc. of potassium iodide T.S., allow to stand for five minutes, and titrate the liberated iodine with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal bromine corresponds to 0.001835 Gm. of $C_6H_4(OH)_2$.

This assay is explained on page 1468.

Preserve in well-closed containers, protected from light.

N. F. Preparations—Curatio Paraffini; Pasta Resorcinolis Fortis; Pasta Resorcinolis Mitis; Unguentum Resorcinolis Compositum.

Uses—Resorcinol is an antiseptic closely resembling phenol in its physiological action but less powerful. It is used mainly externally in various skin diseases. Occasionally it is given internally as a gastric antiseptic. The dose of resorcinol is two to three grains (0.12 to 0.2 Gm.).

Unofficial Compounds of Resorcinol

Euresol, N. N. R.—Resorcin Monacetate.—Resorcinyl Acetate—$CH_3.CO.O.(C_6H_4.OH)$—The acetic acid ester of resorcinol, $C_6H_4(OH)_2$, 1: 3.

A thick, honey-yellow, oily liquid, boiling at 283° C. and soluble in acetone.

Actions and Uses—Its action is similar to that of resorcinol, but milder and more lasting because of the gradual liberation of the phenol.

Euresol is said to be useful in acne, sycosis, chilblains, and particularly in the treatment of alopecia and seborrhea. Applied pure, in acetone solution, and as a 5 to 50 per cent ointment. For scalp lotions, from 3 to 5 per cent alcoholic solutions are used.

Manufactured by E. Bilhuber, Inc., New York.

Hexylresorcinol—Caprokol—A synthetic chemical, $C_6H_3(OH)_2C_6H_{13}$, said to possess about 45 times the germicidal power of Phenol.

An internal urinary antiseptic, indicated in the treatment of infections of the urinary tract. Claimed to be non-toxic in therapeutic doses. Administered in capsules, in oil solution, in doses of two and one-half grains (0.15 Gm.).

Manufactured by Sharp and Dohme, Baltimore, Md.

ACIDUM SALICYLICUM. U. S. Salicylic Acid

[Acid. Salicyl.—Orthohydroxy Benzoic Acid]

Salicylic Acid, dried at 100° C. for two hours, contains not less than 99.5 per cent of $C_6H_4(OH).COOH$ 1: 2 (138.08).

Preparation—Although salicylic acid may be obtained from several natural sources, it is obtained, according to Kolbe's patent, by treating sodium phenol (or carbolate) with carbon dioxide. For this purpose, the most concentrated caustic soda solution is evaporated with the corresponding amount of phenol to a dry powder; this is then heated to 100° C. while a stream of dry carbon dioxide is passed over it. The temperature is gradually raised to 180° C. and increased to 220° C. as soon as phenol distils over, and finally raised to 250° C. until no more phenol distils. The residue left in the retort is essentially composed of sodium sodio-salicylate, ($C_6H_4ONaCOONa$). In the retort, the

half of the phenol used remains as sodium salicylate, while the other half is distilled over unchanged. The reactions are expressed as follows:

$$\underset{\text{phenol}}{C_6H_5OH} + \underset{\text{sodium hydroxide}}{NaOH} = \underset{\text{sodium-phenol}}{C_6H_5ONa} + \underset{\text{water}}{H_2O}$$

$$\underset{\text{sodium-phenol}}{2C_6H_5ONa} + \underset{\text{carbon dioxide}}{CO_2} = \underset{\text{phenol}}{C_6H_5OH} + \underset{\text{sodium sodio-salicylate}}{C_6H_4\begin{cases}ONa\ ①\\COONa\ ②\end{cases}}$$

The sodium salt thus obtained is dissolved in water and decomposed by hydrochloric acid as follows:

$$\underset{\text{sodium sodio-salicylate}}{C_6H_4\begin{cases}ONa\ ①\\COONa\ ②\end{cases}} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{salicylic acid}}{C_6H_4\begin{cases}OH\ ①\\COOH\ ②\end{cases}} + \underset{\text{sodium choride}}{2NaCl}$$

The salicylic acid is then filtered off, washed, and crystallized from a hot aqueous solution, or purified by sublimation in a current of superheated steam or dialyzed.

In Schmitt's improved method carbon dioxide reacts upon sodium-phenol, in closed vessels at a temperature of 130° C., forming sodium-phenol carbonate which passes into sodium salicylate. By this modification no separation of phenol occurs. Salicylic acid is also made from oil of gaultheria by adding to it a strong solution of potassium hydroxide whereby potassium salicylate is formed; this is then poured into diluted hydrochloric acid and the separated crystals of salicylic acid purified by recrystallization.

Description and Physical Properties—Fine needles, or a bulky crystalline powder. It has a sweetish, afterwards acrid taste, and is stable in the air.

Synthetic Salicylic Acid is white and odorless. When prepared from natural methyl salicylate, the Acid may have a slightly yellow or pink tint, and a faint, gaultheria-like odor.

One Gm. of Salicylic Acid is soluble in 460 cc. of water, 2.7 cc. of alcohol, 42 cc. of chloroform, 3 cc. of ether, 3 cc. of acetone, 135 cc. of benzene, and in 52 cc. of oil of turpentine, at 25° C. One Gm. is soluble in about 15 cc. of boiling water.

Tests for Identity—Salicylic Acid melts between 157° and 159° C.

Salicylic Acid responds to the reactions for salicylates, page 826.

Tests for Purity—Ash: not more than 0.05 per cent.

Allow a solution of 1 Gm. of Salicylic Acid in 3 cc. of alcohol to evaporate spontaneously in a glass or porcelain dish, protected from dust: the synthetic Acid yields a white, crystalline residue, while the Acid prepared from natural methyl salicylate yields a white, or not more than a slightly yellow, or a slightly pink residue (*coloring matter*).

Dissolve 1 Gm. of Salicylic Acid in an excess of cold sodium carbonate T.S., agitate the liquid with an equal volume of ether, separate the ether layer, and allow it to evaporate spontaneously: the residue, if any, is free from the odor of phenol.

A solution of 0.5 Gm. of the synthetic Salicylic Acid in 10 cc. of sulphuric acid acquires not more than a light yellow color. The Acid prepared from natural methyl salicylate under similar conditions may produce a slightly brown color (*readily carbonizable substances*).

Dissolve 0.5 Gm. of Salicylic Acid in 10 cc. of alcohol containing a few drops of nitric acid: the solution is unaffected by the addition of a few drops of silver nitrate T.S. (*chloride*).

Assay—Dissolve about 0.5 Gm. of Salicylic Acid, previously dried at 100° C. for two hours and accurately weighed, in 25 cc. of diluted alcohol, which previously has been neutralized with tenth-normal sodium hydroxide, using phenolphthalein T.S. as indicator. Titrate the solution with tenth-normal barium hydroxide until the pink color is restored. Each cc. of tenth-normal barium hydroxide corresponds to 0.01381 Gm. of $C_6H_4(OH).COOH$.

This assay is explained on page 1456.

N. F. Preparations—Collodium Salicylicum Compositum; Glycerogelatinum Acidi Salicylici; Mulla Acidi Salicylici; Mulla Creosoti Salicylata; Pasta Zinci; Pulvis Antisepticus; Pulvis Talci Compositus; Stili Acidi Salicylici Dilubilis.

Uses—Salicylic acid is used internally in rheumatism and as an analgesic, also as a urinary antiseptic. Externally it is used in skin diseases for its antiseptic effect and also its power of softening the keratin of the skin; it is the latter effect which explains its value in "corn-plasters". The dose is eight grains (0.5 Gm.). A number of salts of the acid are official—ammonium, bismuth, phenyl, quinine, strontium, sodium, and acetylsalicylic acid; methyl salicylate is an official liquid. The sodium salt is very valuable, and is generally relied upon for the internal administration of the acid.

Tests for Salicylates

Salicylates—In moderately dilute solutions of salicylates, ferric chloride T.S. produces a violet color. The addition of acids to moderately concentrated solutions of salicylates produces a precipitate of salicylic acid.

PHENYLIS SALICYLAS. U.S. Phenyl Salicylate

[**Phenyl. Salicyl.**—SALOL]

$C_6H_4(OH)COOC_6H_5$ 1:2 (214.15).

Preparation—Phenyl salicylate is prepared by heating salicylic acid with phenol in the presence of certain acid chlorides (phosphoryl chloride or carbonyl chloride); the elements of water are withdrawn by this action, and the phenyl group is caused to unite with the salicylic radical.

The reaction is expressed thus:

$$2C_6H_4\begin{cases}OH\ ①\\COOH\ ②\end{cases} + 2C_6H_5OH + POCl_3 =$$

salicylic acid — phenol — phosphoryl chloride

$$2C_6H_4\begin{cases}OH\ ①\\COOC_6H_5\ ②\end{cases} + HPO_3 + 3HCl$$

phenyl salicylate — metaphosphoric acid — hydrochloric acid

Description and Physical Properties—A white, crystalline powder, having an aromatic odor, and a characteristic taste.

One Gm. of Phenyl Salicylate is soluble in 6670 cc. of water and in 6 cc. of alcohol, at 25° C. It is very soluble in chloroform, ether, benzene, and in fixed or volatile oils.

Tests for Identity—It melts between 41° and 43° C.

Heat about 0.3 Gm. of Phenyl Salicylate with 3 cc. of sodium hydroxide T.S. for a few minutes and then acidify the solution with hydrochloric acid: salicylic acid separates and the odor of phenol is recognizable.

The addition of diluted ferric chloride T.S. to an alcoholic solution of the salt (1 in 20) produces a violet color.

Test for Purity—Phenyl Salicylate does not redden moistened blue litmus paper (*free acid*).

Ash: not more than 0.05 per cent.

Shake 1 Gm. of Phenyl Salicylate with 50 cc. of distilled water and filter the liquid: the addition of one drop of ferric chloride T.S. to 10 cc. of the filtrate produces no violet color (*uncombined phenol or salicylic acid*).

Ten cc. portions of the filtrate prepared for the preceding test, when tested separately with barium nitrate T.S. and silver nitrate T.S., show no turbidity (*sulphate or chloride*).

Preserve in well-closed containers, in a cool place.

Uses—Phenyl salicylate is used as an intestinal antiseptic, it being decomposed in the small intestine, when in contact with alkaline fluids, into phenol and salicylic acid. It is also employed as a mild antirheumatic and analgesic. It is also used pharmaceutically to coat pills by rolling them in the salol, fused at a low temperature, forming what are termed *enteric pills*, intended to pass through the stomach unaltered, the salol being insoluble in the stomach (see page 1731). The dose is from five to thirty grains (0.3 to 2 Gm.).

ACIDUM ACETYLSALICYLICUM. U. S. Acetylsalicylic Acid

[Acid. Acetylsal.—Aspirin, Empirin]

Acetylsalicylic Acid contains not less than 99.5 per cent of $C_6H_4.O(CH_3CO).COOH$ 1:2 (180.11).

The acetyl derivative of salicylic acid, prepared by the action of acetic anhydride or acetyl chloride on salicylic acid. Condensation takes place as follows:

$$(CH_3CO)_2O + 2C_6H_4\begin{matrix}OH\ ① \\ COOH\ ②\end{matrix} = 2C_6H_4\begin{matrix}OCH_3CO\ ① \\ COOH\ ②\end{matrix} + H_2O$$

acetic anhydride — salicylic acid — acetyl salicylic acid — water

Description and Physical Properties—Small, colorless crystals or needles, or a white, crystalline powder. It is odorless, and in dry air is stable, but in contact with moisture it gradually decomposes into salicylic and acetic acids.

One Gm. of Acetylsalicylic Acid is soluble in about 300 cc. of water, 5 cc. of alcohol, 17 cc. of chloroform, and in from 10 to 15 cc. of ether, at 25° C. It is less soluble in absolute ether. It is also soluble with decomposition in solutions of alkali hydroxides and carbonates.

Tests for Identity—The melting point of Acetylsalicylic Acid, when determined in a bath previously heated to 120° C., is not below 132° C.

When the Acid is heated with water for several minutes, then cooled and a drop or two of ferric chloride T.S. added, a violet-red color is produced.

Boil about 0.5 Gm. of Acetylsalicylic Acid, with 10 cc. of sodium hydroxide T.S. for a few minutes, cool, and add 10 cc. of diluted sulphuric acid: a white precipitate of salicylic acid is produced, and the odor of acetic acid is perceptible. Filter, add to the filtrate 3 cc. of alcohol and 3 cc. of sulphuric acid, and warm; the odor of ethyl acetate becomes noticeable.

Tests for Purity—Ash: not more than 0.05 per cent.

A solution of 0.5 Gm. of Acetylsalicylic Acid in 10 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

A solution of 0.5 Gm. of the Acid, in 10 cc. of warm sodium carbonate T.S. is clear.

Shake 1 Gm. of Acetylsalicylic Acid with 20 cc. of distilled water and 1 cc. of nitric acid for one minute, and filter: five cc. portions of the filtrate yield no opalescence or turbidity at once on the addition of a few drops of silver nitrate T.S. (*chloride*) or barium chloride T.S. (*sulphate*).

Warm 1 Gm. of Acetylsalicylic Acid with 10 cc. of distilled water and 1 cc. of hydrochloric acid for two minutes, dilute with 40 cc. of distilled water, cool, and filter: the filtrate meets the requirements of the test for *heavy metals*, page 1519.

Dissolve 1 Gm. of Acetylsalicylic Acid in 5 cc. of alcohol, and allow the solution to evaporate spontaneously in a dish protected from dust: a white, crystalline residue is obtained (*coloring matter, resinous substances*).

Dissolve 0.1 Gm. of Acetylsalicylic Acid in 1 cc. of alcohol, dilute the solution with 48 cc. of cold distilled water, and add at once 1 cc. of a freshly prepared diluted ferric ammonium sulphate solution (made by adding 1 cc. of normal hydrochloric acid to 2 cc. of ferric ammonium sulphate T.S. and diluting with water to 100 cc.): the coloration, if any, produced in one-half minute, is not greater than that produced in a control test, using 1 cc. of a solution containing 0.1 Gm. of salicylic acid and 1 cc. of glacial acetic acid in 1 liter of water (*free salicylic acid*).

Assay—Add 50 cc. of half-normal sodium hydroxide to about 1.5 Gm. of Acetylsalicylic Acid, previously dried for three hours over sulphuric acid and accurately weighed, and boil gently for ten minutes. Titrate the excess of sodium hydroxide with half-normal sulphuric acid, using three drops of phenolphthalein T.S. as indicator. Make a blank test, using 50 cc. of half-normal sodium hydroxide, and from the comparisons make any necessary corrections. Each cc. of half-normal sodium hydroxide corresponds to 0.04503 Gm. of $C_6H_4.O(CH_3CO).COOH$.

This assay is explained on page 1454.

Preserve in well-closed containers.

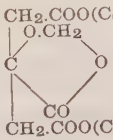
Uses—Acetylsalicylic acid is employed in rheumatic conditions, and especially as analgesics and antipyretics in colds, neuralgias, etc. The analgesic effects surpass those of sodium salicylate, with less danger of local irritation. It is used as a gargle in tonsillitis, five grains being dissolved in several ounces of water and used frequently.

The promiscuous use of acetylsalicylic acid (aspirin) by the laity, especially for the relief of headache, has frequently led to cases of rather severe poisoning, the chief symptoms being edema of the lips, tongue, eyelids, nose or of the entire face; also urticarial rashes, vertigo, nausea and sometimes cyanosis. Some individuals are especially susceptible to the effects of acetylsalicylic acid and these symptoms are usually ascribed to an idiosyncrasy.

Dose—From 0.3 to 1 Gm. (5 to 15 grains), repeated once in three hours until symptoms of salicylism (ringing in the ears, etc.) are noted. It may be administered in the form of a powder, wafers, or capsules. If prescribed as a powder, this may be administered by dissolving it in sweetened water, or by placing it on the tongue, and taking a swallow of water. The powder should be dispensed in wax paper. It is decomposed when dissolved in water and therefore only extemporaneously prepared aqueous solutions should be used.

Unofficial Salicylic Acid Compounds

Novaspirin, N. N. R.—*Salicitrin.*—Methylene-Citrylsalicylic Acid.



$CH_2.COO(C_6H_4.COOH)$
$O.CH_2$
C O
CO
$CH_2.COO(C_6H_4.COOH)$.—

A compound of anhydro-methylene-citric acid and salicylic acid.

Novaspirin is a grayish-white, odorless, crystalline powder, permanent in the air, having a faint acidulous taste. It is almost insoluble in water; soluble in alcohol; less soluble in ether or chloroform.

Actions and Uses—Similar to acetylsalicylic acid (see page 827), in doses of 15 grains (1 Gm.).

Ethyl Salicylate, N. N. R.—*Aethylis Salicylas,* Sal-ethyl—$C_6H_4.OH.C.O.O.(C_2H_5)$—The salicylic acid ester of ethyl alcohol analogous to methyl salicylate (oil of wintergreen).

A transparent, colorless, volatile liquid, possessing a pleasant characteristic odor and taste.

Actions and Uses—Ethyl salicylate has the same action as methyl salicylate, but is said to be less irritant and less toxic.

Dose—From 0.3 to 0.6 cc. (5 to 10 minims) three or four times a day.

Its specific gravity is 1.132 at 20° C. and it boils at from 230° to 232° C. It is insoluble in water, but soluble in alcohol.

Manufactured by Merck and Company, and Parke, Davis and Company.

Mesotan, N. N. R.—*Salmester*—$C_6H_4.OH.CO.O.(CH_2.O.CH_3)$—Methyl-oxymethyl salicylate, an ester of salicylic acid, analogous to methyl salicylate.

A clear, yellowish, faintly aromatic, oily fluid; specific gravity 1.2 at 15° C. and boiling at about 162° C. It is but slightly soluble in water, but readily soluble in the usual organic solvents and miscible with oils in all proportions.

It should be kept in a cool place and preserved dry in well-stoppered bottles.

Actions and Uses—Mesotan is an active counterirritant, used especially in rheumatic conditions, similarly to the local application of methyl salicylate. It is more irritant than the latter, and lacks its odor. It is absorbed from the skin, but its action is predominantly local, relieving pain and swelling. It is not an efficient means for producing the systemic actions of salicylates.

Dose—For application mesotan is diluted with 1 to 4 parts of olive oil or cottonseed oil, and painted over the affected area, usually twice daily. Friction should not be used, and dressings, if any are necessary, should be light and permeable. The site of application should be changed, if possible, after each treatment; or the area may be rested for two days after four days of treatment.

Distributed by The Winthrop Chemical Company. Manufactured by The Bayer Company.

Spirosal, N. N. R., 1925—*Monoglycol Salicylate*—Glysal—$C_6H_4OH.CO.O.(CH_2.CH_2.OH)$—The salicylic acid ester of monoglycol.

An almost odorless and colorless oily fluid, with a boiling point of from 169° to 170° C. at 12 mm. pressure. It is easily soluble in alcohol, ether, chloroform and benzol and soluble in about 110 parts of water and 8 parts of olive oil.

Actions and Uses—When spirosal is applied to the skin, about one-fifth to one-sixth of the amount used is absorbed. Usually it causes very little irritation even when rubbed in thoroughly.

Dose—It is used undiluted or mixed with from 2 to 3 parts of alcohol or in a mixture with olive oil, 1 to 8, or in ointments with equal parts by weight of petroleum or lard.

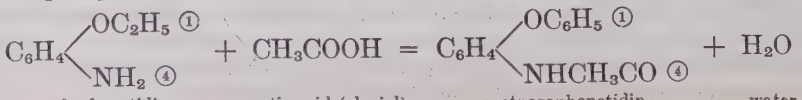
Distributed by The Winthrop Chemical Company. Manufactured by The Bayer Company.

ACETPHENETIDINUM. U. S. Acetphenetidin

[**Acetphen.**—PHENACETIN (PHENACETINUM)]

Monoacetyl para-amidophenetol [$C_6H_4(OC_2H_5).NH.CH_3CO$ 1:4 = 179.16].

Preparation—Acetphenetidin is made by treating paraphenetidin $C_6H_4(NH_2)OC_2H_5$ with glacial acetic acid, which introduces the acetyl group, and acetparaphenetidin ($C_6H_4(NHC_2H_3O)OC_2H_5$) is formed.



C_6H_4 (OC_2H_5 ①, NH_2 ④) + CH_3COOH = C_6H_4 (OC_6H_5 ①, $NHCH_3CO$ ④) + H_2O

paraphenetidin — acetic acid (glacial) — acetparaphenetidin — water

Description and Physical Properties—White, glistening, crystalline scales, or a fine, white, crystalline powder. It is odorless, has a slightly bitter taste, and is stable in the air.

One Gm. of Acetphenetidin is soluble in 1310 cc. of water, 15 cc. of alcohol, 14 cc. of chloroform and in about 130 cc. of ether, at 25° C. One Gm. is soluble in 82 cc. of boiling water and in 2.8 cc. of boiling alcohol.

Tests for Identity—Acetphenetidin melts between 134° and 135° C.

Boil about 0.1 Gm. of Acetphenetidin for one minute with 1 cc. of hydrochloric acid, dilute with 10 cc. of distilled water, cool, filter, and add a drop of potassium dichromate T.S. to the filtrate: a ruby-red color results.

Tests for Purity—Ash: not more than 0.05 per cent.

Shake about 1 Gm. of Acetphenetidin with 20 cc. of distilled water during two minutes, and filter: the filtrate is neutral to litmus paper.

A mixture of about 0.005 Gm. of Acetphenetidin and 1 cc. of nitric acid develops a yellow color which becomes darker on standing. A solution of 0.5 Gm. of Acetphenetidin in 5 cc. of sulphuric acid is only faintly yellow (*readily carbonizable substances*).

Boil 0.5 Gm. of Acetphenetidin with 10 cc. of distilled water for one minute, cool, filter, and add bromine T.S. to the filtrate, drop by drop, agitating after each addition until the solution remains permanently yellow: neither turbidity nor precipitation results (*acetanilid*).

A mixture of 0.3 Gm. of Acetphenetidin with 1 cc. of alcohol and one drop of tenth-normal iodine does not acquire a red tint when diluted with three times its volume of distilled water and boiled (*paraphenetidin*).

Uses—Acetphenetidin, or *phenacetin*, is a valuable antipyretic and analgesic; the absence of paraphenetidin in the product should be assured; the dose is from five to fifteen grains (0.3 to 1 Gm.).

ACETANILIDUM. U.S. Acetanilid

[**Acetanil.**—ACETANILIDE, ANTIFEBRIN, PHENYLACETAMIDE]

Monoacetyl aniline [$C_6H_5NH.CH_3CO = 135.12$].

Preparation—Acetanilid or *antifebrin* is made by the prolonged heating of a mixture of aniline and glacial acetic acid at the boiling point; the cooled, congealed residue is purified by sublimation or recrystallization.

The reaction is illustrated by the following equation:

$$\underset{\text{acetic acid (glacial)}}{CH_3COOH} + \underset{\text{aniline}}{C_6H_5NH_2} = \underset{\text{acetanilid}}{CH_3CONHC_6H_5} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Colorless, shining, crystalline leaflets, or a white, crystalline powder. It is odorless, and is stable in the air.

One Gm. of Acetanilid is soluble in 190 cc. of water, 3.4 cc. of alcohol, 3.7 cc. of chloroform, 17 cc. of ether, 4 cc. of acetone, 47 cc. of benzene, and in about 5 cc. of glycerin, at 25° C. One Gm. is soluble in 20 cc. of boiling water and in 0.6 cc. of boiling alcohol. It is slightly soluble in petroleum benzin.

Tests for Identity—Acetanilid melts between 113° and 115° C.

Boil about 0.1 Gm. of Acetanilid with 5 cc. of sodium hydroxide T.S.: the characteristic odor of aniline becomes noticeable. Add 1 cc. of chloroform, and heat the mixture: the disagreeable odor of phenylisocyanide (a poisonous substance) is evolved.

Boil about 0.1 Gm. of Acetanilid for several minutes with 2 cc. of hydrochloric acid: a clear solution results, which, when mixed with 3 cc. of an aqueous solution of phenol (1 in 20) and 5 cc. of a filtered, saturated solution of chlorinated lime, acquires a brownish-red color which becomes deep blue upon supersaturation with ammonia water.

Bromine T.S. produces a white, crystalline precipitate in a saturated aqueous solution of Acetanilid.

Tests for Purity—Ash: not more than 0.05 per cent.

Shake 1 Gm. of Acetanilid with 20 cc. of distilled water for two minutes and filter: the filtrate is neutral to litmus paper. Add five drops of ferric chloride T.S. to 5 cc. of the filtrate: the color does not differ from that produced by adding five drops of ferric chloride T.S. to 5 cc. of distilled water (*aniline salts*).

The solution of 0.5 Gm. of Acetanilid in 5 cc. of sulphuric acid is colorless or only faintly yellow (*readily carbonizable substances*).

N. F. Preparation—Pulvis Acetanilidi Compositus.

Uses—Acetanilid is an antipyretic and analgesic. When in very fine powder it is occasionally used as an antiseptic application to wounds. It is largely

employed in popular headache remedies, but should always be used with caution as an overdose is dangerous. The dose is from three to ten grains (0.2 to 0.6 Gm.).

Unofficial Preparation

Ammoniated Acetanilid — A mixture containing acetanilid 25 parts; sodium bicarbonate 5 parts; ammonium carbonate 10 parts and milk-sugar 60 parts. It has been recommended in place of acetanilid, being less depressing in action.

ANTIPYRINA. U. S. Antipyrine

[**Antipyr.**—PHENAZONE, PHENYL-DIMETHYL-PYRAZOLON]

Phenyldimethyl pyrazolon [$C_3HON_2(CH_3)_2.C_6H_5 = 188.17$).

Preserve it in well-closed containers.

Preparation—Antipyrine is made by Knorr's process by acting on phenyl-hydrazine with aceto-acetic ether when phenylmethyl pyrazolon is formed; this is methylated by treatment with methyl-iodide, resulting in the formation of phenyldimethyl pyrazolon or antipyrine.

Description and Physical Properties—Colorless crystals, or a white, crystalline powder. It is odorless, and has a slightly bitter taste.

One Gm. of Antipyrine is soluble in less than 1 cc. of water, 1.3 cc. of alcohol, 1 cc. of chloroform, and in 43 cc. of ether, at 25° C.

Tests for Identity—Antipyrine melts between 111° and 113° C.

The addition of tannic acid T.S. to an aqueous solution of Antipyrine produces an abundant white precipitate.

Mix 0.1 Gm. of sodium nitrite and 12 cc. of an aqueous solution of Antipyrine (1 in 100): a nearly colorless liquid is obtained, which, upon the addition of 1 cc. of diluted sulphuric acid, develops a deep green color.

One drop of ferric chloride T.S. added to 2 cc. of a dilute aqueous solution of Antipyrine (1 in 1000) produces a deep red color, which, upon the addition of ten drops of sulphuric acid, is changed to light yellow.

Tests for Purity—Its aqueous solution (1 in 20) is neutral to litmus paper.

Ash: not more than 0.1 per cent.

Antipyrine is completely soluble in its own weight of cold distilled water, the solution being colorless or not more than slightly yellow when viewed transversely in a tube having a diameter of about 20 mm.

An aqueous solution of Antipyrine meets the requirements of the test for *heavy metals*, page 1519.

Uses—Antipyrine is an antipyretic, analgesic, and antirheumatic. It is employed as a local remedy in nose and throat diseases. The dose is five grains (0.3 Gm.).

AMIDOPYRINA. U. S. Amidopyrine

[**Amidopyrin.**—PYRAMIDON]

Dimethylamino-antipyrine [$C_3ON_3(CH_3)_4.C_6H_5$].

Dimethylamino-phenyl-dimethyl-pyrazolon, differing from antipyrine, $C_{11}H_{12}N_2O$, in that a dimethylamino group, $N(CH_3)_2$, has replaced a hydrogen atom of the pyrazolon nucleus.

Description and Physical Properties—Colorless or white, small crystals, or a white, crystalline powder. It is odorless, and is stable in the air.

One Gm. of Amidopyrine is soluble in 18 cc. of water, 1.5 cc. of alcohol, 12 cc. of benzene, 1 cc. of chloroform, and in 13 cc. of ether, at 25° C.

Tests for Identity—Amidopyrine melts between 107° and 109° C.

An aqueous solution of Amidopyrine (1 in 25) is slightly alkaline to litmus paper.

To 5 cc. of an aqueous solution of Amidopyrine (1 in 25) add three drops of diluted hydrochloric acid and 1 cc. of ferric chloride T.S.: a bluish-violet color is produced. On the subsequent addition of a few cc. of diluted sulphuric acid, the color changes to violet-red.

The addition of five drops of silver nitrate T.S. to 5 cc. of an aqueous solution of Amidopyrine (1 in 25) produces an intensely violet color (other oxidizing substances yield the same color). On allowing the mixture to stand, a grayish-black precipitate of metallic silver is deposited.

To a solution of about 0.02 Gm. of Amidopyrine in 5 cc. of distilled water, add two drops of sulphuric acid and two drops of a 10 per cent solution of sodium nitrite: a transient blue color is produced which disappears quickly, the liquid remaining colorless (the appearance of a green color indicates *antipyrine*).

An aqueous solution of Amidopyrine (1 in 25) added to a freshly prepared solution of potassium ferricyanide, containing a little ferric chloride, produces at once a dark blue color or precipitate (difference from *antipyrine*).

Tests for Purity—Ash, not more than 0.1 per cent.

A solution of 0.1 Gm. of Amidopyrine in 1 cc. of sulphuric acid is colorless (*readily carbonizable substances*).

Its aqueous solution (1 in 25) meets the requirements of the test for *heavy metals*, page 1519.

The addition of a few drops of silver nitrate T.S. to 5 cc. of an aqueous solution of Amidopyrine (1 in 25), previously acidulated with a few drops of diluted nitric acid, produces no turbidity at once (*chloride*).

Uses—Amidopyrine acts as an antipyretic and anodyne, like antipyrine, but is effective in smaller doses. The action, while somewhat slower at the beginning, is more lasting. It is claimed to be comparatively free from harmful influences on the blood, heart or kidneys. It is said to be useful, particularly in the chronic fevers of tuberculosis, as well as in the acute febrile conditions incident to typhoid fever, erysipelas and pneumonia.

Dose—From 5 to 6 grains (0.3 to 0.4 Gm.), most conveniently in the form of tablets, a single dose usually suffices for twenty-four hours. The title pyramidon is trade marked.

Unofficial Compounds

Apinal, N. N. R.

Obtained in the destructive distillation of the wood of *Pinus palustris* and *Pinus australis*. Claimed to be mainly levomenthone. Antiseptic, germicidal, local anesthetic and expectorant. Dose, 5 to 15 min. (0.3 to 1 cc.) on sugar. It may be applied directly to wounds

Benzene, Medicinal, N. N. R.—C_6H_6
Medicinal benzol
Crystallizable benzol

A liquid consisting almost entirely of benzene, prepared by fractional distillation. A colorless, mobile liquid, having a strong characteristic odor. Insoluble in water but soluble in 90 per cent alcohol. It has been used in the treatment of leukemia. Use with caution. Dose, 8 to 15 min. (0.5 to 1 cc.) four times a day. May be administered in capsules or as an emulsion

CHAPTER LIX

BENZOIC ACID—ITS COMPOUNDS AND DERIVATIVES

FORMERLY benzoic acid was considered under benzoin, but since it is now almost entirely produced synthetically and, especially, since many important compounds of benzoic acid are now employed in medicine, a special chapter has been provided for their consideration.

Tests for Benzoates

Benzoates—In neutral solutions, benzoates yield a salmon-colored precipitate with ferric chloride T.S. In moderately concentrated aqueous solutions, benzoates yield a precipitate of benzoic acid upon acidulation with diluted sulphuric acid. This precipitate is readily soluble in ether.

ACIDUM BENZOICUM. U.S. Benzoic Acid
[Acid. Benz.]

Benzoic Acid, dried at 100° C. for two hours, contains not less than 99.3 per cent of $C_6H_5.COOH$ (122.08).

Preparation—Benzoic acid is found naturally in benzoin, balsam of tolu, balsam of Peru, storax, and other resinous substances. It may be obtained from these by sublimation as described on page 146; but, owing to the small yield afforded in this way, commercial benzoic acid is made artificially in several ways:

1. It was formerly prepared from the urine of cattle, by mixing it with lime in excess, evaporating and decomposing the lime hippurate with hydrochloric acid. The separated hippuric acid, after purification with animal charcoal was again treated with hydrochloric acid, when benzoic acid and *glycocine* are produced, the hydrochloric acid not being decomposed. This process has been replaced by one of the following.

2. Benzoic acid may be made from *naphthalene*, $C_{10}H_8$, which, on treatment with nitric acid, yields *phthalic acid*, this, when heated with excess of calcium hydroxide, yields calcium benzoate and carbonate. The calcium benzoate is treated with hydrochloric acid and the benzoic acid is precipitated.

3. Benzoic acid is also largely made from toluene, C_7H_8, a coal-tar hydrocarbon. Benzotrichloride is first formed, and this when heated with water in close vessels yields benzoic acid.

$$\underset{\text{benzotrichloride}}{C_6H_5.CCl_3} + \underset{\text{water}}{2H_2O} = \underset{\text{benzoic acid}}{C_6H_5.COOH} + \underset{\text{hydrochloric acid}}{3HCl}$$

Description and Physical Properties—Lustrous scales or friable needles. The synthetic Acid is white and odorless, or it may have a slight odor of benzaldehyde. The natural Acid is white or yellowish, acquiring a darker color on exposure to light, and has a slight odor of benzoin. Benzoic Acid is somewhat volatile at moderately warm temperatures, and freely volatile with steam.

One Gm. of Benzoic Acid is soluble in 275 cc. of water, 2.3 cc. of alcohol, 4.5 cc. of chloroform, 3 cc. of ether, 10 cc. of benzene, 30 cc. of carbon disulphide or carbon tetrachloride, and in 23 cc. of oil of turpentine, at 25° C. One Gm. is soluble in 18 cc. of boiling water, and in 1.5 cc. of boiling alcohol. It is soluble in fixed or volatile oils and is sparingly soluble in petroleum benzin.

Tests for Identity—Benzoic Acid melts between 120° and 122° C.

Benzoic Acid responds to the reactions for benzoates, page 832.

Tests for Purity—Ash: not more than 0.05 per cent.

A solution of 0.1 Gm. of the synthetic Acid in 2 cc. of sulphuric acid does not become darker than light yellow when warmed for five minutes at 50° C. The color produced by the Acid from benzoin tested in the same manner does not become darker than light brown (*readily carbonizable substances*).

Dissolve 0.3 Gm. of the Acid in 15 cc. of hot water, and add to the solution 2 cc. of tenth-normal potassium permanganate: the odor of benzaldehyde is not perceptible (*cinnamic acid*).

Mix 0.5 Gm. of Benzoic Acid and 0.7 Gm. of calcium carbonate with a little distilled water in a crucible, dry the mixture, and incinerate it at a low red heat. Dissolve the residue in 20 cc. of diluted nitric acid, filter, wash the filter and insoluble residue with 15 cc. of distilled water, add to the filtrate 0.5 cc. of tenth-normal silver nitrate, and dilute with distilled water to 50 cc. Dis-

solve 0.7 Gm. of the same calcium carbonate in 20 cc. of diluted nitric acid, filter if necessary, add 0.5 cc. of tenth-normal silver nitrate, and dilute with distilled water to 50 cc. Add to this solution fiftieth-normal hydrochloric acid, drop by drop, mixing well after each addition, until the turbidity matches that in the test with the Benzoic Acid. If the synthetic Acid is tested, not more than 0.6 cc. of fiftieth-normal hydrochloric acid is required in the control test to match the turbidity and, if the natural Acid is tested, not more than 0.3 cc. of fiftieth-normal hydrochloric acid is required (*chlorinated compounds*).

Assay—Dry about 1 Gm. of Benzoic Acid at 100° C. for two hours, and dissolve 0.5 Gm. of the dried Acid, accurately weighed, in 25 cc. of diluted alcohol, which has previously been neutralized with tenth-normal sodium hydroxide, using three drops of phenolphthalein T.S. as indicator. Titrate this solution with tenth-normal barium hydroxide until the pink color is restored. From the number of cc. of tenth-normal barium hydroxide consumed, subtract one-fifth of the volume of fiftieth-normal hydrochloric acid used in the test for chlorinated compounds. Each cc. of tenth normal barium hydroxide corresponds to 0.01221 Gm. of $C_6H_5.COOH$.

This assay is explained on page 1456.

Preserve in well-closed containers, in a cool place, protected from light.

U. S. P. Preparation—Tinctura Opii Camphorata.

N. F. Preparation—Nebula Aromatica.

Uses—This acid is useful in forming *benzoates*, a class of salts which have been employed frequently during the last few years. It is stimulant, expectorant, and irritant to the mucous membranes. The commercial nomenclature of benzoic acid is both interesting and important; the natural acid, sublimed from the drug is known as *"English Benzoic Acid"* also as *Flowers of Benzoin* or *Flowers of Benjamin.*

The synthetic benzoic acid is known as *"German Benzoic Acid"*.

Benzoic acid is an active germicide but is used in medicine chiefly in the form of its salts. It is sometimes used in mouth washes or in lozenges for its stimulating and antiseptic effect. Dose, fifteen grains (1 Gm.), administered in thick mucilage or syrup.

GLUSIDUM. U. S. Gluside

[**Glusid.**—Benzosulphinidum U. S. P. IX, Saccharin]

The anhydride [$C_6H_4.CO.SO_2.NH$ 1:2 = 183.14] of ortho-sulphamide-benzoic acid.

Saccharin, as it is commercially named, is made from the coal-tar product, toluene, by converting it into toluene-sulphonic chloride. This is treated with ammonia, whereby the sulphamide is formed, which by oxidation is converted into the sulphinide, saccharin being the anhydride of ortho-sulphamide-benzoic acid. The soluble form, which is a sodium salt, is also official (see page 834).

Description and Physical Properties—White crystals, or a white, crystalline powder. It is odorless, or has a faint, aromatic odor. Gluside in aqueous solution is from 300 to 500 times sweeter than sucrose.

One Gm. of Gluside is soluble in 290 cc. of water and in 31 cc. of alcohol, at 25° C. One Gm. is soluble in about 25 cc. of boiling water. It is slightly soluble in chloroform and in ether, and is easily dissolved by ammonia water, by solutions of alkali hydroxides, and by solutions of alkali bicarbonates with the evolution of carbon dioxide.

Tests for Identity—The melting point of Gluside is not below 222° C. Pure Gluside melts at about 228° C.

A saturated aqueous solution of Gluside is acid to litmus paper.

Dissolve about 0.1 Gm. of Gluside in 5 cc. of an aqueous solution of sodium hydroxide (1 in 10), evaporate the solution to dryness, and gently fuse the residue over a small flame until ammonia is no longer evolved. Allow the residue to cool, dissolve in 20 cc. of distilled water, neutralize the solution with diluted hydrochloric acid, and filter; the addition of a drop of ferric chloride T.S. to the filtrate produces a violet color.

Mix about 0.02 Gm. of Gluside with about twice its weight of resorcinol, add ten drops of sulphuric acid, and heat the mixture over a small flame until it acquires a dark green color. Allow it to cool, add 10 cc. of distilled water, and an excess of sodium hydroxide T.S.: a fluorescent, green liquid results.

Tests for Purity—Ash: not more than 0.5 per cent.

A solution of 0.2 Gm. of Gluside in 10 cc. of sulphuric acid, kept at a temperature of from 48° C. to 50° C. on a water bath, develops no darker color than light brown within ten minutes (*readily carbonizable substances*).

A solution of 0.2 Gm. of Gluside in 5 cc. of sodium hydroxide T.S. is clear, and, when mixed with 5 cc. alkaline cupric tartrate T.S. does not deposit cuprous oxide on heating (*glucose, lactose*).

Add ferric chloride T.S, drop by drop, to 10 cc. of a hot, saturated aqueous solution of Gluside: no precipitate or violet color appears (*benzoic or salicylic acid*).

No odor of ammonia is noticeable on warming 0.5 Gm. of Gluside with about 1 Gm. of magnesium oxide and 10 cc. of distilled water (*ammonium compounds*).

U. S. P. Preparation—Fluidextractum Cascaræ Sagradæ Aromaticum.

N. F. Preparations—Elixir Terpini Hydratis et Creosoti Compositum; Lavatio Ori; Oleum Ricini Aromaticum; Tabellæ Phenolphthaleini; Tabellæ Santonini; Tabellæ Santonini Compositæ.

Uses—Benzosulphinide is used for sweetening, but the Food and Drugs Act and most State food laws prohibit its use in foods and beverages. It has many times the sweetening power of sugar.

Average dose—As a sweetening agent, for diabetics, Gluside is used in the proportion of about 1 to 10,000 (Metric, 0.1 Gm. per liter—Apothecaries, $\frac{1}{20}$ grain per ounce) or, in place of an ordinary "lump" of sucrose, one-half grain (0.03 Gm.).

GLUSIDUM SOLUBILE. U. S. Soluble Gluside

[**Glusid. Sol.**—Sodii Benzosulphinidum U. S. P. IX, Soluble Saccharin]

The sodium salt [$NaC_7H_4O_3NS + 2H_2O = 241.1$] of benzosulphinide. Preserve it in well-closed containers.

Preparation—It is prepared by neutralizing ortho-sulphamidebenzoic acid or "saccharin" with sodium bicarbonate.

$$C_6H_4.CO.SO_2NNa.2H_2O$$

Description and Physical Properties—Colorless crystals or a white, crystalline powder. It is odorless or has a faint, aromatic odor, and an intensely sweet taste even in dilute solutions, being from 300 to 500 times sweeter than sucrose. It is somewhat efflorescent.

One Gm. of Soluble Gluside is soluble in 1.2 cc. of water, and about 50 cc. of alcohol, at 25° C.

Tests for Identity—Soluble Gluside responds to the identity tests with ferric chloride and with resorcinol under *Glusidum*.

When Soluble Gluside is incinerated, a residue remains consisting chiefly of sodium sulphate, which imparts a yellowish color to a non-luminous flame.

On mixing 10 cc. of its aqueous solution (1 in 10) with 1 cc. of hydrochloric acid, a crystalline precipitate of gluside is produced.

Tests for Purity—An aqueous solution of Soluble Gluside (1 in 10) is neutral or only slightly alkaline to litmus paper, but produces no red color with phenolphthalein T.S.

Add three drops of ferric chloride T.S. to 10 cc. of an aqueous solution of Soluble Gluside (1 in 20), previously acidulated with five drops of acetic acid: no precipitate or violet color is produced (*benzoate or salicylate*).

Soluble Gluside complies with the tests for *ammonium compounds, readily carbonizable substances, and for glucose and lactose*, under *Glusidum*.

Uses—It is used as a sweetening substance, chiefly by persons who are suffering from diabetes or other serious complaints in which sugar is contraindicated. The sodium salt is more readily soluble than gluside but does not possess quite an equal sweetening power, gluside is approximately five hundred times sweeter than sugar, and the sodium salt about four hundred times. Its use as a sweetening agent in beverages and food is prohibited by the Food and Drugs Act and by many State laws.

Average dose—As a sweetening agent, in diabetes, etc., Soluble Gluside is used in the proportion of about 1 to 10,000 (Metric, 0.1 Gm. per liter—Apothecaries, $\frac{1}{20}$ grain per ounce) or, in place of an ordinary "lump" of sucrose, one-half grain (0.03 Gm.).

ÆTHYLIS AMINOBENZOAS. U. S. Ethyl Aminobenzoate

[**Æthyl. Aminobenz.**—Benzocaine, Anesthesin]

The ethyl ester [$C_6H_4NH_2COO(C_2H_5)1:4 = 165.14$] of 4-aminobenzoic acid.

This is one of a group of synthetic products based upon the discovery that the local anesthetic action of cocaine is due to the radicle of benzoic acid in

combination with a nitrogen-containing basic group. Among the preparations of this type now in use are benzocaine, orthoform, stocaine, procaine, alypin, butesin, etc. Those which are slowly absorbed (benzocaine, orthoform, and butesin) are suitable for a dressing to painful wounds, etc. The others are employed hypodermatically for immediate anesthesia (see uses below).

Description and Physical Properties—Small, white or colorless crystals, or a white, crystalline powder. It is odorless and is stable in the air.

One Gm. of Ethyl Aminobenzoate is soluble in about 2500 cc. of water, 5 cc. of alcohol, 2 cc. of chloroform, 4 cc. of ether, and in from 30 to 50 cc. of expressed oil of almond or olive oil, at 25° C. It is soluble in dilute acids.

Tests for Identity—Ethyl Aminobenzoate melts between 88° and 90° C.

When boiled with alkali hydroxides, alcohol is liberated.

Dissolve about 0.02 Gm. of Ethyl Aminobenzoate in 10 cc. of distilled water with the aid of a few drops of diluted hydrochloric acid, and add to the solution five drops of a 10 per cent sodium nitrite solution, followed by 2 cc. of a solution of 0.1 Gm. of betanaphthol in 5 cc. of sodium hydroxide T.S.: an orange-red precipitate is produced.

Its aqueous solution (1 in 50), prepared with the aid of a slight excess of diluted hydrochloric acid, yields a precipitate with iodine T.S., and instantly reduces potassium permanganate T.S.

Tests for Purity—Ash: not more than 0.1 per cent.

A solution of 0.1 Gm. of Ethyl Aminobenzoate in 1 cc. of sulphuric acid is colorless (*readily carbonizable substances*).

Dissolve 1 Gm. of Ethyl Aminobenzoate in 10 cc. of neutral alcohol: a clear solution results. Dilute this solution with 10 cc. of distilled water, add two drops of phenolphthalein T.S. and one drop of tenth-normal sodium hydroxide: a red color is produced (*free acid*).

The addition of a few drops of silver nitrate T.S. to a solution of 0.2 Gm. of Ethyl Aminobenzoate in 5 cc. of alcohol, previously acidulated with a few drops of diluted nitric acid, produces no immediate turbidity (*chloride*).

An aqueous solution of Ethyl Aminobenzoate (1 in 20) prepared with the aid of just sufficient hydrochloric acid meets the requirements of the test for *heavy metals*, page 1519.

Heat a crucible to redness, and add, in small portions, an intimate mixture of 0.2 Gm. of Ethyl Aminobenzoate, about 0.5 Gm. of potassium nitrate, and about 0.3 Gm. of anhydrous sodium carbonate. Maintain a red heat until the reaction ceases, then boil the cooled residue for five minutes with 10 cc. of diluted sulphuric acid, filter, and wash the undissolved residue with 10 cc. of distilled water. Evaporate the filtrate and washings until sulphuric acid vapors begin to evolve: the residue, dissolved in 5 cc. of distilled water, meets the requirements of the test for *arsenic*, page 1512.

Uses—The slight solubility of benzocaine renders it unsuitable for injection, but the slow absorption renders it safer than other anesthetics, especially for ulcers, wounds, and mucous surfaces. The anesthesia is usually not so complete as with the soluble local anesthetics but is more lasting. Orthoform and benzocaine (see page 839) are about equally effective through intact mucous membranes; butesin (see page 839) is claimed to be more effective than benzocaine. They are practically nonirritant and non-toxic.

They are used for painful wounds, ulcers, etc., of the skin and accessible mucous membranes; for instance, after dental operations. They have all been used to relieve or control the pain of gastric ulcer or cancer and other gastralgias, but here their efficiency is doubtful.

Dose—Internally, from 5 to 8 grains (0.3 to 0.5 Gm.). Externally, it is applied as a dusting powder, either pure or diluted. It may be applied in ointment or in the form of suppositories.

PROCAINÆ HYDROCHLORIDUM. U. S. Procaine Hydrochloride [Procain. Hydrochl.]

Para-aminobenzoyl-diethylaminoethanol hydrochloride $[NH_2(C_6H_4CO)OC_2H_4N(C_2H_5)_2.HCl = 272.71]$.

Description and Physical Properties—Small, colorless crystals, or a white, crystalline powder. It is odorless, and is stable in the air.

One Gm. of Procaine Hydrochloride is soluble in 0.6 cc. of water and in 30 cc. of alcohol, at 25° C. It is slightly soluble in chloroform, and almost insoluble in ether.

Tests for Identity—Procaine Hydrochloride melts between 153° and 156° C.

An aqueous solution of Procaine Hydrochloride (1 in 10) yields precipitates with gold chloride T.S., iodine T.S., mercuric potassium iodide T.S. and picric acid T.S.

An aqueous solution of Procaine Hydrochloride (1 in 10) remains unchanged upon the addition of a solution of sodium bicarbonate, but with sodium hydroxide T.S. or sodium carbonate T.S., a colorless, oily precipitate is produced, which becomes crystalline on standing.

Silver nitrate T.S. produces in an aqueous solution of the salt (1 in 20) a white precipitate insoluble in nitric acid, but soluble in ammonia water.

Dissolve 0.1 Gm. of Procaine Hydrochloride in 5 cc. of distilled water, add two drops each of hydrochloric acid and solution of sodium nitrite (1 in 10), and then a solution of 0.2 Gm. of beta-naphthol in a mixture of 3 cc. of sodium hydroxide T.S. and 7 cc. of distilled water. A scarlet-red precipitate is produced (*difference from phenacaine* which yields a white precipitate).

To a solution of 0.1 Gm. of Procaine Hydrochloride in 5 cc. of distilled water add three drops of diluted sulphuric acid, followed by five drops of potassium permanganate T.S.: the violet color of the latter is immediately discharged (*difference from cocaine hydrochloride*).

Tests for Purity—Its aqueous solution (1 in 20) is neutral to litmus paper.

The ash from 0.5 Gm. is negligible.

A solution of 0.1 Gm. of Procaine Hydrochloride in 1 cc. of sulphuric acid is colorless or nearly colorless (*readily carbonizable substances*).

An aqueous solution of Procaine Hydrochloride meets the requirements of the test for *heavy metals*, page 1519.

Uses—Procaine hydrochloride is a local anesthetic similar in action to cocaine, but less toxic than cocaine and most other cocaine substitutes. When injected subcutaneously it exerts a prompt and powerful anesthetic action, but the effect is not sustained. This may be remedied by the simultaneous injection of epinephrine. Procaine hydrochloride is nonirritant. It is relatively ineffective when applied to intact mucous membranes.

Dose—For infiltration anesthesia, solutions of 0.25 Gm. (4 grains) procaine hydrochloride in 100 or 50 cc. (3.2 or 1.6 ounces) physiological solution of sodium chloride, with 0.3 or 0.6 cc. (5 or 10 minims) of epinephrine solution (1 in 1000); for instillations and injections, solutions of 0.1 Gm. (1½ grains) procaine in 10 or 5 cc. (160 or 80 minims) physiological solution of sodium chloride, with or without 0.6 cc. (10 minims) of epinephrine solution (1 in 1000). In ophthalmology, 1 to 5 or even up to 10 per cent solution; in rhinolaryngology, 5 to 20 per cent solutions are recommended, with the addition of 0.4 to 0.5 cc. (6 to 8 minims) of epinephrine solution (1 in 1000) to each 10 cc. (160 minims). Internally, owing to its feeble toxicity, it may be given in doses up to 0.5 Gm. (8 grains) to adults.

LIQUOR PROCAINÆ HYDROCHLORIDI. N.F. Solution of Procaine Hydrochloride

[Liq. Procain. Hydroch.—Dental Anaesthetic Solution]

	Metric	Alternative
Procaine Hydrochloride	**2.00 Gm.**	146 gr.
Sodium Chloride	**0.92 Gm.**	67 gr.
Thymol	**0.02 Gm.**	1.5 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**100 cc.**	1 pint

Dissolve the procaine hydrochloride and sodium chloride in about 98 cc. [15½ fl.oz.] of sterilized distilled water, and boil the solution for ten minutes under sterile conditions. Then cool, dissolve the thymol in the solution and add sufficient sterilized, distilled water to make the product measure 100 cc. [1 pint].

Solution of Procaine Hydrochloride is a clear, colorless, almost odorless liquid, neutral to litmus paper, and having a slightly saline taste.

One cc. portions of this solution show marked precipitation with iodine T.S., mercuric potassium iodide T.S., and picric acid T.S.

Silver nitrate T.S. gives a white precipitate with the Solution, soluble in an excess of ammonia T.S.

To 5 cc. of the Solution add two drops each of hydrochloric acid and sodium nitrite solution (1 in 10); then 2 Gm. of betanaphthol in 3 cc. of sodium hydroxide T.S. and 7 cc. of water. A bright red precipitate should be produced (*difference from phenacaine*).

Preserve the solution in bottles of resistant glass.

To each cc. of this Solution add 0.05 cc. Solution of Epinephrine Hydrochloride just before employing hypodermatically.

Uses—(See Procainæ Hydrochloridum, above).

Unofficial Compounds of Benzoic Acid

Alypin, N. N. R.—The hydrochloride of 2-benzoxy-2-dimethyl-amino-methyl-1-dimethyl-amino-butane—$CH_3.CH_2.C(C_6H_5COO)\ [CH_2N(CH_3)_2].CH_2N : (CH_3)_2.HCl$.

A white, crystalline powder; odorless; taste bitter, hygroscopic. It is very soluble in water; freely soluble in alcohol and chloroform; insoluble in ether. Its aqueous solutions are neutral and are not rendered turbid on the addition of sodium bicarbonate solution in moderate quantities. Its aqueous solution may be sterilized by boiling for a period not exceeding five minutes without decomposition. Two and four per cent aqueous solutions are quite stable, but weaker solutions are likely to become moldy. It should be protected from the air in well-stoppered containers.

Uses—Alypin is a local anesthetic, claimed to be equal to cocaine, but is not a mydriatic. It is said to be less toxic than cocaine, but the evidence is rather conflicting.

Dose—Alypin is used in solutions the strength of which is about the same as that of cocaine hydrochloride. In ophthalmology, 2 to 4 per cent; in rhinolaryngology, 5 to 10 per cent; in urology, 1 to 4 per cent; in minor surgery, ½ to 2 per cent; in dentistry, 2 per cent.

Alypin solutions may be sterilized by boiling the required amount of water for ten minutes in a test tube stoppered with cotton; the drug is then added and the boiling continued over a small flame for another minute. Solutions should be freshly prepared. Epinephrine preparations may be added when a vasoconstrictor effect is desired.

Distributed by The Winthrop Chemical Company, Inc.

Apothesine, N. N. R.—γ-diethylaminopropyl cinnamate hydrochloride—$(C_2H_5)_2N.CH_2.CH_2CH_2.COO.CH : CH.C_6H_5HCl$. The hydrochloride of a condensation product prepared by the action of cinnamoyl chloride on γ-diethylaminopropyl-alcohol.

In white masses which are composed of small, white crystals; practically odorless; faintly bitter, but producing a sense of numbness of the tongue; permanent in the air. It is soluble in water and alcohol; slightly soluble in acetone or ether. Its aqueous solution is neutral to litmus paper. The solution is stable.

Uses—Apothesine is a local anesthetic of the procaine rather than the cocaine type, that is, it belongs to that type which while effective for injection anesthesia (especially when combined with epinephrine), is relatively inefficient when applied to mucous membranes. It is rather slower in action than procaine. Its absolute toxicity is less than that of cocaine (as 20 to 15) but about twice that of procaine as (20 is to 40). It is efficient and generally safe for injection. Apothesine solutions are not injured by boiling.

Dose—As a local anesthetic 0.5 to 2 per cent solution generally with epinephrine in sterile water or physiologic solution of sodium chloride. For spinal anesthesia 2 cc. of a 4 per cent solution. For oral administration 0.03 Gm. repeated at half hour intervals.

Manufactured by Parke, Davis and Company.

Benzyl Alcohol, N. N. R—*Alcohol Benzylicum*—Phenmethylol—$C_6H_5.CH_2OH$—An aromatic alcohol occurring as an ester in tolu and other balsams; the product on the market is produced synthetically.

A colorless liquid with a faint aromatic odor, and a sharp burning taste. When placed on the tongue, it produces numbness, even if only a small quantity is used. It is soluble, 1 cc. in 25 cc. of water, and miscible in all proportions with alcohol, ether, and chloroform. One volume of benzyl alcohol should dissolve in 1.5 volumes of 50 per cent alcohol.

Uses—Benzyl alcohol is used as a local anesthetic by injection and by application to mucous membranes. It is practically nonirritant and non-toxic in the ordinary concentrations and doses.

Dose—Usually used in the form of a 1 to 4 per cent solution in water or physiological solution of sodium chloride. Such solutions may be sterilized by boiling, without danger of decomposition. Pure benzyl alcohol is markedly antiseptic.

Benzyl Benzoate—*Benzyl Benzoas*—$C_6H_5COO.C_6H_5CH_2$—The benzyl alcohol ester of benzoic acid. It contains not less than 95 per cent benzyl benzoate.

A colorless oily liquid above about 20° C. It is odorless, or has a faint aromatic odor, and a sharp burning taste. It is insoluble in water or glycerin but miscible in all proportions with alcohol, chloroform and ether.

Benzyl benzoate boils at 340° to 350° C. with partial decomposition. When ignited it burns with a very smoky flame. Benzyl Benzoate is neutral to litmus paper. Specific gravity 1.09 to 1.13 at 15° C., 1.083 to 1.122 at 25° C.

One of the commercial preparations consists of a solution of 20 Gm. of benzyl benzoate in 78 Gm. of ethyl alcohol to which is added 2 Gm. of powdered castile soap as an emulsifying agent.

Uses—Benzyl Benzoate lowers the tone of unstriped muscle, and has been suggested as a remedy against renal, biliary, uterine, and intestinal colic and other spasms of smooth muscle, including angiospasm. Its clinical use is still in the experimental stage.

Benzyl Benzoate is sometimes administered in capsules, usually mixed with an equal quantity of a fixed oil.

Dose—5 to 7 minims (0.3 to 0.5 cc.).

The following formulas have been suggested for its administration.

Elixir Benzyl Benzoate

Benzyl Benzoate	200 cc.
Glucide Benzosulphinide	5.0 cc.
Oil of Bitter Almond	1.5 cc.
Oil of Sweet Orange Peel	1.0 cc.
Glycerin	90.0 cc.
Alcohol, *a sufficient quantity,*	
To make	1000 cc.

Mix the benzyl benzoate with the alcohol and when solution is effected, add the glucide, then the oils and lastly, slowly add the glycerin.

Emulsion Benzyl Benzoate

Benzyl Benzoate	200 cc.
Olive Oil	60 cc.
Oil of Cinnamon	5 cc.
Oil of Clove	5 cc.
Oil of Nutmeg	5 cc.
Acacia	100 Gm.
Syrup	120 cc.
Distilled Water, *a sufficient quantity,*	
To make	1000 cc.

Mix the benzyl benzoate with the oils, add the acacia in granular form, emulsify with 100 cc. of water, and then add the syrup and enough water to make the product measure 1000 cc.

Butyn, N. N. R.—Paraaminobenzoyl-gammadinormalbutylamino-propanol sulphate; γ-dibutylamino-propyl-*p*-aminobenzoate-*N*-sulphate—$[NH_2.C_6H_4.COO(CH_2)_3.N(C_4H_9)_2]_2.H_2SO_4$. The normal sulphate of a base resembling the base of procaine (paraaminobenzoyl-diethylaminoethanol); but it differs in that butyn possesses a butyl group in place of the ethyl group of procaine base, and a propanol group in place of the ethanol group.

A colorless, odorless solid which rapidly produces a sense of numbness when placed upon the tongue. It melts at from 98° to 100° C.

Butyn is soluble in less than its own weight of water at 20° C. It dissolves slowly in cold water, but rapidly in hot water. It is very soluble in warm alcohol and in acetone, from which it does not readily separate on cooling. It is slightly soluble in chloroform, and insoluble in ether.

Uses—Butyn is a local anesthetic proposed as a substitute for cocaine, particularly in surface anesthesia, as for the eye, nose and throat. It has the special advantage of acting through intact mucosæ almost as effectively as cocaine. On the normal human eye, a 0.5 per cent solution of butyn is less effective than a 1 per cent solution of phenacaine (holocaine), but more efficient than a 1 per cent solution of cocaine or a 1 per cent solution of eucaine. Butyn solutions are nonirritant.

Dose—For ophthalmologic work, butyn is generally used in 2 per cent solutions. A single application produces, within one minute, an anesthesia sufficient to permit the removal of superficially placed foreign bodies, the application of irritant astringents and the use of the tonometer. Four instillations, three minutes apart, permit operative work within five minutes after the last instillation, producing an anesthesia sufficient to perform all of the commoner operations on the eye. In nose and throat work, solutions of from 2 to 5 per cent are usually employed. Butyn solutions may be sterilized by boiling.

Manufactured by The Abbott Laboratories.

Novocain Base, N. N. R.—*Procaine Base*—Para-amino-benzoxydiethylamino-ethane—$C_6H_4.NH_2COO.C_2H_4.N(C_2H_5)_2$—The base contained in procaine.

A white, odorless, granular powder; permanent in air; insoluble in water; soluble in alcohol, ether, chloroform, and benzene; also soluble in fixed and volatile oils.

Uses and dose—The same as those for procaine hydrochloride. Because of its solubility in oil, it is suitable for an oil spray. A 10 per cent solution in expressed almond oil may be used.

Manufactured by H. A. Metz Laboratories, Inc.

Phenacaine, N. N. R.—*Phenacaina*—Holocaine Hydrochloride—Ethenyl-Paradiethoxy-Diphenyl-Amidine Hydrochloride—$CH_3C:-(NC_6H_4OC_2H_5).(NH.C_6H_4OC_2H_5).HCl.H_2O$—The hydrochloride of phenetidyl-acetphenetidin, a basic condensation product of paraphenetidin (para-ethoxy-amino-benzene) and acetparaphenetidin (phenacetin). Phenacine was first introduced as holocaine hydrochloride.

Small, colorless crystals; odorless; faintly bitter and producing transient numbness on the tongue; permanent in the air.

Phenacaine is soluble in about 50 parts of water; freely soluble in alcohol and in chloroform; insoluble in ether. On boiling in glass vessels, the aqueous solution becomes turbid owing to a separation of a small quantity of the free base by the alkali derived from the glass. Phenacaine forms a clear, colorless solution in water, the solution having a neutral or faintly alkaline reaction on litmus.

Uses—Phenacaine is a local anesthetic like cocaine but having the advantage of a quicker effect. Five minims of a 1 per cent solution when instilled into the eye are usually sufficient to cause anesthesia in from one to ten minutes. This is preceded by temporary smarting.

Dose—It is applied in a 1 per cent aqueous solution. Phenacaine is incompatible with alkalies and their carbonates and the usual alkaloidal reagents. Glass vessels should be avoided in preparing the solution, porcelain being used instead. The solutions are permanent, as the drug is itself antiseptic. They are not injured by boiling.

Manufactured by H. A. Metz Laboratories, Inc.

Procaine Nitrate, N. N. R.—*Procainæ Nitras*—$C_6H_4.NH_2COO.C_2H_4.N(C_2H_5)_2.HNO_3$—1-para-aminobenzoyl-2-diethyl-amino ethanol mononitrate; para-aminobenzoxydiethylamino ethane mononitrate; β-diethylaminoethyl-*p*-amino benzoate mononitrate.

In small colorless and odorless crystals, soluble in water and alcohol. The aqueous solution is neutral in reaction.

Uses—The same as those of procaine. It may be prescribed in combination with silver salts, with which it forms no precipitate.

Dose—Used in 3 per cent solutions.

Manufactured by H. A. Metz Laboratories, Inc.

Saligenin, N. N. R.—*Saligeninum*—Salicyl Alcohol—*o*-Hydroxy-benzyl Alcohol—1 : 2-Phenol-methylol—$C_6H_4(OH).CH_2OH$.

In white rhombohedral plates, or as a white crystalline powder, permanent in air; odor faintly aromatic; taste slightly burning, followed by a sense of numbness. Saligenin is soluble in water and chloroform; freely soluble in alcohol and ether; also soluble in the fixed and volatile oils.

Uses—Saligenin is a local anesthetic similar in action to procaine. It is said to be as effective as procaine but much less toxic; also the anesthesia produced lasts longer and for this reason the addition of epinephrine is not necessary. Weak solutions are relatively ineffective when applied to intact mucous membranes, but strong solutions (12 per cent) exert a definite numbing effect.

Dose—The same as that of procaine.

Stovaine, N. N. R.—Benzoyl-dimethylaminoethylpropanol hydrochloride; dimethylaminoethyl propylbenzoate hydrochloride—$CH_3.CH_2.C(C_6H_5COO)(CH_3)CH_2N(CH_3)_2.HCl$—The hydrochloride of 2-benzoxy-2-methyl-1-dimethylamino butane. It is closely related to alypin.

Small, brilliant scales, which melt at 175° C. It is extremely soluble in water and easily in methyl alcohol and acetic ether, but requires 5 parts of absolute alcohol for solution and is only slightly soluble in acetone. It is quite stable and its solutions may be sterilized at 115° C. without suffering decomposition. The aqueous solution is slightly acid to litmus, neutral to methyl orange. It is precipitated by all the alkaloidal reagents and is decomposed even by very dilute alkalies.

Uses—Stovaine acts as a local anesthetic. It has about the same power as cocaine, but dilates the blood vessels, whereas cocaine contracts them. It is only about one half as toxic as cocaine.

It is used as a local anesthetic.

Dose—Internally, $\frac{1}{30}$ grain (0.002 Gm.) in pill form. Locally it may be used in the eye in 4 per cent solution and applied to other mucous membranes, as in laryngology, in from 5 to 10 per cent solution. For hypodermic injections for local anesthesia it can be used in 0.75 to 1 per cent solution.

Manufactured by Poulenc Frères Company, Paris, France, and distributed by Geo. J. Wallau, Inc., New York.

Butesin, N. N. R.—*n*-butyl-para-aminobenzoate—$C_6H_4NH_2.COO(C_4H_9)$—The normal butyl ester of 4-amino-benzoic acid, $C_6H_4NH_2.COOH$.

A white, crystalline powder, odorless and tasteless. It is almost insoluble in water (about 1 in 7,000); soluble in dilute acids, alcohol, chloroform, ether and benzene; also soluble in fatty oils. Butesin is slowly hydrolyzed when boiled with water.

Uses—The actions and uses of butesin are similar to those of ethyl amino-benzoate (benzocaine), but it is claimed to be more effective.

Dose—Butesin is used as a dusting powder, either pure or diluted. It may be used in the form of troches, ointment, suppositories or dissolved in a fatty oil. Its oil solutions may be sterilized by heat.

Manufactured by The Abbott Laboratories.

Butesin Picrate, N. N. R.—Dinormalbutylparaminobenzoate-trinitrophenol.—$(C_6H_4.NH_2.COO.C_4H_9)_2.C_6H_2(NO_2)_3OH$—Compound consisting of one molecule of trinitrophenol (picric acid) and two molecules of the normal butyl ester of 4-amino benzoic acid.

A yellow, amorphous powder; odorless; taste slightly bitter. One part of butesin picrate is soluble in 1,400 parts of water; also soluble in 100 parts of cottonseed oil; soluble in alcohol, chloroform, ether and benzene.

Uses—Butesin picrate combines the anesthetic action of butesin with the antiseptic properties of trinitrophenol (picric acid). An aqueous solution of 1 : 1,400 produces immediate and complete anesthesia of the eye which lasts from ten to twenty minutes. Butesin picrate is used in the treatment of burns, ulcers and other denuded painful lesions of the skin.

Dose—For use a 1 per cent butesin picrate ointment is proposed.

Manufactured by The Abbott Laboratories.

Orthoform, N. N. R.—*Orthoform-New*—Methyl Metaaminoparaoxybenzoate—$C_6H_4.NH_2.OH.CO.O(CH_3)$, 3 : 4 : 1—The metaaminoparaoxybenzoic acid ester of methyl alcohol.

A fine, white, crystalline powder, neutral in reaction, odorless and tasteless. It is almost insoluble in water; freely soluble in alcohol; soluble in ether. It is decomposed by boiling with water or by warming with alkalies or their carbonates, into methyl alcohol and paraoxybenzoic acid or the alkali salt of it.

Uses—Orthoform is a local anesthetic, but penetrates the tissues very slowly on account of its insolubility. It has no action on the unbroken skin. It is practically non-toxic in the usual doses.

Orthoform is used internally to relieve the pain of gastric ulcer. It has been applied locally as an analgesic to wounds of every description. It has been used in dentistry, in nasal catarrh, hay fever, etc.

Dose—Internally, from 8 to 15 grains (0.5 to 1 Gm.) in emulsion; locally, in substance as a dusting-powder or mixed with lactose for insufflation, dissolved in ether and mixed with oil for pencilings, or as an ointment with wool fat, etc.

Distributed by H. A. Metz Laboratories, Inc.

CHAPTER LX

COLORING PRINCIPLES—NATURAL AND ARTIFICIAL

Coloring principles may be variously classified. They may be grouped as natural or artificial or as animal, vegetable, or mineral. Mineral colors are usually termed pigments and are of importance in the paint industry. The term pigment is also applied generically to plant colors by writers on plant chemistry. Many drugs contain coloring principles which are only incidental to their composition, their principal use being for the therapeutic effect. The green leaf drugs, such as belladonna, digitalis, etc., containing chlorophyll; certain cathartic drugs, such as rhubarb, aloes, etc., and many others are in this class. Some vegetable and animal products ordinarily classed among the drugs are used almost exclusively for coloring. Among these are cudbear, cochineal, red saunders, etc. Then there are artificial colors, usually of coal-tar origin. The number of these is very great. A few are of therapeutic value such as methylene blue and scarlet red.

It has been considered appropriate to include in this chapter such vegetable, animal and artificial products as are used primarily for their coloring effect, discussing some basic coloring constituents, and also the tests for identifying certain types of colors.

Chlorophyll is a complex organic principle found in green vegetable tissue. It originates in the cell constituents known as *chloroplasts*. The name was given to chlorophyll by Pelletier and Caventou, who first studied it. It is a mixture of two closely related substances called *chlorophyll a*, ($C_{55}H_{72}O_5N_4Mg$), and *chlorophyll b*, ($C_{55}H_{70}O_6N_4Mg$). It is insoluble in water but is soluble in certain organic solvents, particularly in ethyl alcohol and methanol.

Accompanying chlorophyll are several other coloring principles collectively known as the *carotinoids*. They are *carotin*, *xanthophyll*, and *fucoxanthin*.

Carotin ($C_{40}H_{56}$) is a hydrocarbon. It occurs largely in the carrot and in flower petals of yellow and red shades and also in green leaves. It is insoluble in water and soluble in most organic solvents, chiefly in petroleum benzin and in alcohol.

Xanthophyll ($C_{40}H_{56}O_2$) is probably an oxidation product of carotin, and may be converted into the latter by reducing agents. It is insoluble in water and in petroleum benzin, sparingly soluble in alcohol, but readily soluble in acetone. It occurs in flower petals and in green leaves.

Fucoxanthin ($C_{40}H_{54}O_6$) is a basic compound occurring chiefly in brown algæ. It is insoluble in water but soluble in methanol.

A number of other coloring principles are more or less generally distributed in the vegetable kingdom, particularly in flower petals.

They are called *anthoxanthins* and include *flavone* and *xanthone*. Flavone ($C_{15}H_{10}O_2$) yields a number of derivatives which also occur in plant tissues. Among these are *chrysin*, *quercetin*, *rhamnetin*, *morin*, and *luteolin*. *Xanthone* ($C_{13}H_8O_2$) yields *euxanthone*, *gentisin*, and *datiscetin*.

The anthoxanthins are almost insoluble in water but are dissolved by acids and by alkalies with the formation of yellow solutions.

The *anthocyanins* are plant coloring principles of a blue, red, or violet tint occurring in flowers, fruits, and leaves. Among these are *cyanin*, *idæin*, *myrtillin*, *œnin*, *delphinin*, *pelargonin*, *althæin* and *malvin*. The anthocyanins

are all glucosidal in character. The derivatives of the anthocyanins are numerous and are productive of most of the innumerable hues of flowers. The anthocyanins as well as many of the derivatives are soluble in water, alcohol, and ether and show color changes in acid and alkaline solutions which makes them valuable as indicators in some cases.

Phycoerythrin is a pigment found in red seaweed. It is soluble in water forming a rose-colored solution with a marked orange fluorescence.

There is a certain structural similarity between chlorophyll, which is an organic magnesium compound, and hemoglobin the coloring principle of the blood, which is a combination of an albuminous group with hematin ($C_{32}H_{30}FeN_4O_3$), an organic iron compound.

The coal-tar colors date from 1856 when W. H. Perkin accidentally discovered *mauveine*, usually known as *Perkin's purple*, while engaged in an unsuccessful attempt to synthesize quinine. Other discoveries along this line followed soon after, and a great industry grew up in the field of coal-tar chemistry, which in its broadest sense includes research on synthetic medicinals as well as coal-tar dyes. The earliest colors were prepared from aniline and for many years all coal-tar dyes were called aniline colors, irrespective of their origin. The coal-tar dyes include more than a dozen well defined groups among which are the *nitroso-dyes*, the *nitro-dyes*, the *azo-dyes*, the *azines*, *oxazines*, and *thiazines*, the *indigoids*, the *anthraquinones*, the *acridines*, the *quinolines*, and others. These in turn are classified as *acid dyes* and *basic dyes*, or *direct dyes* and *mordant dyes*.

Most dyes are used in coloring fabrics and for various artistic purposes. Many coal-tar dyes were originally used in foodstuffs and beverages without careful selection or discrimination between those which were harmless and those which were toxic, and without any supervision as to purity or freedom from poisonous constituents derived from their manufacture.

After the passage of the Food and Drugs Act in 1906, the U. S. Department of Agriculture established regulations by which a few colors came to be known as permitted colors. At the present time the list of permitted colors includes the following:

Red colors: *amaranth*, *ponceau*, and *erythrosine*.
Yellow colors: *naphthol yellow S*, and *tartrazine*.
Orange color: *orange I*.
Blue color: *sodium indigodisulphonate*.
Green color: *light green S. F. yellowish*.

These are only permitted to be used after certification by some competent authority that they are true to name and free from poisonous impurities. Hence the term "*certified*" and "*permitted*" *colors*. The word "permitted" is used in a restricted sense. It does not carry with it the right to use colors for purposes of deception, even though they be "permitted" colors; for all food laws have clauses prohibiting the coloring of foods and beverages in a manner so as to conceal inferiority or to give a false appearance of value.

From this small list of permitted colors, by skilful blending and mixing, may be produced all of the colors that are practical and desirable for legal use in foods, beverages, and pharmaceutical preparations.

Inasmuch as some states limit the use of coal-tar colors or prohibit their use entirely, methods of differentiating between coal-tar colors and those of vegetable or animal origin are important.

The water-soluble coal-tar dyes are either acid or basic. The basic dyes are precipitated from solution by tannin and may be dyed upon strips of pure

white wool, from neutral or slightly alkaline solution. The acid dyes are not affected by tannin and are identified by dyeing upon strips of pure white wool, from slightly acid solution. The dyed wool strips in this case may have the color removed by treatment with weak ammonia solution, when, by removal of the original wool strip and acidulation of the solution, the dyeing can be accomplished a second time upon a fresh strip of wool. This is known as the double dyeing test and serves to exclude most vegetable colors. Other tests for the detection of coal-tar colors will be found described under cudbear and carmine.

Official Vegetable or Animal Colors

COCCUS. U. S. Cochineal

Cochineal consists of the dried female insects, *Coccus cacti* Linné (Fam. *Coccidæ*), enclosing the young larvæ.

Description—Somewhat ovate in outline, convex above, concave beneath, from 3.5 to 5 mm. in length, consisting of from 9 to 12 segments; externally grayish-purple or grayish; in the shell-like, somewhat horny abdomen lie numerous larvæ less than 1 mm. in diameter; the mature larvæ with 8-jointed antennæ, 3 pairs of legs, the lower having from 6 to 8 segments, and a characteristic beak or rostrum composed of 4 thread-like parts which pair off into 2 coils; easily pulverizable; odor characteristic; taste slightly bitter.

For further description and tests, see the U. S. P. X.

U. S. P. Preparation—Tinctura Cardamomi Composita.

N. F. Preparation—Liquor Cocci; Syrupus Asari Compositus; Tinctura Kino et Opii Composita.

Cochineal owes its red color to *carminic acid* or *carmine-red*, $C_{11}H_{12}O_6$. $2H_2O$, which is present to the extent of 8 to 10 per cent. This substance may be precipitated by most metallic salts; aluminum hydroxide forms what is termed a *lake*. It is very soluble in ammonia water and advantage is taken of these facts in preparing the N. F. solution of cochineal and carmine. It contains mucilage, fat, inorganic salts, etc.

Uses—Its only use in pharmacy is to impart a bright red color to various preparations, like compound tincture of cardamom, elixirs, etc.

LIQUOR COCCI. N. F. Cochineal Color

[**Liq. Cocci**—Liquor Coccineus]

	Metric	Alternative
Cochineal, in fine powder	**65 Gm.**	2 oz. av. 74 gr.
Potassium Carbonate	**32 Gm.**	1 oz. av. 30 gr.
Alum	**32 Gm.**	1 oz. av. 30 gr.
Potassium Bitartrate	**65 Gm.**	2 oz. av. 74 gr.
Glycerin	**450 cc.**	14 fl. oz. 192 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the cochineal intimately with the potassium carbonate, then add 500 cc. [1 pint] of water, followed by the alum and potassium bitartrate, successively. Heat the mixture slowly to boiling, in a capacious vessel, set it aside to cool, then add the glycerin and filter the mixture, passing enough water through the filter to make the finished product measure 1000 cc. [2 pints].

Cochineal color is a very brilliant red solution, having a somewhat aromatic odor.

Add 1 cc. of the Solution to 500 cc. of water: a very bright scarlet solution results which darkens upon the addition of ammonia water.

To a mixture of 10 cc. of the Solution and 40 cc. of water, add 1 cc. of diluted hydrochloric acid; immerse in the mixture a piece of white woolen cloth about 2 inches square. Boil the solution for 15 minutes, then remove the cloth, wash it thoroughly in cold water, and place it in a solution of about 20 cc. of water and 1 cc. of ammonia water and gently heat for 15 minutes. Remove the cloth and place a new piece of cloth of the same size in the solution, dilute it to 50 cc., acidify with 2 cc. of diluted hydrochloric acid, and boil for 10 minutes. The second piece of cloth should not be dyed a distinct red color (*coal-tar dyes*).

CARMINUM. N. F. Carmine

[Carmin.]

The aluminum lake of the coloring principle obtained from cochineal. Preserve it in well-stoppered, amber-colored bottles, protected from light.

Preparation—It is prepared from cochineal (see Coccus, page 842).

Official Description—It occurs in irregular, angular, bright red fragments or as a powder. When burned, Carmine emits an odor resembling that of burned feathers.

Odor and Taste—Without odor or taste.

Solubility—Slightly soluble in water to which it imparts a red color; freely soluble in ammonia water and alkaline liquids, forming a dark purplish-red solution.

Tests for Identity—The yield of ash does not exceed 12 per cent.

Impurities and Tests for Impurities—*Tin, Lead, and Soluble Barium Compounds*—Fuse the ash of 1 Gm. of Carmine with 1 Gm. of sodium cyanide, dissolve the fused mass in hydrochloric acid with the addition of a few drops of nitric acid, then dilute it with distilled water to 30 cc. and filter the solution. Separate portions of 10 cc. each of this solution yield no precipitate with hydrogen sulphide T.S. or with sulphuric acid.

Barium Sulphate—Fuse the ash from 1 Gm. of Carmine with a mixture of 1 Gm. of sodium cyanide and 1 Gm. of potassium carbonate, extract the fused mass with boiling distilled water, filter, wash with hot distilled water and dissolve the residue in diluted hydrochloric acid; this solution does not become turbid on the addition of a few drops of sulphuric acid.

N. F. Preparations—Liquor Carmini; Trochisci Phenolphthaleinum.

Uses—It is used exclusively as a red coloring substance. Often used in dental preparations, ointments, and in making cakes and candies. To obtain the maximum color value from the carmine, it should be dissolved in a small amount of strong ammonia water and the solution triturated with the powder to be colored, or, preferably, the N. F. solution may be used. Because of its cost and also because of its lack of permanence, it is now largely replaced in dentifrices and perfumes by aniline dyes.

LIQUOR CARMINI. N. F. Solution of Carmine

[Liq. Carmin.]

	Metric	Alternative
Carmine	**65 Gm.**	2 oz av. 74 gr.
Ammonia Water	**365 cc.**	11 fl. oz. 326 min.
Glycerin	**365 cc.**	11 fl. oz. 326 min.
Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the carmine to a fine powder, gradually add the ammonia water, and afterwards the glycerin, with constant trituration. Transfer the mixture to a porcelain dish and heat it on a water bath, constantly stirring, until the liquid is entirely free from ammoniacal odor. Then cool the liquid and add sufficient water to make the finished product measure 1000 cc. [2 pints].

Solution of Carmine is a deep reddish liquid free from ammoniacal odor.

Specific gravity: about 1.116 at 25° C.

Evaporate 10 cc. of the Solution at a temperature not exceeding 100° C., it leaves not more than 4.972 Gm. of a thick viscous residue. Incinerate the residue from 10 cc. of the Solution; it leaves not more than 0.046 Gm. of ash.

Dilute 5 cc. of the solution with 100 cc. of water. Lead Acetate T.S. will precipitate the carmine leaving at most a faintly pink, transparent, supernatant liquid.

To 10 cc. of the solution in a beaker, add 10 cc. of dilute sulphuric acid and 50 cc. of water. Add a small piece of white woolen cloth and boil for a few minutes. Remove the fabric and boil first in a very dilute solution of hydrochloric acid and then in water until free from acid. Then remove the color from the fabric by boiling in a weak ammoniacal solution. Now remove the cloth from the solution, and acidulate the latter with hydrochloric acid. Introduce a fresh piece of fabric in this solution and boil. No stain forms upon the fabric (*absence of coal-tar dyes*).

SANTALUM RUBRUM. U. S. Red Saunders

[Santal. Rub.]

Red Saunders is the heart-wood of *Pterocarpus santalinus* Linné filius (Fam. *Leguminosæ*).

Description—Usually in the form of a coarse powder, of a purplish to brownish-red color and nearly odorless and tasteless.

For further description and tests see the U. S. P. X.

U. S. P. Preparations—Tinctura Lavandulæ Composita; Liquor Potassii Arsenitis (from Compound Tincture of Lavender).

Uses—This wood contains *santalic acid* (*santalin*), a resinous substance, *pterocarpin*, and *santal*. It is used solely as a red coloring.

CARAMEL. N.F. Caramel

[**Caram.**—Saccharum Ustum, Burnt Sugar Coloring]

A concentrated aqueous solution of the product obtained by heating sugar or glucose until the sweet taste is destroyed and a uniform dark-brown mass results, a small amount of alkali or alkali carbonate being added while heating (see page 897).

Description and Physical Properties—Caramel is a thick, dark brown liquid having the characteristic odor of burnt sugar and a pleasant, bitter taste.

Caramel mixes clear with water in all proportions, 1 part dissolved in 1000 parts of distilled water yielding a clear solution having a distinct sepia tint. The color of this solution is not changed and no precipitate is formed after exposure to sunlight for six hours. It is soluble in diluted alcohol but is precipitated when the alcoholic content of the solution is increased to 80 per cent by volume, or more. It is insoluble in ether, chloroform, acetone, benzene, petroleum, benzin, or oil of turpentine.

Specific gravity: not less than 1.35 at 25° C.

Spread a thin layer of Caramel on a glass plate; it appears homogeneous, reddish-brown and transparent.

Tests for Purity—No precipitate is produced in 20 cc. of an aqueous solution of Caramel (1 in 20) on the addition of 0.5 cc. of phosphoric acid.

Caramel swells when incinerated and forms a coke-like charcoal, which burns off only after prolonged heating at a high temperature, and yields not more than 8 per cent of ash.

N. F. Preparations—Elixir Ammonii Valeratis (from Compound Tincture of Cudbear); Elixir Cinchonæ Alkaloidorum (from Compound Tincture of Cudbear); Elixir Pepsini et Bismuthi (from Tincture); Elixir Strychninæ Valeratis (from Compound Tincture of Cudbear); Elixir Vanillini Compositum; Syrupus Bromidorum (from Compound Tincture); Tinctura Caramellis; Tinctura Opii et Gambir Composita; Tinctura Persionis Composita.

Uses—It is used to produce a brown color in elixirs, syrups, etc.

HÆMATOXYLON. N.F. Hematoxylon

[**Hæmatox.**—Logwood]

Hematoxylon is the heart-wood of *Hæmatoxylon campechianum* Linné (Fam. *Leguminosæ*).

It contains about 12 per cent of the crystalline substance *hematoxylin*, $C_{16}H_{14}O_6$, a colorless, sweet principle, which is reddened upon exposure to light, and turned blackish-purple upon contact with alkalies, yielding *hematëin*, $C_{16}H_{12}O_6.H_2O$ (see Reagents, Page 1534); it also contains tannin, extractive, and a little volatile oil.

Hematoxylon contains not more than 2 per cent of foreign organic matter.

Description—Usually in small chips, occasionally in billets, reddish-brown, the freshly cut surface dark yellowish-red. Odor faint, agreeable; taste sweetish, astringent.

For further description see the N. F. V.

N. F. Preparation—Extractum Hæmatoxyli.

Uses—A mild astringent; used in diarrhea. Dose, ten to thirty grains (0.6 to 2 Gm.). Hematoxylon is used as an indicator in volumetric analysis and the wood is used in the dye industry.

PERSIO. N.F. Cudbear

Cudbear is a purplish-red powder prepared from species of *Roccella* De Candolle, *Lecanora Acharius*, or other lichens.

Cudbear yields not more than 12 per cent of total ash.

Preparation—This coloring agent is prepared by boiling the lichens with water containing chalk in suspension and then concentrating the liquid in a vacuum to a specific gravity of about 1.06. The lichen residue is then dried, transferred to a large vat, mixed with twice its weight of the concentrated liquid and one-sixth its weight of ammonia water, and kept at a temperature between 25° and 30° C. for two or three months with occasional stirring. Finally the mass is dried and powdered.

Description and Tests—An aqueous or alcoholic preparation of Cudbear is of a deep red color which is rendered lighter in tint by the addition of acids, and is changed to purplish-red on the addition of alkalies.

Agitate 2 Gm. of Cudbear occasionally with 200 cc. of water during thirty minutes and then filter; the deep red-colored filtrate conforms to the following tests: Add to 5 cc. of the filtrate five drops of glacial acetic acid and boil for one minute; then add five drops of stannous chloride T.S., and boil again for one minute; the liquid is only faintly pink (*brazilwood or logwood* which produce solutions of a deep red color); add 25 Gm. of kaolin to 100 cc. of the filtrate in an Erlenmeyer flask, shake frequently during one hour and then filter; the filtrate is almost entirely decolorized in comparison with some of the original filtrate (*a number of coal-tar colors*).

N. F. Preparations—It is used to color the following: Elixir Ammonii Valeratis (from Compound Tincture); Elixir Aromaticum Rubrum; Elixir Cinchonæ Alkaloidorum (from Compound Tincture); Elixir Quininæ Valeratis et Strychninæ (from Compound Tincture); Elixir Strychninæ Valeratis (from Compound Tincture); Elixir Trium Bromidorum; Liquor Antisepticus Alkalinus; Syrupus Bromidorum (from Compound Tincture); Syrupus Phosphatum Compositus (from Tincture); Syrupus Pini Strobi Compositus; Syrupus Pini Strobi Compositus cum Morphina; Tinctura Persionis; Tinctura Persionis Composita.

Uses—It is used as a red color in elixirs, syrups, etc. (see official preparations). Because of the difficulty of extracting it with liquid solvents, and the consequent lack of uniformity in the coloring power of the tincture, the drug, in most cases, is now added directly to the preparations, and, after maceration, the preparation filtered.

Unofficial Vegetable Colors

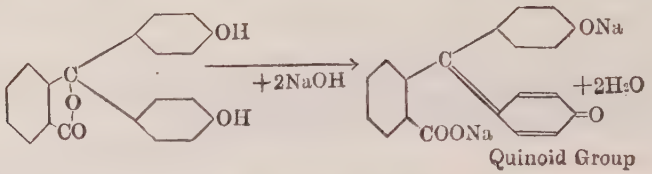
Alkanet	The root of *Anchusa tinctoria*. Used exclusively for coloring oils, ointments, and plasters, which are beautifully reddened by $\frac{1}{10}$ of their weight of the root
Annatto	A coloring substance, consisting of the pulp which surrounds the seeds in the fruit of *Bixa Orellana*. Used for coloring cheese and butter, and for dyeing silk and cotton orange-yellow
Archil	A violet dye obtained from several species of lichens especially *Roccella tinctoria*, *R. fuciformis* and *Lecanora tartarea*. It is fugitive but imparts a brilliant luster. There are three commercial forms: *archil* proper, a pasty mass, *persis*, a mass of drier character, and *cudbear*, a reddish powder (see also page 844)
Brazilwood	The heavy dyewood of *Biancaea sappan* (also known as *sapon wood*). It produces red and purple dyes. Similar wood from other tropical American trees of the species *Caesalpinia* are also sold under this name
Camwood	The hard wood of an African tree (*Baphia nitida*) used as a dye wood. It is one of the more important insoluble redwoods
Carthamus American Saffron. Safflower	Used in infusion. Made in the proportion of two drachms to a pint of boiling water
Catechu	This resin-like substance is used medicinally as an astringent (see page 1096), but is also employed in tanning and used for dyeing brown and composite shades
Fustic	A yellow dye-wood, obtained from *Chlorophora tinctoria* (L.). Gaud. (*Maclura tinctoria* D. Don.), a tree of the Fam. *Moraceæ*, growing in the West Indies and South America. It is not used in medicine or pharmacy
Indigo	This well-known and highly important dye-stuff is obtained from various species of *Indigofera* (Fam. *Leguminosæ*). It is insoluble in water or alcohol but is readily dissolved by concentrated or fuming sulphuric acid, because of the formation of monsulphindigotic and disulphindigotic acids, of which the first is difficultly soluble in water and the second easily soluble. The sodium salt of this latter constitutes the indigo-carmine of commerce. Indigo is soluble in chloroform, aniline, oil of turpentine, paraffin, phenol and benzene It is now almost exclusively produced synthetically. It is an important dye and is rarely used medicinally
Lac Dye	A crimson dye prepared from stick-lac by treating it with a weak alkaline solution and precipitating with alum. Lac is a resinous substance secreted by a scale insect (*Coccus lacca*) which lives on the banyan and other trees. The insects are extensively cultivated
Litmus	See page 1450
Madder	A European herb (*Rubia tinctorium*). The root is used in dyeing. The chief coloring principle being *alizarine*. It was known from antiquity and extensively cultivated until the discovery of a synthetic method of preparing alizarine. Alumina lake of madder is a red pigment, other lakes are prepared as madder orange, madder purple and madder yellow
Quercitron	A yellow dye stuff consisting of the crushed or rasped inner bark of certain oaks (as *Quercus Velutoria*). Quercetin, a yellow, crystalline substance, $C_{15}H_{10}O_7$, is the true dye stuff of quercetron. Quercetin also occurs in apple tree bark, horse chestnut leaves, etc.
Safflower	A dyestuff prepared from the flowerheads of *Carthamus tinctorius* and used in dyeing silk and cotton light red
Saffron	The dried stigmas of *Crocus sativus* containing a deep orange colored substance which has been used in coloring, candy, liquors, and cakes. It is rarely used today
Turmeric	An East Indian plant (*Curcuma longa*). Largely used as a condiment, especially in curry powder. Also used as a yellow dye

Coal Tar Types

The Phenolphthalein Dyes

The following description of the chemistry and therapeutic use of phenolphthalein is taken largely from the 1925 N. N. R.

Phenolphthalein—long used by chemists as an indicator before its therapeutic properties were discovered—is a condensation product of phthalic anhydride and phenol. In neutral and acid mediums it exists in a form in which there is no quinoid group, but the presence of alkali (pH = 8 to 10) causes the characteristic rearrangement with typical salt formation and the presence of a quinoid group whereby the beautiful red color is formed.



This reaction is also characteristic of other members of the series. Phenolsulphonphthalein—which chemists also use as an indicator and which is now official as a diagnostic reagent—contains an SO_2 group in place of the CO group in the phthalic anhydride nucleus. In phenoltetrachlorphthalein, the four hydrogen atoms in the benzene ring belonging to the phthalic acid nucleus have been replaced by chlorine; in tetrabromphenolphthalein, the four bromine atoms are in the phenol groups, two in each; this, it will be noted, is a different substitution than in the case of phenoltetrachlorphthalein.

PHENOLSULPHONPHTHALEINUM. U. S. Phenolsulphonphthalein

[**Phenolsulphonphthal.**—Phenol Red]

A product, $(C_6H_4OH)_2CO.C_6H_4SO_2$ (354.27), of the interaction of phenol and sulphobenzoic acid anhydride, differing from phenolphthalein in that a CO group of the latter is replaced by a SO_2 group.

Description and Physical Properties—A crystalline powder, varying in color from bright to dark red. It is stable in the air.

One Gm. of Phenolsulphonphthalein is soluble in about 1300 cc. of water, 350 cc. of alcohol, and in 500 cc. of acetone. It is almost insoluble in chloroform and ether.

Tests for Identity—It is readily soluble in solutions of alkali hydroxides and carbonates as well as in ammonia water, and in solutions of ammonium carbonate, with a color varying from deep red in concentrated solutions to a violet-tinted red in dilute solutions. The red color is changed to orange or yellow by a slight excess of acid. Its solution in alkali hydroxides is decolorized by warming with zinc dust.

Tests for Purity—Dried to constant weight at 110° C., Phenolsulphonphthalein loses not more than 1 per cent.

Ash: not more than 0.2 per cent.

Fill a 100 cc. glass-stoppered flask with thoroughly boiled and cooled distilled water to within a few cc. of the stopper. Add 1 cc. of an alcoholic solution of Phenolsulphonphthalein (1 in 1000) and 0.5 cc. of fiftieth-normal sodium hydroxide, stopper immediately, and mix well: a strong red color is produced (*sensitiveness*).

To about 1 Gm. of Phenolsulphonphthalein, accurately weighed, add a filtered solution of 0.5 Gm. of sodium bicarbonate in 20 cc. of distilled water. Rotate frequently during one hour, dilute to 100 cc., and let stand over night. Filter through counterbalanced filters or a Gooch crucible, wash at first with 25 cc. of a 1 per cent solution of sodium bicarbonate, then with 25 cc. of distilled water, and dry to constant weight at 110° C.: the weight of the insoluble residue does not exceed 0.2 per cent.

Heat a crucible to redness, and introduce, in small portions, an intimate mixture of 0.2 Gm. of Phenolsulphonphthalein, about 0.5 Gm. of potassium nitrate, and about 0.3 Gm. of anhydrous

sodium carbonate. Maintain a red heat until the reaction ceases, boil the cooled residue for five minutes with 10 cc. of diluted sulphuric acid, filter, and wash the undissolved residue with 10 cc. of distilled water. Evaporate the filtrate and washings until sulphuric acid vapors begin to evolve: the residue dissolved in 5 cc. of distilled water meets the requirements of the test for *arsenic*, page 1512.

Uses—Phenolsulphonphthalein is used for determining the functional activity of the kidney. When injected intramuscularly or intravenously, it begins to be excreted in normal cases in from five to ten minutes. In case of a deficient functional activity, the first appearance of its secretion is delayed. In normal cases, after intramuscular injections, almost the total amount is excreted within two hours (from 60 to 80 per cent.). Failure to excrete nearly the full amount within two hours indicates a deficient functional activity, and the degree of this functional deficiency may be estimated by the proportionate amount excreted within two hours. The average normal eliminations after intravenous administration are from 35 to 45 per cent in fifteen minutes, from 50 to 65 per cent in thirty minutes, and from 65 to 80 per cent in the first hour.

Dose—One cc. of a sterile solution, containing 0.006 Gm. of phenolsulphonphthalein as the monosodium salt, is injected into the lumbar muscles. Great care must be taken that all of the solution is injected.

From twenty minutes to half an hour before administering the test, the patient is given from 200 to 400 cc. of water in order to insure free urinary secretion; otherwise delayed time of appearance may be due to lack of secretion.

Under aseptic precautions a catheter is introduced and the bladder is completely emptied, or the patient is allowed to empty it voluntarily. The time is noted, and 1 cc. of a carefully prepared solution of the phenolsulphonphthalein containing 6 mgm. to the cubic centimeter is accurately administered intramuscularly or intravenously by means of an accurately graduated syringe.

The urine is allowed to drain into a test tube in which has been placed a drop of 25 per cent sodium hydroxide solution, and the time of the appearance of the first faint pinkish tinge is noted.

In patients having no urinary obstruction, the catheter is withdrawn at the time of the appearance of the drug in the urine. If injection is made *intramuscularly*, the patient is instructed to void into a receptacle at the end of one hour and ten minutes, and into a second receptacle at the end of the second hour. If injection is made *intravenously*, the patient is instructed to void into a receptacle at the end of fifteen or thirty minutes or one hour.

When the passing of a catheter is disagreeable and no urinary retention is present, its use can be dispensed with and the time of appearance of the drug can be disregarded.

The urine collected is made alkaline with a 25 per cent solution of sodium hydroxide and then diluted to 1 liter. The solution is thoroughly mixed and a small filtered portion taken, to compare with the standard which is used for all of these estimations. Comparison is made in a colorimeter, a special form of which has been devised for this purpose.

Unofficial Phenolphthalein Dyes

Phenoltetrachlorphthalein-H. W. & D., N. N. R.—*Phenoltetrachlorphthaleinum*—A dibasic dye formed by the condensation of phenol and tetrachlorphthalic acid or its anhydride.

A pink powder; odorless; permanent in the air. It is practically insoluble in water; very soluble in acetone; soluble in alcohol, ether and glacial acetic acid; slightly soluble in chloroform, benzene and carbon disulphide. It dissolves in solutions of the alkalies and carbonates to form solutions which are deep purple when concentrated, but which change to violet-red on dilution, and in very dilute solutions assume a bluish tint (*distinction from phenolphthalein*).

Uses—Phenoltetrachlorphthalein has been used for the determination of the functional activity of the liver. It can be used, *in form of the sodium salt*, intravenously; it cannot be given subcutaneously or intramuscularly. It has been proposed that the excretion can be determined by any one of these methods:

1. The excretion of the drug in the stool.
2. The excretion of the drug in the duodenum by means of a duodenal tube.
3. Its disappearance from the blood stream.

Dose—From 0.05 to 0.4 Gm. administered in the form of the disodium salt. The solution must not be exposed unduly long, as the salt is sensitive to the action of the carbon dioxide of the atmosphere.

Manufactured by Hynson, Westcott & Dunning.

Tetrabromphenolphthalein Sodium, N. N. R.—*Tetrabromphenolphthaleini Sodium*—$NaOOC.C_6H_4C : C_6H_2Br_2O.C_6H_2Br_2ONa$—The sodium salt of a dibasic dye, tetrabromphenolphthalein. The sodium salt contains about 47 per cent of bromine.

A purple powder, odorless. It is very soluble in water; its aqueous solution has a reaction of pH = 8 to 10. It is very slightly soluble in alcohol, insoluble in ether.

Actions and Uses—Tetrabromphenolphthalein sodium is used for the roentgenologic examination of the gall bladder. Following intravenous injection, the substance appears in the gall bladder in sufficient concentration to cast shadows to the roentgen ray.

Dose—A dose of 0.1 Gm. per kilogram has been found sufficient to cast a shadow. To visualize the gall bladder in the patient, 4.5 to 5 Gm. of tetrabromphenolphthalein sodium (which has not undergone change by exposure to light) are dissolved in 35 to 40 cc. of freshly distilled water and filtered. The solution is then sterilized by heating the container in boiling water for twenty minutes. This dose is sufficient for a person weighing 125 pounds or more and should be reduced for patients weighing less. The solution is given intravenously with a syringe in two doses, one-half hour apart, in the morning before breakfast. Care should be taken not to allow extravasation on account of tissue necrosis.

Bromsulphalein-H. W. & D., N. N. R.—Disodium phenoltetrabromphthaleinsulphonate—$O.CO.C_6Br_4.C[C_6H_3(OH)SO_3Na]_2$—The disodium salt formed by the interaction of tetrabromphthalic acid (or anhydride) and phenol with subsequent sulphonation. It contains from 37 to 38 per cent of bromine.

A white, crystalline powder, soluble in water, insoluble in alcohol or acetone. The aqueous solution is almost colorless.

Uses—Bromsulphalein-H. W. & D. is used as a test of liver function; the amount remaining in the blood stream after intravenous injection, as determined colorimetrically, is considered a measure of hepatic dysfunction.

Dose—0.002 Gm. per kilogram of body weight is injected intravenously in 5 per cent aqueous solution without dilution. To carry out the test, the solution of salt may be injected into an arm vein; thirty minutes after the injection, a specimen of blood (from 4 to 5 cc.) is drawn, preferably from the opposite arm, by allowing the blood to run from the needle directly into a dry test tube; after the blood has coagulated it is centrifugalized and the serum is pipetted into two small test tubes; to one of these is added one or two drops of a 10 per cent solution of sodium hydroxide, and to the other tube, a drop of hydrochloric acid; the amount of dye present is determined by comparison with a series of standards.

Manufactured by Hynson, Westcott & Dunning.

Tetrabromophthalein Sodium (Formerly called Tetrabromphenolphthalein Sodium, see New and Non-official Remedies, 1925, p. 141.

Tetraiodophthalein Sodium, N. N. R.—*Tetraiodophthaleinis Sodium*—Tetraiodophenolphthalein Sodium—$NaOOC.C_6H_4C : C_6H_2I_2O.C_6H_2I_2ONa$—The sodium salt of a dibasic dye, tetraiodophenolphthalein. Tetraiodophthalein sodium contains not less than 53 per cent of iodine.

A dark blue, somewhat hygroscopic, crystalline powder, odorless. It is soluble in water and in alcohol. The aqueous solution (1 : 300) has a reaction of *p*H 7 to 9.

Uses—Tetraiodophthalein sodium is used for the roentgenologic examination of the gall bladder. Following the intravenous injection or, if decomposition is avoided, the oral administration, the substance appears in the normal gall bladder in sufficient concentration to cast a shadow to the roentgen ray.

Dose—To visualize the gall bladder in a patient weighing between 115 and 160 pounds, 3 Gm. of tetraiodophthalein sodium is dissolved in 24 cc., or 3.5 Gm. of tetraiodophthalein sodium is dissolved in 28 cc. of freshly distilled water; the solution is then sterilized by heating the container in boiling water for twenty minutes. For patients weighing less than 115 pounds, the amount of salt is to be reduced. The solution is injected intravenously in two doses, one-half hour apart in the mornings before breakfast. Care must be taken not to allow extravasation on account of tissue necrosis. Breakfast is omitted. At noon a glass of milk is permitted, and the evening meal is allowed as usual. Water by mouth is allowed at all times.

Tetraiodophthalein sodium may be administered orally in the form of capsules or pills coated with phenyl salicylate. The average dose is 5 Gm., administered in five capsules or pills of 1 Gm. each during the evening meal. Breakfast is omitted. Since the capsules may not be dissolved, any evidence of abnormality found by the oral method should be checked up by the intravenous method.

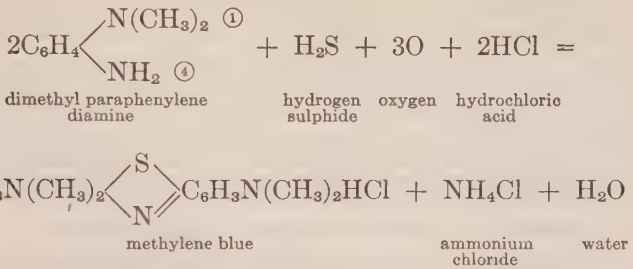
METHYLTHIONINÆ CHLORIDUM. U. S. Methylthionine Chloride

[**Methylthionin. Chlor.**—METHYLTHIONINÆ HYDROCHLORIDUM, U. S. P. IX, METHYLENE BLUE]

Tetramethylthionine chloride [$C_{16}H_{18}N_3ClS.3H_2O$ = 373.82].

Preparation—It is made by treating an acid solution of dimethylparaphenylene diamine with hydrochloric acid, hydrogen sulphide, and ferric chloride as the oxidizing agent.

The reaction is expressed thus:



Description and Physical Properties—Dark green crystals or a crystalline powder, having a bronze-like luster. It is odorless, and is stable in the air.

Methylthionine Chloride is freely soluble in water and in alcohol; soluble in chloroform, the solutions having a deep blue color.

Tests for Identity—The addition of hydrochloric acid to its aqueous solution changes the color to a lighter shade of blue. The addition of sodium hydroxide T.S. changes the color to a purplish shade, and, if added in excess, produces, on standing, a precipitate having a dull violet color.

A solution of Methylthionine Chloride in diluted sulphuric acid is gradually decolorized upon the addition of zinc dust.

Tests for Purity—Methylthionine Chloride, dried to constant weight at 110° C., loses not more than 16 per cent (*moisture*).

Ash: not more than 1 per cent.

Intimately mix 0.2 Gm. of Methylthionine Chloride with about 0.5 Gm. each of powdered potassium nitrate and anhydrous sodium carbonate, and heat the mixture in a crucible until the organic matter is completely oxidized. Dissolve the cooled residue in 15 cc. of diluted sulphuric acid, and evaporate the solution over a flame until the vapors of sulphuric acid begin to evolve: the residue so obtained meets the requirements of the test for *arsenic*, page 1512.

Heat 0.5 Gm. of Methylthionine Chloride at a temperature below a red heat until it is completely carbonized, boil the powdered residue with 10 cc. of diluted hydrochloric acid for five minutes, filter, and wash the residue with 10 cc. of distilled water. Boil the combined filtrate and washings with 1 cc. of nitric acid, supersaturate with ammonia T.S., and filter if necessary: the liquid remains clear upon the addition of an equal volume of hydrogen sulphide T.S. (*zinc*).

Dissolve 1 Gm. of Methylthionine Chloride in 50 cc. of boiling alcohol, filter through counterbalanced filters, wash the residue on the filter with boiling alcohol until the washings cease to be colored blue, and dry it at 100° C.: the weight corresponds to not more than 1 per cent (*dextrin*).

Uses—Methylene blue, as it is usually called, is used as an antiperiodic and analgesic, also in gonorrhea. Its intense and persistent color makes it a difficult substance to dispense easily. It is administered most satisfactorily in capsules, in doses of two to four grains (0.125–0.25 Gm.).

SODII INDIGOTINDISULPHONAS. U. S. Sodium Indigotindisulphonate

[Sod. Indigotin.—Indigo Carmine, Céruléine]

Chiefly the sodium salt [$C_{16}H_8O_2N_2(SO_3Na)_2 = 466.28$] of indigotindisulphonic acid.

Preparation—It may be made by adding sodium carbonate to a solution of indigotindisulphonic acid, the latter being prepared by gradually adding powdered indigo to strong sulphuric acid, keeping the mixture cold during the reaction, and washing and drying the precipitate.

Description and Physical Properties—A blue powder or a dark purple paste.

When compressed, it acquires a coppery luster.

Sodium Indigotindisulphonate is sparingly soluble in water, yielding a dark blue solution. It is almost insoluble in alcohol.

Tests for Identity—If in the form of a paste, Sodium Indigotindisulphonate should be deprived of water by drying to constant weight at 100° C. before applying the following tests:

The addition of nitric acid, bromine T.S. or chlorine T.S. to an aqueous solution of the salt (1 in 200) discharges the blue color. The blue color is also discharged by warming the solution with sodium hydroxide and zinc dust or with stannous chloride T.S.

Tests for Purity—Dissolve 1 Gm. of Sodium Indigotindisulphonate, previously dried to constant weight at 100° C., in 200 cc. of distilled water, filter the solution through counterbalanced filters or a Gooch crucible, wash the residue and the filters with distilled water until the washings cease to be colored blue, and dry at 100° C.: the residue remaining on the filter does not exceed 2 per cent.

Boil 0.2 Gm. of Sodium Indigotindisulphonate for two minutes with 10 cc. of distilled water, cool, and then agitate the solution with small portions of bromine T.S. until the blue color disappears. On now adding a few drops of potassium iodide T.S. to the liquid, no blue color is produced (*starch or starch iodide*).

Add 15 cc. of hydrogen dioxide T.S. and 10 cc. of sodium hydroxide T.S. to 0.2 Gm. of the salt, shake the mixture until the blue color disappears, evaporate the liquid to about 10 cc., cool, acidulate with hydrochloric acid and add a few drops of ferrous sulphate T.S.: no blue color is produced (*iron ferricyanide or ferrocyanide*).

U. S. P. Preparation—Toxitabellæ Hydrargyri Chloridi Corrosivi.

Uses—In the U. S. P. it is recommended as a blue coloring for "Bichloride Tablets", being preferable to other blue dyes because of its stability. It is also used as a dye and for the volumetric estimation of oxidizing agents such as nitrates and chlorine.

Unofficial Coal-Tar Dyes

The N. N. R. (1925) describes and classifies "medicinal dyes", and the following general information is from that source:

The dyes which have been introduced in medicine, for the most part in the last decade, are practically all organic synthetics. Roughly they may be divided into five classes: (1) the *azo dyes*, of which scarlet red medicinal, scarlet red sulphonate and dimazon have been in use for considerable time; (2) the *acridine dyes*, such as acriflavine, neutral acriflavine and proflavine; (3) the *fluoresceine dyes*, either as fluorescein or combined with the metal mercury, such as mercurochrome-220 soluble and flumerin; (4) the *phenolphthalein dyes*, such as phenolphthalein and phenolsulphonphthalein, which are official in the U. S. P., and the unofficial chlorine and bromine substitution products; (5) the *triphenylmethane* or *rosaniline series*, which comprise a large list of substances used in the industries, extensively in laboratory practice and more recently in medicine, such as gentian violet, crystal violet, methyl violet and fuchsin; (6) *miscellaneous dyes*, including such dyes as methylene blue and sodium indigotindisulphonate of the U. S. P. Much confusion has existed concerning the composition of dyes, various manufacturers of commercial dyestuffs making similar dyes of varying composition both qualitatively and quantitatively; usually the commercial dye contains a diluent, such as dextrin or salts, and is judged by tinctorial power. In order to obtain comparable results when employed clinically, the dyes should be of constant composition, preferably without diluent.

The Azo Dyes

The azo dyes have been used in medicine for many years—more generally recalled under the name "scarlet R". The exact constitution of the "scarlet R" dyes which have been used seems to have varied in minor details with different investigators. Chemically they have been azo compounds (that is, they contain the linkage —N : N—) combined with betanaphthol. In the N. N. R., a distinction between two scarlet R compounds has been made; scarlet R medicinal Biebrich is described as toluylazotoluylazo-betanaphthol; scarlet red sulphonate is described as the sodium salt of azobenzenedisulphonic acid azobetanaphthol; it differs from the former in that the methyl group (CH_3—) of toluyl radicles has been replaced by sodium sulphonate (—SO_3Na) groups.

In addition to the scarlet R compounds is the chemically related diacetylamido-azotoluene (dimazon); this contains only one azo group and has a diacetylamido [$(CH_3CO)_2N$—] group.

Scarlet Red Medicinal Biebrich, N. N. R.—*Rubrum Scarlatinum*—Toluylazotoluylazo-β-naphthol —$CH_3C_6H_4N : NC_6H_3.CH_3N : N.C_{10}H_5.OH$—A compound of betanaphthol and diazotized amido-azo-ortho-toluol.

A dark, brownish-red powder, nearly insoluble in water, slightly soluble in benzene and acetone and easily soluble in chloroform, oils, fats and phenols. It is slightly soluble in cold alcohol, somewhat more soluble in hot alcohol, while warm petrolatum and paraffin dissolve rather large quantities.

Uses—Scarlet red medicinal Biebrich and scarlet red sulphonate have a marked power of stimulating the proliferation of epithelial cells. They are used to promote the growth of epithelium in the treatment of burns, wounds, chronic ulcers, etc. In chronic ulcers, however, it is requisite that the local circulation be good in order to obtain a permanent result.

Dose—The scarlet red preparations are generally used in the form of an ointment containing from 4 to 8 per cent of the substance. The 8 per cent ointment is somewhat irritating and should be alternated with a soothing ointment.

Scarlet Red Sulphonate, N. N. R.—The sodium salt of azo benzene disulphonic acid azobetanaphthol —$C_6H_4.(SO_3Na)N : N.C_6H_3.(SO_3Na).N : N.C_{10}H_6OH$.

A dark, brownish-red powder; odorless. It is soluble in water; slightly soluble in ether, alcohol and acetone; almost insoluble in chloroform, benzene, fixed oils, fats and petrolatum.

Uses and dose—The same as for scarlet red medicinal.

Dimazon, N. N. R.—Diacetylamidoazotoluene—$CH_3.C_6H_4.N : N.C_6H_3(CH_3)N(CH_3CO)_2$.

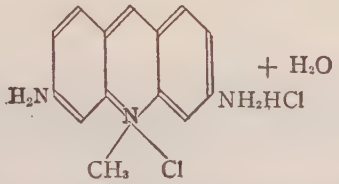
Dimazon is prepared by the acetylization of amido-azotoluene. It is an orange colored, crystalline powder, insoluble in water but readily soluble in alcohol, ether, chloroform, acetone and benzene, oils, fats and petrolatum. It can be removed from cloth by washing with soap and water. It melts at 75° C.

Uses—Dimazon is generally used in the form of a 2 per cent ointment; it is also employed as a dusting powder (mixed with talcum) or as a solution (in oil).

The Acridine Dyes

The acridine derivatives are mostly yellow dyes—acridine dyes obtained from coal tar—to which the term "flavine" has been applied ("flavine" should more correctly be applied to a vegetable coloring matter). The representative acridine dyes used in medicine are acriflavine, neutral acriflavine, and proflavine. In 1912, Ehrlich found that the acridine dye, diamino-methylacridinium chloride hydrochloride, possessed therapeutic properties when used in trypanosome infections and hence he termed it *trypaflavine*. Later this substance was investigated in England, particularly in regard to its effects as a wound antiseptic, and the name "acriflavine" was applied to it. Another closely related substance, diamino-acridine monohydrogen sulphate, was studied also, to which was given the name "proflavine". A considerable number of bacteriologic and clinical reports on these substances have been published. It appears to be established that these dyes possess marked antiseptic and germicidal properties, and on this account, they have been employed in a number of pathologic conditions.

Acriflavine, N. N. R.—*Acriflavina*—3 : 6-diamino-10-methylacridinium chloride monohydrochloride; 2 : 8-diamino-10-methylacridinium chloride monohydrochloride.



A brownish-red, odorless, crystalline powder. It is soluble in about 3 parts of water and in alcohol, forming dark red solutions which fluoresce on dilution and which have a bitter taste. Nearly insoluble in ether, chloroform, liquid petrolatum, fixed oils and volatile oils.

Uses—The antiseptic action of acriflavine and proflavine does not appear to be weakened in the presence of serum. In the treatment of wounds, it is claimed that acriflavine and proflavine are comparatively free from toxic or irritant action on living tissues and that they do not inhibit appreciably the phagocytic action of the leukocytes on the healing process. Acriflavine is claimed to exert a specific bactericidal action on the gonococcus. The evidence indicates that acriflavine has a greater antiseptic action than proflavine, though the action of acriflavine is slower. Applications of acriflavine, neutral acriflavine and proflavine have been employed in the treatment of wounds, urethritis, gingivitis, gonorrheal conjunctivitis, blenorrhea, eczema, furunculosis, otitis media, and other conditions requiring the use of a germicide. When taken by mouth, the dyes tend to render the urine antiseptic provided the reaction of the secretion be alkaline. The use of neutral acriflavine rather than acriflavine has been suggested in areas where freedom from irritation (due to the acid reaction of acriflavine and proflavine) is desirable. The intravenous use of neutral acriflavine has been proposed, but critical evidence for its necessity is lacking.

Dose—In the treatment of wounds, the solution generally employed is 1 : 1000 in physiological solution of sodium chloride, although weaker solutions may be used. In suppurating wounds, this solution is used for syringing and swabbing the wound after free incision, for irrigation after providing adequate drainage, and for saturating the gauze with which the wound is finally covered. Evaporation should be prevented by protective dressing. In cavities, gauze saturated with the solution may be used as a light packing. Fresh wounds are cleansed thoroughly with the solution, and as much of the solution as possible is left in contact with the injured surfaces. Such wounds may be closed by suture and may be expected to heal by first intention.

In the treatment of open wounds, an ointment has been used which contains 1 per cent of proflavine oleate (prepared from proflavine base) in an ointment base composed of equal parts of petrolatum and calcium carbonate. A thick layer of the ointment may be spread on gauze and applied to the surface of the cleansed wound, or the ointment may be spread on the wound directly. The primary dressing need not be changed for several days.

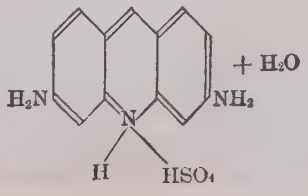
In gonorrhea, a strength of 1 : 1000 in physiological solution of sodium chloride may be used for injection into the urethra. For irrigation, when relatively large quantities are to be used, a 1 : 4000 solution is preferable because it is less irritating; solutions of from 1 : 6000 to 1 : 10,000 have been used. In throat infections a spray of 1 : 1000 solution is used. In middle ear suppurations a 1 : 500 solution in 50 per cent alcohol is dropped into the ear or the cavity may be packed with gauze wet with the solution. In gingivitis the mouth is irrigated with a 1 : 1000 solution. Solutions of acriflavine, neutral acriflavine and proflavine may be boiled, or heated in an autoclave to 130° C., without decomposition, but they are sensitive to light and should be stored in amber bottles. Solutions over a week old should be discarded.

Neutral Acriflavine, N. N. R.—*Acriflavina Neutra*—The base, 3 : 6—diamino-10-methylacridinium chloride, $C_{14}H_{14}N_3Cl + H_2O$.

A brownish-red, odorless, granular powder. It is soluble in about 3 parts of water, forming a brownish-red solution which fluoresces on dilution and which has a bitter taste; incompletely soluble in alcohol; nearly insoluble in ether, chloroform and the fixed and volatile oils. An aqueous solution of neutral acriflavine (1 : 250) is neutral to congo paper.

Uses—(See Acriflavine, preceding article).

Proflavine N. N. R.—*Proflavina*—3 : 6-diaminoacridinium monohydrogen sulphate; 2 : 8-diaminoacridinium monohydrogen sulphate.

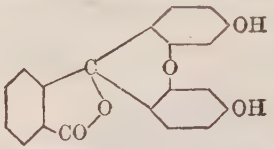


A reddish-brown, colorless, crystalline powder. It is soluble in water and in alcohol, forming brownish solutions which fluoresce on dilution, is nearly insoluble in ether, chloroform, liquid petrolatum, fixed oils and volatile oils.

Uses—(See Acriflavine, preceding article).

The Fluorescein Pyronine Dyes

Fluorescein is formed by combining resorcinol ($C_6H_4(OH)_2$) with phthalic anhydride ($C_6H_4<\begin{matrix}CO\\CO\end{matrix}>O$): at the same time water is given off yielding a product having the structural formula. The product is closely



related to phenolphthalein and its derivatives (which are described in the next section), differing chiefly in the presence of the oxygen molecule between the two ortho positions of the resorcinol nuclei. In common with the phthaleins, it forms salts with alkali whereby a rearrangement takes place and the quinoid group is formed. Flourescein is easily brominated, the tetrabrom compound being the beautiful dye eosin. Fluorescein has been combined with one molecule of mercury (—HgOH), the sodium salt of which is flumerin; in mercurochrome-220 soluble, two of the hydrogen atoms of flumerin have been replaced by two bromine atoms.

Fluorescein, N. N. R.—*Fluoresceinum—Resorcinolphthalein* (a term not strictly correct but commonly used)—Dioxyfluoran—$O : (C_6H_3OH)_2 : C.C_6H_4.COO$—The anhydride of fluoresceinic acid, $O : (C_6H_3OH)_2 : C(OH).C_6H_4(COOH)$.

Uses—The soluble sodium salt of fluorescein (fluorescein 2 Gm., sodium bicarbonate 3 Gm., water to make 100 cc.) has been used for the diagnosis of corneal lesions and the detection of minute foreign bodies embedded in the cornea.

Copper Fluorescein—This is a reddish powder used in trachoma by blowing a minute quantity into the eye. It is prepared by adding a solution of copper sulphate to a solution of fluorescein, collecting, washing and drying the precipitate. *Zinc fluorescein* has also been prepared and used for the same purpose.

The Triphenylmethane (Rosaniline) Dyes

Of the derivatives of triphenylmethane and its homologue tolyldiphenylmethane, the most interesting medicinally are those which result from the introduction of amino groups forming pararosaniline (triaminotriphenylcarbinol ($NH_2C_6H_4)_3COH$) and rosaniline (triaminodiphenyltolylcarbinol ($NH_2C_6H_4)_2(CH_3NH_2.C_6H_3).COH$). On treating rosaniline with hydrochloric acid, the hydroxyl of the carbinol group is split off, permitting the formation of a quinoid group; thus is formed a typical dye known as fuchsin, $NH_2C_6H_4.CH_3.NH_2.C_6H_3.C : C_6H_4 : NH_2.Cl$. The red color of pararosaniline chloride or fuchsin is changed to violet by the entrance of a methyl group in the amino groups, the intensity of the violet color increasing with an increasing number of methyl groups. Thus, there is the closely related gentian violet, crystal violet and methyl violet. Gentian violet is a mixture of pentamethylpararosaniline chloride and hexamethylpararosaniline chloride; by some it is defined as a mixture of methyl violet and crystal violet. Crystal violet is a relatively pure form of hexamethylpararosaniline chloride; methyl violet is considered to contain mostly pentamethylpararosaniline chloride with some of the hexa derivative and probably some tetra derivative also. Hence, one definition of gentian violet is practically the same as the other. It seems likely that in therapeutics it will be found that there is little difference between the penta and hexa derivatives and the mixtures of the two, so that the one most easily obtained in pure form (crystal violet) will be the one most used. The material which has been used by the workers so far, however, has been gentian violet.

Gentian Violet Medicinal, N. N. R.—A mixture of pentamethylpararosaniline and hexamethylpararosaniline chlorides.

A dark green ("bronze") powder or greenish glistening pieces having a metallic luster. It is soluble in alcohol or chloroform; insoluble in ether. Its solution in alcohol or chloroform has a deeper hue than the same strength aqueous solution. Concentrated sulphuric acid dissolves methyl violet with an orange to brownish-red color; on slowly diluting this solution in distilled water, the solution assumes a brown, then green and finally a blue color.

Uses—The use of gentian violet in therapeutics has recently been proposed by Churchman, who found that solutions of the dye had a selective action on certain bacteria and that the majority of gram-negative organisms survived exposure to gentian violet solutions in strengths far in excess of that required to kill gram-positive organisms; in fact, the action of the dye is sufficiently selective, so that often a "strain within a species" is not affected. Churchman's work, however, was done largely with a product containing dextrin as a diluent. Gentian violet is stated to possess properties of great penetration; to be bactericidal, also bacteriostatic in vivo toward the selective organisms. Its chief application has been in the treatment of affections of the pleural cavity and of the joints, particularly in empyema and arthritis—affections in which staphylococci, *B. pyocyaneus* and *B. diphtheriæ* are the causative agents. Intravenous injection of the dye in doses of 0.005 Gm. per kilogram of body weight causes marked cyanosis, which persists for a few hours after injection, owing to the intense color of the dye. In feeble patients, cardiac stimulants should be given. Churchman also has found that acid fuchsin (the acid sodium salt of fuchsin disulphonic and trisulphonic acids) is in some respects the opposite of that of gentian violet in selective power, a stained culture of *B. prodigiosus* being killed by the acid fuchsin, while the gram-positive *B. anthracis* would be unaffected. The selective action of acid fuchsin, however, is clearly brought out only when the organisms are exposed to the dye with slight elevation of temperature (about 50° C.). Acid fuchsin is incompatible with gentian violet, and the compatibility of all mixtures of dyes should be determined before any combination is prepared Churchman claims, however, that acriflavine possesses much the same selectivity as acid fuchsin, so he has proposed the use of a mixture of these two dyes. The effectiveness of such a solution has not yet been established clinically. None of the rosaniline dyes are strong bactericides.

Dose—For direct application, a solution of from 1 : 500 to 1 : 1000 may be employed; for instillation, a 1 : 10,000 solution. For intravenous use, Young and Hill recommend 0.005 Gm. per kilogram of body weight, injected in 0.5 per cent dilution.

Coal-Tar Dyes Largely used as Diagnostic Reagents

Azur II (Azur Blue II, Methylene-Azur II)—A mixture of equal parts of the chlorides of methylene blue (tetramethylthionine) and methylene-azur (methylene blue sulphonate). A dark green powder, entirely soluble in water with a deep blue color, less soluble in alcohol and slightly soluble in chloroform; insoluble in ether. The addition of tannic acid T.S. to an aqueous solution of azur II (1 in 1000) produces a blue precipitate. The addition of a few drops of hydrochloric acid to a mixture of 5 cc. of an aqueous solution of this dye (1 in 1000) and 0.5 Gm. of zinc dust causes decolorization. When the decolorized mixture is filtered, and solution of hydrogen dioxide is added, the deep blue color is restored (reduction to leuco base and re-oxidation). The addition of either hydrochloric acid or ammonia water to an aqueous solution of azur II (1 in 1000) produces no change. The addition of sodium hydroxide T.S. to an aqueous solution of azur II (1 in 1000) produces a violet coloration; upon heating the solution a violet precipitate is formed. The addition of potassium iodide T.S. to an aqueous solution of the dye (1 in 1000) produces a violet precipitate; the addition of potassium dichromate T.S. produces a red violet precipitate. Azur II dissolves in concentrated sulphuric acid with a bright green color [distinction from *methylene violet* (dimethylthionolin)]; upon cautiously diluting with distilled water the solution assumes a blue color, remaining clear. Acidulate an aqueous solution of azur II (1 in 1000) with a few drops of hydrochloric acid, then shake it with ether, remove the ethereal layer, and shake it with a diluted solution of sodium hydroxide T.S.; the latter remains uncolored (distinction from *azur II-eosin*).

Azur II-Eosin—A mixture of methylene blue eosin (methylene blue eosinate and methylene-azur-eosin (methylene blue sulphone-eosinate). A dark green powder only very slightly soluble in water, more readily soluble in alcohol or glycerin. A warm saturated aqueous solution of azur II-eosin (about 1 in 2000) possesses a blue color with intense shading into violet. Highly dilute solutions possess a slight, greenish opalescence. Its solutions in alcohol or glycerin possess the same color with a strong yellowish-green fluorescence. A saturated aqueous solution of azur II-eosin is precipitated upon the addition of tannic acid T.S. The addition of zinc dust and ammonia water to an aqueous solution of this dye causes decolorization. When filtered, the colorless filtrate, upon standing in the air, quickly assumes a blue color (reduction to a leuco base and reoxidation to original color). A hot, saturated and filtered, aqueous solution of azur II-eosin assumes a pale blue color upon the addition of hydrochloric acid, and the dye separates in blue floccules. If this acid solution is agitated with ether and the ethereal layer removed and shaken with diluted sodium hydroxide T.S., the latter assumes an eosin color (distinction from *azur II*). The addition of sodium hydroxide T.S. to a saturated aqueous solution of azur II-eosin intensifies its violet color. Azur II-eosin dissolves in concentrated sulphuric acid with a deep green color which, upon dilution with water, changes to a blue, a portion of the dye (eosin) separating in floccules (distinction from *azur II*).

Dimethylaminoazobenzene (Butter Yellow), $C_6H_5N : N.C_6H_4N(CH_3)_2$—It forms yellow plates melting between 115° and 117° C. It is insoluble in water, soluble in alcohol; soluble in hydrochloric acid with a red color from which solution sodium hydroxide T.S. in excess precipitates the orange-yellow base. The solution of this dye in sulphuric acid is yellow and changes to red on dilution with water.

Eosin A (Yellowish Eosin), $O[C_6H(Br_2O)_2Na]C.C_6H_4COONa$—The sodium salt of tetra-brom-fluorescein. Fine red crystals of bluish, glossy luster, or a brownish-red powder; readily soluble in water, less soluble in alcohol and insoluble in ether. A concentrated aqueous solution of eosin A has a deep brownish-red color while a dilute solution (1 in 500) is yellowish-red with a greenish fluorescence. The alcoholic solutions show a yellowish-green fluorescence. The addition of tannic acid T.S. to an aqueous solution of eosin A (1 in 500), produces no change. When about 0.5 Gm. of zinc dust, followed by 5 cc. of ammonia water, is added to 5 cc. of an aqueous solution of eosin A (1 in 500) and the mixture agitated, rapid decolorization takes place. When this mixture is filtered, the addition of solution of hydrogen dioxide to the filtrate restores the pink-color of the solution. The addition of hydrochloric acid to an aqueous solution (1 in 500) causes an orange precipitate which, upon agitating with ether, yields a yellow solution. This solution is decolorized upon agitating it with a dilute solution of an alkali. The addition of sodium hydroxide T.S. intensifies the color of an aqueous solution of eosin A (1 in 500). Eosin A dissolves in concentrated sulphuric acid (see page 1542) with a yellow color and, when this solution is cautiously diluted with distilled water, a yellowish-red precipitate is produced.

Fluorescein (Resorcinolphthalein)—A derivative [$C_{20}H_{12}O_5$ or $O(C_6H_3OH)_2C.C_6H_4COO$] of resorcinol obtained by the condensation of resorcinol and phthalic anhydride. Fluorescein occurs as a yellowish-red to dark red powder; odorless and tasteless. It is very slightly soluble in water or ether, soluble in alcohol. Fluorescein dissolves in solutions of alkali hydroxides or carbonates, forming a liquid which appears red when observed in transmitted light and fluorescent bright green in reflected light. An alkaline solution of fluorescein, even when highly diluted, shows a greenish-yellow fluorescence, which is discharged by the addition of a slight excess of acid. Incinerate 1 Gm. of fluorescein; the ash does not exceed 0.0025 Gm. Heat about 1 Gm. of fluorescein at a temperature below a red heat until it is completely carbonized, then boil the powdered residue with 10 cc. of diluted hydrochloric acid for five minutes, filter and wash the residue with 10 cc. of distilled water. The combined filtrate, when boiled with a few drops of nitric acid, and supersaturated with ammonia and filtered, if necessary, remains clear upon the addition of an equal volume of hydrogen sulphide T.S. (*zinc*). Shake about 1 Gm. of fluorescein with 20 cc. of distilled water and filter; one drop of tenth-normal sodium hydroxide V.S. imparts to 10 cc. of the filtrate a bright green fluorescence. The addition of a drop of ferric chloride T.S. to the remaining portion of the filtrate does not produce a bluish coloration (*resorcinol and various other phenolic compounds*).

Fuchsin (Basic Fuchsin, Magenta, Rubin, Rosaniline)—The hydrochloride or acetate of rosaniline (triamido-diphenyl-tolyl-carbinol) frequently with the same salts of para-rosaniline (triamido-triphenyl-carbinol). In well developed crystals or irregular crystalline fragments of a glossy, greenish-bronze luster. Soluble in water, alcohol, or amyl alcohol. An aqueous solution (1 in 500), upon the addition of tannic acid T.S., yields a red precipitate. The addition of about 0.5 Gm. of zinc dust (see page 1543), and 10 cc. of ammonia water to 10 cc. of an aqueous solution of fuchsin (1 in 500) produces decolorization when the mixture is well shaken. Place a few drops of this decolorized solution on filter paper, and then add near by a few drops of hydrochloric acid; the zone where the two neutralizing fluids meet assumes a red color. Sulphurous acid (see page 1543), when added slowly, with agitation, to an aqueous solution of fuchsin (1 in 500) causes decolorization. The original color is restored upon the subsequent addition of a solution of formaldehyde. Upon slowly adding hydrochloric acid, to an aqueous solution of fuchsin (1 in 500), the red color gradually changes to a brownish-red which subsequently changes to a yellow when the reagent is in excess. The addition of sodium hydroxide T.S. to an aqueous solution of fuchsin (1 in 500) precipitates the red colored free base. Finely pulverized fuchsin dissolves in concentrated sulphuric acid (see page 1542) with a yellow to yellowish-brown color, which solution, upon the cautious addition of distilled water, becomes yellow to colorless.

Fuchsin, Acid (Acid Magenta, Acid Rubin, Fuchsin S)—Chiefly the acid sodium salt of fuchsin di- and tri-sulphonic acids. Acid fuchsin occurs as metallic, greenish, glistening granules, or as a greenish-brown,

crystalline powder; soluble in water, forming a cherry-red solution, very slightly soluble in alcohol; insoluble in ether. The addition of tannic acid T.S. to an aqueous solution of acid fuchsin (1 in 500) produces no precipitation (*acid color*). The addition of about 0.5 Gm. of zinc dust and 5 cc. of ammonia water to 10 cc. of an aqueous solution of acid fuchsin (1 in 500) produces decolorization when the mixture is well shaken. When this mixture is filtered, the addition of hydrochloric acid to the colorless filtrate restores its original red color. This solution, when agitated with ether, imparts no color to the latter (*phthaleins*). The addition of sodium hydroxide T.S. to an aqueous solution of the salt (1 in 500) almost decolorizes the solution. The addition of hydrochloric acid to an aqueous solution (1 in 500) produces no change. It dissolves in concentrated sulphuric acid with a yellow to brownish-red color and this solution, upon the cautious addition of distilled water, changes to its original fuchsin-red color.

Methyl Violet 6B (Paris Violet 6B)—A mixture of penta- and hexa-methyl-para-rosaniline chlorides. A very dark greenish powder which dissolves readily in water or alcohol, yielding a deep violet solution. Its solution in alcohol or chloroform has a deeper blue color than the aqueous solution. Insoluble in ether. An aqueous solution of methyl violet (1 in 500) when added, drop by drop, to tannic acid T.S. forms a deep blue precipitate (*basic color*). The addition of a few drops of hydrochloric acid to a mixture of about 0.5 Gm. of zinc dust and 5 cc. of an aqueous solution of methyl violet (1 in 500) causes rapid decolorization. Place a few drops of this decolorized solution near a few drops of ammonia water on filter paper; the zone of contact assumes a blue color. Add hydrochloric acid slowly, drop by drop, with agitation, to an aqueous solution of the salt (1 in 500); the violet color gradually changes to blue-green, green, and finally to brownish-yellow, the solution remaining clear. Upon gradually diluting this solution with distilled water, the color changes take place in the reverse order. Add 5 cc. of sodium hydroxide T.S. to 5 cc. of an aqueous solution of methyl violet (1 in 500); a blue precipitate gradually forms and upon heating, the mixture becomes colorless and deposits white floccules. Concentrated sulphuric acid dissolves methyl violet with an orange to brownish-red color; upon slowly diluting this solution with distilled water, the solution assumes a brown, then green, and finally a blue color. Incinerate 1 Gm. of methyl violet; not more than 0.01 Gm. of ash remains.

Methylene Green (Mono-nitro-methylene blue, Tetra-methyl-mono-nitro-thioninchloride), $(CH_3)_2.N.C_6H_3 : N(S)C_6H_2(NO_2).N.(CH_3)_2Cl$—A very dark brown to gray-black powder; soluble in water and slightly soluble in alcohol, yielding greenish-blue solutions. An aqueous solution of methylene green (1 in 500) yields a precipitate upon the addition of tannic acid T.S. The addition of 0.5 Gm. of zinc dust and 5 cc. of ammonia water to 10 cc. of an aqueous solution of the salt (1 in 500) and warming the resulting mixture causes decolorization. Add a few drops of solution of hydrogen dioxide to the decolorized liquid, keeping the solution alkaline; a violet color is produced. The addition of hydrochloric acid to an aqueous solution of methylene green (1 in 500) produces no change; sodium hydroxide T.S. produces a violet precipitate which dissolves upon heating (distinction from *methylene blue*). Methylene green dissolves in sulphuric acid with a green color and on cautiously diluting this solution with distilled water it changes to greenish-blue.

Orange G (the sodium salt of azo-benzene-beta-naphthol disulphonic acid), $C_6H_5. : N.C_{10}H_4(OH)(SO_3Na)_2(2.6.8)$—Orange to brick-red powder, or dark red crystals; readily soluble in water, yielding an orange-yellow solution, slightly soluble in alcohol, insoluble in ether or chloroform. The addition of tannic acid T.S. to an aqueous solution of orange G (1 in 500) causes no precipitation (*acid color*). The addition of hydrochloric acid to a mixture of 0.5 Gm. of zinc dust and 10 cc. of an aqueous solution of the color (1 in 500) produces decolorization. When filtered, the colorless filtrate, on standing exposed to the air, does not regain its original color (presence of *azo group*). When heated, orange G does not deflagrate (distinction from *nitro colors*). The addition of barium or calcium chloride T.S. to a concentrated aqueous solution of orange G produces a colored, crystalline precipitate. The addition of hydrochloric acid to an aqueous solution of the dye (1 in 500) produces no change; the addition of sodium hydroxide T.S. to a similar solution produces a yellowish-red to a bordeaux color but no precipitation. Orange G dissolves in concentrated sulphuric acid with an orange to yellowish-red color; no change in color results upon diluting the solution cautiously with distilled water.

Orcin (Orcinol; Dihydroxy-methyl-benzene 1.3.5.), $C_6H_3(CH_3).(OH).(OH). + H_2O$—In the form of monoclinic prisms, white with a reddish tint, which fuse at about 58° to 60° C. Orcin has an intensely sweet and astringent taste; very soluble in hot water, less soluble in cold water, readily soluble in alcohol or ether. The anhydrous substance fuses between 106° and 108° C. Anhydrous crystals are deposited from an ether solution. When exposed to light or air the crystals assume a reddish-brown color. The addition of a few drops of ferric chloride T.S. to an aqueous solution of orcin (1 in 20) produces a deep blue color. Warm 10 cc. of an aqueous solution of orcin (1 in 10) with 10 cc. of sodium hydroxide T.S. and add a few drops of chloroform; the solution assumes a purple-red color then bright red, and, after diluting with distilled water, shows an intense, greenish-yellow fluorescence. Aqueous solutions of orcin (1 in 20) tested separately do not yield precipitates upon the addition of test solutions of mercuric chloride, cupric sulphate, tannic acid or lead acetate; with basic lead acetate T.S., a white precipitate is obtained (characteristic of *resorcinol derivatives*). Dissolve about 1.3 Gm. of orcin, accurately weighed, in sufficient distilled water to measure 1000 cc. Introduce 25 cc. of this solution, 25 cc. of tenth-normal bromine V.S., and 50 cc. of distilled water into a glass-stoppered flask of about 300 cc. capacity, and then add 25 cc. of dilute sulphuric acid T.S. After thoroughly agitating the mixture, set it aside for ten minutes, then cautiously lift the stopper, quickly introduce 2 Gm. of potassium iodide and close the flask at once. Agitate the solution and, after five minutes, determine the liberated iodine by means of tenth-normal sodium thiosulphate V.S.; conduct a blank experiment, omitting the addition of the solution of orcin and note the number of cc. of tenth-normal sodium thiosulphate V.S. consumed. The difference in cc. of tenth-normal sodium thiosulphate V.S. required in the original titration and the blank test, when multiplied by 0.002068, gives the quantity of anhydrous orcin present, which corresponds to not less than 85 per cent.

CHAPTER LXI

ORGANO-METALLIC COMPOUNDS AND ORGANIC-HALOGEN COMPOUNDS

ORGANO-METALLIC compounds are compounds in which a metal enters into definite chemical combination with or in an organic group. This classification does not include metallic salts of organic acids.

The earliest compounds of this kind to be discovered were zinc ethyl, $Zn(C_2H_5)_2$; zinc methyl, $Zn(CH_3)_2$; lead tetraethyl, $Pb(C_2H_5)_4$, etc.

The latter of these under the name tetraethyl lead has come into prominence as a "carbon knock" remover in motor fuels.

Mercury and arsenic are among the metals occurring in the compounds of therapeutic importance belonging to this class.

Official representatives of this group are the silver protein compounds and the arsenobenzoles. Mercurochrome is an unofficial example.

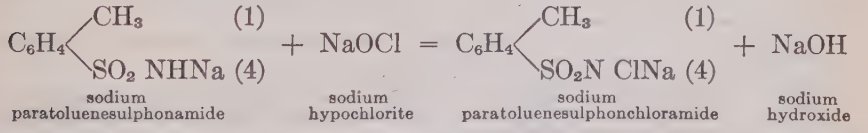
The organic halogen compounds are combinations in which a halogen element enters into intimate combination in an organic group. Chloroform, carbon tetrachloride, the chloramines, chlorinated paraffin, thymol iodide, and thyroxin are official examples of this group.

CHLORAMINA. U.S. Chloramine

[**Chloram.**—SODIUM PARATOLUENESULPHONCHLORAMIDE, CHLORAMINE-T]

Chloramine $[C_6H_4(CH_3)(SO_2NNaCl).3H_2O = 281.67]$ contains not less than 11.5 per cent and not more than 13 per cent of active chlorine.

Chloramine was introduced into medicine during the World War, by H. D. Dakin and his co-workers. It is made from toluene by converting it into p-toluene sulphonic acid. The sodium salt of this acid is then formed and the product, when treated with phosphorous pentachloride, becomes p-toluene sulphonchloride. The next step is to convert this into p-toluene sulphonamide by the action of ammonia. This compound is finally converted into sodium paratoluenesulphonchloramide, or chloramine, by the action of an alkaline solution of sodium hypochlorite, as follows:



Description and Physical Properties—White or faintly yellow crystals, or a crystalline powder, having a slight odor of chlorine. It slowly decomposes on exposure to air, losing chlorine.

One Gm. of Chloramine is soluble in about 7 cc. of water at 25° C. and in about 2 cc. of boiling water. It is decomposed by alcohol, and is insoluble in benzene, chloroform, and ether.

At about 95° to 100° C. Chloramine loses its water of crystallization without decomposition.

Tests for Identity—An aqueous solution of Chloramine (1 in 20) is alkaline to litmus paper or phenolphthalein T. S.

The addition of potassium iodide T.S. to an aqueous solution of Chloramine (1 in 20) causes the liberation of iodine, but bromine is not liberated from alkali bromides unless the mixture is acidulated with an acid (*difference from dichloramine*).

Acids produce in an aqueous solution of Chloramine (1 in 20) a white turbidity or precipitate which redissolves in an excess of alkali hydroxide solutions. When strong mineral acids are used, chlorine is also liberated.

Tests for Purity—On adding 2 cc. of sulphuric acid to 0.1 Gm. of Chloramine, chlorine is evolved but no appreciable darkening occurs (*readily carbonizable substances*).

Assay—Dissolve about 0.5 Gm. of Chloramine, accurately weighed, in 50 cc. of water, add 5 cc. of potassium iodide T.S. and 5 cc. of acetic acid, and allow the mixture to stand in a glass-stoppered bottle for ten minutes. Titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.001773 Gm. of active chlorine.

This assay is explained on page 1465.

Preserve in well-closed containers, protected from light.

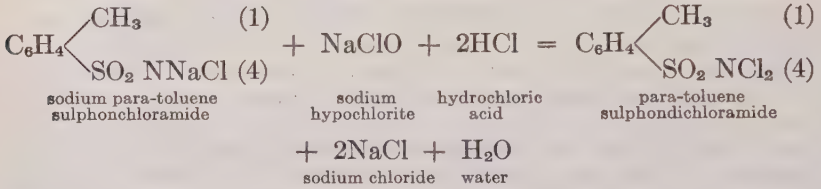
Uses—The actions of chloramine-T are essentially similar to those of surgical solution of chlorinated soda (see page 570). It has the advantages of greater stability, convenience of preparation, and produces less irritation. On the other hand, it lacks the solvent action of alkaline hypochlorites. It is practically non-toxic, but should not be used by mouth, since it is decomposed by the gastric juice. It is used in 0.1 to 4 per cent aqueous solutions. For wounds the normal strength is from 1 to 2 per cent applied by the same technic as the surgical solution of chlorinated soda. It has also been employed for irrigation of the urethra, bladder and uterus, and as a mouth wash.

DICHLORAMINA. U. S. Dichloramine

[Dichloram.—PARATOLUENESULPHONDICHLORAMIDE, DICHLORAMINE-T]

Dichloramine $[C_6H_4(CH_3)(SO_2NCl_2) = 240.08]$ contains not less than 28 per cent and not more than 30 per cent of active chlorine.

Dichloramine was introduced into medicine by H. D. Dakin and his coworkers. It may be prepared by passing chlorine through a solution of paratoluenesulphonamide in caustic soda, the two materials giving the effect of sodium hypochlorite. Upon acidification with acid the dichloramine is precipitated as follows:



Description and Physical Properties—Pale yellow crystals or a yellowish crystalline powder, having an odor of chlorine. It gradually decomposes on exposure to air, losing chlorine.

Dichloramine is almost insoluble in water. It is soluble in eucalyptol and in chlorinated paraffin hydrocarbons, also in glacial acetic acid. One Gm. is soluble in about 1 cc. of benzene or chloroform and in about 2.5 cc. of carbon tetrachloride. It is decomposed by alcohol.

Tests for Identity—Dichloramine melts at about 80° C.

Add about 0.1 Gm. of Dichloramine to 5 cc. of an aqueous solution of sodium bromide (1 in 10): bromine is liberated (*difference from chloramine*).

Strong mineral acids added to Dichloramine liberate chlorine.

Tests for Purity—One Gm. of Dichloramine dissolves completely in 5 cc. of chloroform.

Add 1 cc. of sulphuric acid to 0.1 Gm. of Dichloramine: chlorine is evolved but no appreciable darkening occurs (*readily carbonizable substances*).

Assay—Dissolve about 0.1 Gm. of Dichloramine, accurately weighed, in 20 cc. of glacial acetic acid, in a dry, glass-stoppered bottle. Add 10 cc. of potassium iodide T.S. and 50 cc. of distilled water, allow the mixture to stand for ten minutes, and titrate the liberated iodine with tenth-normal sodium thiosulphate. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.001773 Gm. of active chlorine.

This assay is explained on page 1465.

Preserve in well-closed containers, protected from light.

Uses—It is an effective germicide through its content of active chlorine. It is only sparingly soluble in water, but soluble in chlorinated eucalyptol or chlorinated paraffin. The solution produces a gradual sustained antiseptic action.

It is more irritant than chloramine, but also more solvent. It should not be administered internally.

Dichloramine is claimed to be useful in the prevention and treatment of diseases of the nose and throat; it has been used with success when applied to wounds.

Dichloramine, dissolved in chlorinated paraffin, is used in concentrations of from 0.5 to 10 per cent. In nasopharyngeal work from a 1 to 2 per cent solution is employed; for application to wounds a 5 per cent solution. The solution of dichloramine in chlorinated paraffin is not very stable and should not be kept for more than two or three days. At times the solutions may become irritating to the skin because of the formation of hydrochloric acid. Both dichloramine powder and solution should be protected from sunlight to prevent decomposition.

CHLORALIS HYDRAS. U. S. Chloral Hydrate

[Chloral. Hydr.—Chloralum Hydratum U. S. P. IX, "Chloral", Hydrated Chloral]

Chloral Hydrate contains not less than 99.5 per cent of $CCl_3CHO.H_2O = 165.41$.

Preparation—This valuable compound is made by passing dry chlorine gas, in a continuous stream, through absolute alcohol for six or eight weeks. The chlorine is led into cold alcohol at first, and when no more is absorbed the alcohol is heated at first gently and then to 60° C. When saturated, the mixture formed is agitated with sulphuric acid at a temperature of 60° C. for several hours, during which time most of the hydrochloric acid escapes. The separated chloral is then rectified over calcium carbonate. This is anhydrous chloral, a colorless liquid of a penetrating odor, of the specific gravity 1.502. The pure chloral so obtained is then mixed in glass flasks with the necessary amount of water and the resulting hydrated chloral either cast into cakes or purified by crystallization. As solvents for this purpose, certain of the side products of the chloral manufacture, after being purified, and rectified, are used—for instance, ethylene and ethylidene chloride; or, in their absence, chloroform, petroleum benzin, or carbon disulphide may be employed. The name *chloral* is derived from the first syllables of *chlor*ine and *al*cohol.

The reaction may be thus expressed:

$$\underset{\text{alcohol}}{CH_3CH_2OH} + \underset{\text{chlorine}}{2Cl} = \underset{\text{acetaldehyde}}{CH_3CHO} + \underset{\text{hydrochloric acid}}{2HCl}$$

then

$$\underset{\text{acetaldehyde}}{CH_3CHO} + \underset{\text{chlorine}}{6Cl} = \underset{\text{chloral}}{CCl_3CHO} + \underset{\text{hydrochloric acid}}{3HCl}$$

Chloral is thus seen to be acetaldehyde in which three of the atoms of hydrogen have been replaced by three atoms of chlorine; hence it is termed, in systematic nomenclature, *trichloracetaldehyde.*

Description and Physical Properties—Colorless, transparent crystals, having an aromatic, penetrating, and slightly acrid odor, and a slightly bitter, caustic taste. It slowly volatilizes when exposed to the air.

One Gm. of Chloral Hydrate is soluble in 0.25 cc. of water, 1.3 cc. of alcohol, 2 cc. of chloroform, and in 1.5 cc. of ether, at 25° C. It is very soluble in olive oil and freely soluble in oil of turpentine.

Tests for Identity—Chloral Hydrate is decomposed by caustic alkalies, alkali earths, and ammonia, chloroform and a formate of the base being produced. When warmed with a few drops of aniline and sodium hydroxide T.S., the intensely disagreeable odor of phenylisocyanide is developed.

Tests for Purity—Ash: not more than 0.05 per cent.

An alcoholic solution of Chloral Hydrate (1 in 20) does not at once redden moistened blue litmus paper, nor does it at once become opalescent on the addition of a few drops of silver nitrate T.S. (*chloride*).

Shake about 0.5 Gm. of Chloral Hydrate, at intervals of five minutes during one hour, with 5 cc. of sulphuric acid in a glass-stoppered cylinder, which has previously been rinsed with sulphuric acid: the acid remains colorless or very nearly so when viewed transversely in a tube of about 20 mm. diameter (*readily carbonizable substances*).

Gently ignite 2 Gm. of Chloral Hydrate: no inflammable vapors are evolved (*difference from chloral alcoholate*).

Assay—Dissolve about 4 Gm. of Chloral Hydrate, accurately weighed, in 10 cc. of distilled water, add 30 cc. of normal sodium hydroxide, and allow the mixture to stand for two minutes. Add phenolphthalein T.S., and determine the residual alkali at once by titration with normal sulphuric acid. Each cc. of normal sodium hydroxide corresponds to 0.1654 Gm. of $CCl_3CHO.H_2O$.

This assay is explained on page 1460.

Preserve in tightly-stoppered bottles, in a cool place, protected from light.

Uses—Chloral hydrate is used to produce sleep and to check convulsions. It is generally administered in a flavored syrup. Although chloral hydrate is freely soluble in alcohol, the latter is not a suitable solvent, because its therapeutic action is contraindicated: chloral hydrate should not be prescribed with alkalies or alkaline salts on account of its decomposition by them. Dose, 8 to 30 grains (0.5 to 2 Gm.).

CHLORAL CAMPHORATUM. N. F. Camphorated Chloral

[Chloral Camph.]

	Metric	Alternative
Chloral Hydrate	**50 Gm.**	1 oz. av.
Camphor	**50 Gm.**	1 oz. av.
To make	**100 Gm.**	2 oz. av.

Place the camphor and chloral hydrate in a suitable bottle. Stopper the bottle and warm it in a water bath, with frequent agitation, until the mixture is liquefied.

Uses—It is used as a local anodyne.

CHLOROFORMUM. U. S. Chloroform

[Chlorof.]

Chloroform contains not less than 99 per cent and not more than 99.5 per cent of $CHCl_3$ (119.39), the remainder consisting of alcohol.

Caution—Care should be taken not to vaporize Chloroform in the presence of a naked flame, because of the production of noxious gases.

Preparation—Chloroform was formerly made by mixing six parts of chlorinated lime with twenty-five parts of water and, after transferring the mixture to a still, adding one part of alcohol. Heat is applied, and when the temperature of 40° C. is reached, chloroform containing some alcohol begins to distil over. This is washed with water to separate the alcohol, and the heavy liquid is further purified by redistillation.

The reaction probably takes place in several stages according to the following equations:

$$\underset{\text{alcohol}}{C_2H_5OH} + \underset{\text{chlorinated lime}}{CaOCl_2} = \underset{\text{calcium chloride}}{CaCl_2} + \underset{\text{acetaldehyde}}{CH_3CHO} + \underset{\text{water}}{H_2O}$$

$$\underset{\text{acetaldehyde}}{CH_3CHO} + \underset{\text{chlorinated lime}}{6CaOCl_2} = \underset{\text{calcium chloride}}{3CaCl_2} + \underset{\text{calcium hydroxide}}{3Ca(OH)_2} + \underset{\text{trichlor-acetaldehyde}}{2CCl_3CHO}$$

$$\underset{\text{trichlor-acetaldehyde}}{2CCl_3CHO} + \underset{\text{calcium hydroxide}}{Ca(OH)_2} = \underset{\text{calcium formate}}{Ca(CHO_2)_2} + \underset{\text{chloroform}}{2CHCl_3}$$

Chloroform, $CHCl_3$, is termed chemically *trichlormethane*, because it represents a molecule of methane, or marsh gas, CH_4, in which three atoms of

hydrogen are substituted by three atoms of chlorine. It may also be produced by acting on hydrated chloral with an alkali; thus:

$$\underset{\text{hydrated chloral}}{C_2HCl_3O.H_2O} + \underset{\substack{\text{sodium}\\\text{hydroxide}}}{NaOH} = \underset{\text{chloroform}}{CHCl_3} + \underset{\substack{\text{sodium}\\\text{formate}}}{NaCHO_2} + \underset{\text{water}}{H_2O}$$

But chloroform is now more profitably made by reacting on acetone with chlorinated lime; the distilled acetone resulting from the decomposition of crude acetates at high temperatures may also be used. The acetone must be of a high degree of purity; the yield is sometimes nearly 200 per cent. The reaction is as follows:

$$\underset{\text{acetone}}{2CH_3COCH_3} + \underset{\substack{\text{calcium}\\\text{hypochlorite}}}{6Ca(OCl)_2} = \underset{\text{chloroform}}{2CHCl_3} + \underset{\substack{\text{calcium}\\\text{hydroxide}}}{2Ca(OH)_2} + \underset{\text{calcium acetate}}{Ca(C_2H_3O_2)_2} + \underset{\text{calcium chloride}}{3CaCl_2}$$

Absolutely pure chloroform readily decomposes upon keeping, particularly if exposed to the light, and it has long been known that the presence of a very small percentage (0.6 to 1 per cent) of alcohol will act as a preservative.

Description and Physical Properties—A clear, colorless, mobile liquid, having a characteristic, ethereal odor, and a burning, sweet taste. It is not inflammable, but its heated vapor burns with a green flame.

Chloroform is soluble in 210 volumes of water. It is miscible with alcohol, ether, benzene, petroleum benzin, and with fixed or volatile oils.

Tests for Identity—Specific gravity: 1.474 to 1.478 at 25° C.

Chloroform boils at about 61° C., but is volatile even at lower temperatures.

Tests for Purity—Evaporate 50 cc. of Chloroform in a platinum or porcelain dish on a water bath, and dry to constant weight at 100° C.: the weight of the residue does not exceed 0.001 Gm.

Pour 20 cc. of Chloroform, in small portions, upon a piece of clean, odorless, filter paper, laid flat upon a warmed glass plate, and rock the plate from side to side, until the liquid is completely evaporated: no foreign odor becomes perceptible as the last portions disappear from the paper, and the paper remains odorless.

Agitate 10 cc. of Chloroform with 25 cc. of distilled water, and allow the liquids to separate completely. The aqueous layer is neutral to litmus paper and separate portions of 10 cc. each are not affected by a few drops of silver nitrate T.S. (*chloride*), or colored blue by the addition of a few drops each of potassium iodide T.S. and starch T.S. (*free chlorine*).

Transfer 40 cc. of Chloroform to a 50 cc. glass-stoppered cylinder of colorless glass, having an internal diameter of about 20 mm. and previously rinsed with sulphuric acid, add 4 cc. of colorless sulphuric acid, and shake the mixture vigorously for five minutes. Allow the liquids to separate completely, so that both are transparent: the Chloroform remains colorless, and the acid is colorless or nearly so, when viewed transversely in the cylinder (*substances decomposable by sulphuric acid*).

Dilute 2 cc. of the sulphuric acid separated from the Chloroform in the preceding test with 5 cc. of distilled water: the liquid is colorless and clear, and while hot from the mixing emits but a faint, vinous or ethereal odor (*odorous decomposition products*). When further diluted with 10 cc. of distilled water, it remains clear, and is not affected within one minute by the addition of three drops of silver nitrate T.S. (*chlorinated decomposition products*).

Preserve in well-stoppered bottles, in a cool place, protected from light. Protect Chloroform from contact with cork stoppers by covering them with tin foil or other suitable material.

U. S. P. Preparations—Aqua Chloroformi; Linimentum Chloroformi; Pilulæ Phosphori; Spiritus Chloroformi.

N. F. Preparations—Dentilinimentum Aconiti Compositum; Dentilinimentum Aconiti et Iodi Compositum; Elixir Ammonii Valeratis; Elixir Phosphori; Elixir Terpini Hydratis et Creosoti Compositum; Linimentum Aconiti et Chloroformi; Liquor Pancreatini; Mistura Chloroformi et Morphinæ Compositæ; Mistura Opii et Chloroformi Composita; Petroxolinum Chloroformi Camphoratum; Solutio Mastiches Chloroformica Compositum; Solutio Resinæ Chloroformica; Syrupus Pini Albæ Compositus; Syrupus Pini Albæ Compositus cum Morphina.

Chloroform sometimes contains chlorinated decomposition products which render it unfit for its most important use, that of an anesthetic, and the phar-

macist should assure himself that the chloroform he sells for that purpose strictly conforms to all of the tests of the U. S. P.

Chloroform for anesthesia must be preserved in glass bottles. Metal containers are unsatisfactory.

Uses—Chloroform which corresponds to the official tests, or when purified, is used as an anesthetic by inhalation. Taken internally, in small doses, 5 to 15 minims (0.3 to 1 cc.), it is carminative. Externally it is irritant and used in liniments, it may produce blisters. The caution of the U. S. P. to avoid the use of chloroform in the presence of a naked flame is for the purpose of avoiding the development of irrespirable and irritating vapors.

It is used as a preservative in a number of preparations such as the fluid-glycerates, to prevent decomposition during the process of manufacture. In most instances it is evaporated before the product is finished.

CARBONEI TETRACHLORIDUM. U. S. Carbon Tetrachloride

[Carb. Tetrachlor.]

Tetrachlormethane [$CCl_4 = 153.85$].

Carbon tetrachloride is prepared by the action of chlorine upon carbon disulphide under the influence of a catalytic agent.

Description and Physical Properties—A clear, colorless, mobile liquid. It has a characteristic, ethereal odor, resembling that of chloroform.

It is not inflammable. It is slowly decomposed by light if moisture is present.

Carbon Tetrachloride is soluble in 2000 times its volume of water. It is miscible with alcohol, chloroform, ether, benzene, and with petroleum benzin, and dissolves most of the fixed and volatile oils.

Tests for Identity—Specific gravity: from 1.588 to 1.590 at 25° C.

Carbon Tetrachloride boils between 76° and 77° C., but volatilizes at lower temperatures.

Tests for Purity—Evaporate 50 cc. of Carbon Tetrachloride in a dish on a water bath to about 1 cc., and allow to evaporate spontaneously to dryness: the residue, if any, is odorless. Now dry at 100° C., and weigh: the weight of the residue does not exceed 0.001 Gm.

Shake 15 cc. of Carbon Tetrachloride with 25 cc. of distilled water during five minutes, and allow the liquids to separate completely: the aqueous layer is neutral to litmus paper, and 10 cc. portions are not affected by a few drops of silver nitrate T.S. (*chloride*), nor colored blue by the addition of a few drops each of potassium iodide T.S. and starch T.S. (*free chlorine*).

Warm 10 cc. of Carbon Tetrachloride with 10 cc. of a 25 per cent potassium hydroxide solution for five minutes at about 60° C. with frequent agitation: no yellow or brown color develops in either liquid (*aldehyde*).

Transfer 20 cc. of Carbon Tetrachloride to a glass-stoppered cylinder previously rinsed with sulphuric acid. Add 5 cc. of sulphuric acid, shake vigorously for five minutes, and allow the liquids to separate completely: the sulphuric acid layer is colorless or nearly so (*readily carbonizable substances*).

Mix 10 cc. of Carbon Tetrachloride with an equal volume of a 10 per cent potassium hydroxide solution in dehydrated alcohol, and allow the mixture to stand for one hour. Add 5 cc. of acetic acid, and follow with 1 cc. of copper sulphate T.S.: no yellow precipitate is formed within two hours (*carbon disulphide*).

Preserve in well-closed containers, protected from light.

Uses—Carbon Tetrachloride has narcotic and anesthetic properties somewhat similar to those of chloroform. It has recently come into use as a vermifuge in the treatment of hookworm disease. It also removes some intestinal parasites other than the hookworm such as *Oxyuris vermicularis*, *Ascaris lumbricoides* and *Trichocephalus dispar*, but it is less effective against these worms than some other drugs, such as oil of chenopodium. As a vermifuge it appears to be relatively safe, but serious symptoms and even death have been reported, especially in patients addicted to the use of alcohol. During treatment some of the patients complain of headache. Good results are obtained by administration in water or milk or in gelatin capsules on an empty stomach, followed in three hours by a purgative dose of magnesium sulphate. The capsules may be prepared extemporaneously. A mild laxative is generally given to constipated patients on the day previous to treatment. To insure complete removal of the hookworms a test dose of oil of chenopodium, 45 minims (3 cc.),

may be given a week after the treatment with carbon tetrachloride. A second dose of carbon tetrachloride should not be given within three weeks. Alcohol should not be taken during treatment.

Dose—From 30 to 45 minims (2 to 3 cc.). Children, 2 minims (0.13 cc.) for each year of age up to fifteen years. If the drug is to be given with the purgative the dose for adults is administered in 50 cc. (1½ fluidounces) of a solution of magnesium sulphate. For children the dose of the purgative is appropriately reduced. The dose of 3 cc. should not be exceeded.

Unofficial Preparation of Chlorine

Chlorbutanol, N. N. R., *Trichlor-tertiary-butyl Alcohol,* $CCl_3C(OH).CH_3.CH_3$—A white, crystalline, volatile compound having a camphoraceous odor and taste. It is slightly soluble in water ahd very soluble in alcohol.

Uses—A mild local anesthetic, and for insomnia, vomiting, and spasmodic conditions. The dose is from 5 to 20 grains (0.3 to 1.3 Gm.). A saturated aqueous solution may be used hypodermatically. It is also used as a preservative for solutions for hypodermic injection.

For further details see N. N. R., 1925. Manufactured by Parke, Davis and Company.

Unofficial Preparations of Bromine

The following synthetic organic derivatives of bromine are recognized in the N. N. R. and the descriptions given are in the main from that publication. They are intended to produce the sedative action of bromine without the objectionable effects of the alkali bromides. These compounds split off bromine ions in the system, the decomposition being due to the oxidation of the organic substance with which it is combined, but bromine which is too firmly bound may fail to exert its typical effects. The introduction of bromine into compounds already possessing hypnotic or sedative powers may result in increasing the efficiency of these.

Bromeikon, N. N. R.—*Tetrabromphenolphthalein Sodium*—The sodium salt of the dibasic dye, tetrabromphenolphthalein. It contains about 47 per cent of bromine. A purple, odorless powder; very soluble in water, but only slightly soluble in alcohol.

Uses—Tetrabromphenolphthalein Sodium is used for the roentgenologic examination of the gall bladder. For intravenous injection a solution of 4.5 to 5 Gm. in distilled water is filtered and sterilized by heat. It is then administered in two doses a half hour apart, before breakfast. For a more complete description see New and Non-official Remedies, 1925. Manufactured by the Mallinckrodt Chemical Works.

Brometone, N. N. R.—*Tribrom-Tertiary-Butylalcohol—Acetone-Bromoform*—$CBr_3.C(OH)(CH_3).CH_3$.—1,1,1-tribrom-2-methyl-propan-2-ol produced by the reaction of acetone on bromoform. Brometone is claimed to have the sedative action of the bromides without the disadvantage of producing brominism. The dose is 5 grains (0.3 Gm.) five times a day. In adults, it is claimed that it causes no unpleasant results, produces no disturbance of the digestive organs, and has no appreciable effect on the secretions.

Brometone occurs in fine, white, prismatic crystals which possess a camphoraceous odor and taste. It is slightly soluble in water, soluble in alcohol, ether, benzin and most organic solvents. It melts at about 167° C. and volatilizes on exposure to air. Manufactured by Parke, Davis and Company.

Bromipin 10 per cent, N. N. R.—Brominized Sesame Oil. A bromine addition product of sesame oil, containing from 9.8 to 11.2 per cent of bromine in organic combinations.

Bromipin acts like the inorganic bromides; but since it yields its bromine more slowly, it is thought to have less tendency to produce brominism. The combination is not broken up in the stomach; but a portion of the bromine is split off as soon as the compound enters the intestine; the remaining compound is readily absorbed, and, as in the case of other fats, it is largely deposited in the tissues where it is slowly split up. Bromipin 10 per cent is said to be more lasting in its action than the bromides.

Bromipin 10 per cent is a yellow oily liquid having an oleaginous taste.

The dose is 1 fluidrachm (4 cc.) which may be increased in cases of epilepsy to from 2 to 8 fluidrachms, (8 to 30 cc.). It may be given in emulsion with peppermint water and syrup, or pure, flavored with oil of peppermint. Marketed by Merck and Company.

Bromoform, U. S. P. IX, *Bromoformum.*—A liquid consisting of about 96 per cent by weight, of $CHBr_3$ (252.77) and about 4 per cent of dehydrated alcohol. Preserve it in glass-stoppered bottles, in a cool place, protected from light.

Bromoform may be made by the action of bromine on alcohol in the presence of alkalies or alkali hydroxides, but it is preferably made by the reaction of sodium hypobromite upon acetone, just as chloroform is made by the "acetone process"; sodium acetate and sodium hydroxide are by-products.

A heavy, transparent, colorless, mobile liquid. It has an ethereal odor, and a penetrating, sweet taste, resembling that of chloroform. Bromoform is slightly soluble in water; miscible with alcohol, chloroform, ether, benzene, petroleum benzin or fixed or volatile oils. Specific gravity—2.595 to 2.620 at 25° C.

Uses—Care should be taken in dispensing bromoform to see that it is colorless, free from acidity, and that it conforms strictly to the official tests. It is used as a remedy in whooping cough. Owing to its insolubility in water, it may be administered dissolved in alcohol in proper quantity and this solution mixed with glycerin and a flavored syrup. Dose, three minims (0.2 cc.).

Dibromin, N. N. R.—*Dibromobarbituric Acid*—A colorless powder; almost odorless, soluble in about 33 parts of water.

Uses—An antiseptic and germicide for irrigating infected wounds, nonirritating and non-toxic. Use 1 to 10,000 solutions (6 grains per gallon); gradually increase. Manufactured by Parke, Davis and Company.

Sabromin, N. N. R.—*Calbroben—Calcium Dibrombehenate* $Ca(C_{21}H_{41}Br_2.COO)_2$. Sabromin contains not less than 28.5 per cent of bromine.

Sabromin is converted in the stomach into dibrombehenic acid, and this is absorbed from the intestinal tract. The absorption and elimination are slower than that of the inorganic bromides; hence, sabromin is not adapted to conditions in which a rapid saturation of the system with bromine is required. It is indicated in conditions in which the bromides cannot be administered for continued periods without gastric disturbance or in which brominism is caused readily.

Sabromin is a yellowish-white powder; odorless and tasteless. It is insoluble in water and alcohol, but soluble in ether, chloroform, acetone, benzene, petroleum benzin and carbon tetrachloride.

Dose—The dose is 5 to 20 grains (0.3 to 1.2 Gm.)

Distributed by The Winthrop Chemical Company.

CALCII IODOBEHENAS. U. S. Calcium Iodobehenate

[Calc. Iodobehen.—Calioben, Calcium Monoiodobehenate]

Calcium Iodobehenate consists principally of calcium monoiodobehenate $[(C_{21}H_{42}ICOO)_2Ca]$ and contains, when dried to constant weight at 100° C., not less than 23.5 per cent of iodine [I].

Sajodin is one of the brand names for this product. This compound is the calcium salt of an iodine derivative of one of the higher fatty acids.

Description and Physical Properties—A white or yellowish powder, unctuous to the touch. It is odorless or has a slightly fat-like odor.

Calcium Iodobehenate is insoluble in water, very slightly soluble in alcohol and in ether, but freely soluble in warm chloroform.

Tests for Identity—When strongly heated, Calcium Iodobehenate is decomposed, with the evolution of violet vapors of iodine and of white vapors having an odor of burning fat.

Heat about 0.2 Gm. of Calcium Iodobehenate with 2 cc. of sulphuric acid on a water bath during five or ten minutes, cool, add 2 cc. of chloroform, and shake gently: the chloroform, upon separation, is colored violet.

Tests for Purity—Add 10 cc. of diluted hydrochloric acid to 1 Gm. of Calcium Iodobehenate: no effervescence occurs (*carbonate*). Add 40 cc. of distilled water, and boil gently: a layer of fatty acid which is soluble in ether and chloroform separates on the surface. Make the aqueous layer slightly alkaline with ammonia T.S., and add an excess of ammonium oxalate T.S. (about 5 cc.): a white precipitate of calcium oxalate is produced. Allow to stand for four hours, filter, evaporate the filtrate to dryness, and ignite: the residue does not exceed 0.003 Gm. (*magnesium or alkali salts*).

Dried to constant weight at 100° C., Calcium Iodobehenate loses not more than 2 per cent (*water*).

One Gm. of Calcium Iodobehenate dissolves in 10 cc. of warm chloroform with not more than an opalescence.

Triturate 1 Gm. of Calcium Iodobehenate with 10 cc. of distilled water: the mixture is neutral to litmus paper. Add 15 cc. more of distilled water, mix well during five minutes, and filter. Evaporate 10 cc. of the filtrate to dryness on a water bath, and dry to constant weight at 120° C.: the weight of the residue does not exceed 0.001 Gm. (*soluble salts*). Other 5 cc. portions of the filtrate, tested for halogens and sulphate as described under turbidimetric tests, show no greater turbidity than 0.1 cc. of fiftieth-normal hydrochloric acid or sulphuric acid, page 1520.

Add 40 cc. of tenth-normal hydrochloric acid to about 1 Gm. of Calcium Iodobehenate, previously dried to constant weight at 100° C., and accurately weighed, and boiled gently in a flask until thoroughly decomposed. Cool, and titrate the excess of acid with tenth-normal sodium hydroxide, using methyl orange T.S. as indicator: not less than 20 cc. and not more than 20.6 cc. of the tenth-normal acid is consumed.

Assay—Mix about 0.5 Gm. of Calcium Iodobehenate, previously dried to constant weight at 100° C. and accurately weighed, with about 3 Gm. of anhydrous potassium carbonate. Place the mixture in a platinum crucible, cover with about 1 Gm. more of anhydrous potassium carbonate, and heat moderately, gradually increasing the heat, but not exceeding a dull redness, until completely carbonized. Extract the residue with boiling distilled water, and wash it on the filter with boiling distilled water until the washings produce no opalescence with silver nitrate T.S. Heat the combined filtrate and washings, which measure about 150 cc., on a water bath, and add an aqueous solution of potassium permanganate (1 in 20) in small portions, until the hot liquid remains permanently pink. Add just enough alcohol to remove the pink tint, cool to room temperature, dilute to 200 cc., mix well and filter through a dry filter, rejecting the first 50 cc. of filtrate. To 100 cc. of the subsequent clear filtrate add about 1 Gm. of potassium iodide (free from iodate) and an excess of diluted sulphuric acid, and titrate the liberated iodine with tenth-normal sodium thiosulphate, adding starch T.S. near the end of the titration. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.002115 Gm. of iodine.

This assay is explained on page 1465.

Preserve in well-closed containers, protected from light.

Uses—It is used as a substitute for inorganic iodides, the claim being made that it is longer retained and therefore better utilized. The dose is eight grains (0.5 Gm.).

IODOFORMUM. U. S. Iodoform

[Iodof.]

Triiodomethane [$CHI_3 = 393.77$] usually obtained by the action of iodine upon alcohol or acetone, in the presence of an alkali or alkali carbonate.

Preparation—Iodoform may be made by Filhol's process, which consists in heating, in a water bath, one hundred parts of alcohol, two hundred parts

of sodium carbonate, and one thousand parts of distilled water, and gradually adding one hundred parts of iodine in small portions. As the solution becomes colorless iodoform subsides and can be removed by filtration. More iodoform may be obtained from the filtrate by warming, adding another portion of sodium carbonate and of alcohol and passing chlorine into the mixture to liberate iodine which has been combined with the alkali. Chlorine gas is passed through the mixture to cause the separation of the iodoform, which may be filtered out. The filtrate may be concentrated and decomposed by excess of nitric acid. The collected crystals of iodoform are now well washed with the smallest quantity of cold distilled water, spread out on pieces of bibulous paper, and dried in the open air.

The preparation of iodoform may be described by the following equations:

$$\underset{\text{ethyl alcohol}}{CH_3CH_2OH} + \underset{\text{iodine}}{I_2} = \underset{\text{acetaldehyde}}{CH_3CHO} + \underset{\text{hydriodic acid}}{2HI}$$

$$\underset{\text{acetaldehyde}}{CH_3CHO} + \underset{\text{iodine}}{3I_2} = \underset{\text{tri-iodo acetaldehyde}}{CI_3CHO} + \underset{\text{hydriodic acid}}{3HI}$$

$$\underset{\text{tri-iodo acetaldehyde}}{CI_3CHO} + \underset{\text{sodium carbonate}}{Na_2CO_3} + \underset{\text{water}}{H_2O} = \underset{\text{iodoform}}{2CHI_3} + \underset{\text{sodium formate}}{2NaCHO_2} + \underset{\text{carbon dioxide}}{CO_2}$$

The hydriodic acid formed in the first two steps is immediately changed into sodium iodide by the excess of alkali present.

$$\underset{\text{alcohol}}{C_2H_5OH} + \underset{\text{iodine}}{8I} + \underset{\text{acid potassium carbonate}}{2KHCO_3} = \underset{\text{potassium iodide}}{2KI} + \underset{\text{iodoform}}{2CHI_3} + \underset{\text{water}}{3H_2O} + \underset{\text{carbon dioxide}}{2CO_2}$$

It may also be made by adding a solution of chlorinated soda by drops to a solution of 50 Gm. of potassium iodide, 5 Gm. of sodium hydroxide, and 40 Gm. of acetone in 1000 cc. of water, and collecting the crystals of iodoform which separate.

It may be obtained in very fine powder by making a concentrated solution in alcohol, acetone, or one of its other solvents, and pouring this into water, collecting, washing, and drying the precipitate.

The specific gravity of iodoform, about which a controversy existed, was determined by J. Percy Remington to be 4.000; the specific gravity of 2.000 as given in the U. S. P., 1890, was undoubtedly due to the operator taking the specific gravity of the iodoform in water, and when this is done, it is practically impossible to free the crystals from admixed air; the result was reached by using a saturated solution of iodoform in pure kerosene as the liquid, and by calculation obtaining the equivalent in water.

Description and Physical Properties—A fine lemon-yellow powder, or lustrous crystals. It has a peculiar, very penetrating, persistent odor.

Iodoform is practically insoluble in water to which, however, it imparts its odor and taste. One Gm. of Iodoform is soluble in 60 cc. of alcohol, 80 cc. of glycerin, 10 cc. of chloroform, 7.5 cc. of ether, 2.8 cc. of carbon disulphide, and in 34 cc. of olive oil, at 25° C. One Gm. is soluble in about 16 cc. of boiling alcohol.

Iodoform is slightly volatile even at ordinary temperatures, and distils slowly with the vapor of water.

Tests for Identity and Purity—At about 115° C. it melts to a brown liquid, and at a higher temperature decomposes, emitting vapors of iodine.

Its solutions are neutral to litmus paper.

Ash: not more than 0.2 per cent.

On drying 1 Gm. of Iodoform over sulphuric acid for twenty-four hours, it loses not more than 1 per cent.

Shake about 2 Gm. of Iodoform with 5 cc. of distilled water for one minute, and filter: the filtrate is colorless and free from bitter taste (*soluble yellow coloring matter*), and does not affect the color of litmus paper (*acids or alkalies*).

Preserve in well-closed containers, in a cool place, protected from light.

U. S. P. Preparation—Unguentum Iodoformi.

N. F. Preparation—Glycerogelatinum Iodoformi.

Uses—Iodoform is used very largely as an external application to wounds and ulcers. It is also employed in suppositories for hemorrhoids and occasionally internally as an alterative. The dose is one to four grains (0.065 to 0.25 Gm.).

Unofficial Iodoform Preparations

Title	*Directions*
Collodium Iodoformi (N. F. IV)	Dissolve 5 Gm. of iodoform in 95 Gm. of flexible collodion, in a bottle, by agitation
Iodoformum Aromatisatum (N. F. IV)	Mix 96 Gm. of iodoform with 4 Gm. of coumarin
Petroxolinum Iodoformi (N. F. IV)	Dissolve 3 Gm. of iodoform in 20 Gm. of acetone, add 3 Gm. of eucalyptol, 10 Gm. of oleic acid, and 64 Gm. of liquid petroxolin, and mix thoroughly

THYMOLIS IODIDUM. U. S. Thymol Iodide

[Thymol. Iod.]

Thymol Iodide is a mixture of iodine derivatives of thymol, principally dithymol-diiodide $[(C_6H_2.CH_3.C_3H_7.OI)_2 = 550.13]$, containing, when dried to constant weight over sulphuric acid, not less than 43 per cent of iodine.

Preparation—It may be made by adding to 15 parts of thymol and 16 parts of sodium hydroxide in 300 parts of water, a solution of 60 parts of iodine and 80 parts of potassium iodide in water to make 300 parts. The resulting precipitate is washed and dried at 50° C. (122° F.).

Description and Physical Properties—A reddish-brown or reddish-yellow, bulky powder with a very slight, aromatic odor.

Thymol Iodide is insoluble in water and in glycerin; slightly soluble in alcohol; readily soluble in chloroform, ether, collodion, and in fixed or volatile oils, usually leaving a slight residue. It is insoluble in cold or in hot solutions of the fixed alkali hydroxides.

Tests for Identity—When heated with concentrated sulphuric acid, it is decomposed with the separation of iodine.

Tests for Purity—Heat about 0.5 Gm. of Thymol Iodide, accurately weighed, in a porcelain crucible until charred, cool, add five drops of sulphuric acid, and ignite to constant weight: not more than 1.5 per cent of residue remains.

Digest 0.1 Gm. of Thymol Iodide with 50 cc. of warm, distilled water for 10 minutes, filter, cool, add five drops of diluted nitric acid and 1 cc. of silver nitrate T.S.: the turbidity produced, if any, is not greater than that in a control test made with 1 cc. of a solution containing 0.002 Gm. of potassium iodide (*soluble iodides*).

Shake 0.5 Gm. of Thymol Iodide with 10 cc. of distilled water and filter the mixture: the filtrate is not alkaline to litmus paper (*alkalies*), nor is it colored blue upon the addition of a few drops of starch T.S. (*free iodine*).

Assay—Mix thoroughly about 0.25 Gm. of Thymol Iodide, previously dried to constant weight over sulphuric acid and accurately weighed, with about 3 Gm. of anhydrous potassium carbonate. Place the mixture in a platinum crucible, cover with about 1 Gm. of anhydrous potassium carbonate, and heat moderately, gradually increasing the heat, but not exceeding a dull redness, until the mass is completely carbonized. Extract the residue with boiling distilled water and wash it on a filter with boiling distilled water until the washings cease to produce an opalescence with silver nitrate T.S. Heat the combined washings, which measure about 150 cc., on a water bath, and add an aqueous solution of potassium permanganate (1 in 20) in small portions, until the hot liquid remains permanently pink. Add just enough alcohol to remove the pink tint, cool to room temperature, dilute to 200 cc., mix well, and filter through a dry filter, rejecting the first 50 cc. of filtrate. To 100 cc. of the subsequent clear filtrate, add about 1 Gm. of potassium iodide (free from iodate) and an excess of diluted sulphuric acid, and titrate the liberated iodine with tenth-normal sodium thiosulphate, adding starch T.S. near the end of the titration. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.002115 Gm. of iodine.

This assay is explained on page 1465.

Preserve in well-closed containers, protected from light.

Uses—Thymol iodide or *aristol* is used in antiseptic surgery as a substitute for iodoform as an external application to ulcerations and various skin affections. It is sometimes used as a dusting powder in nose and throat diseases.

Unofficial Complex Iodine Compounds

Iodine compounds with proteins and fats have been introduced with claims that they are less irritating to the digestive tract and that they are less inclined to produce the disagreeable symptoms of iodism.

The following preparations are recognized:

Iodalbin, N. N. R.—A compound of iodine and blood albumin, containing approximately 21.5 per cent of iodine.

When administered it passes unchanged into the intestines and is dissolved by the alkaline secretion and on absorption exerts a physiologic action similar to that of the soluble iodides. The dose is 5 to 10 grains (0.3 to 0.6 Gm.). Iodalbin is a reddish-colored powder, practically tasteless and possessing a peculiar, rather pleasant odor, suggestive of cane syrup or molasses. It is almost insoluble in water, acids, alcohol, and other ordinary solvents, but is readily soluble in strong alkaline solutions; more slowly soluble in dilute alkaline solutions.

Manufactured by Parke, Davis and Company.

Iodo-Casein—Casein Iodine, N. N. R.—A compound of iodine with milk casein, containing about 18 per cent of iodine in organic combination.

This drug undergoes practically no change in the stomach, but is said to be digested in the intestines and absorbed. Its advantage is its less rapid absorption and lack of saline taste. Dose, 5 to 20 grains (0.3 to 1.3 Gm.). Iodo-casein is a yellowish-brown powder, almost odorless and tasteless, insoluble in water, or acid solutions. It is partially dissolved and decomposed by alkalies.

Manufactured by the H. K. Mulford Company.

Iodized Fats and Fatty Acids, N. N. R.—Iodized fats and iodized fatty acids produce in general the same systemic effects as ordinary (inorganic) iodides; but their iodine is more slowly absorbed and excreted, and therefore more persistently retained in the tissues, especially in tissues rich in lipoids, such as the nervous structures.

The iodized fats and fatty acids generally pass the stomach unchanged, and are saponified and absorbed in the small intestine, like ordinary fats. They are then deposited for the most part in lipoid tissues, where they are gradually oxidized, yielding inorganic iodide, which is given off to the blood and excreted. The iodine content of the blood is thus maintained more uniformly than when inorganic iodides are administered. The official calcium iodobehenate (page 862) is representative of this class. Other preparations of the same type are as follows:

Iodipin 10 per cent, N. N. R.—*Iodized Sesame Oil 10 per cent*—An iodine addition product of sesame oil containing from 9.8 to 11.2 per cent of iodine in organic combination. It should be exposed to the light to prevent its darkening. Dose, from 1 to 2 drachms (4 to 8 Gm.). Iodipin 10 per cent is a yellow, oily liquid, having a purely oleaginous taste. It is insoluble in water.

Marketed by Merck and Company.

Iodipin 40 per cent is also available.

Iodostarine, N. N. R.—Diiodotariric acid—$C_{18}H_{32}I_2O_2$—An iodine addition product of tariric acid, $C_{18}H_{32}O_2$, derived from the fruit of a species of *Picramnia*. It contains 47.5 per cent of iodine.

The dose is the same as that of potassium iodide. Iodostarine is a white, crystalline solid, odorless and tasteless. It is insoluble in water; slightly soluble in cold alcohol; soluble in warm alcohol, ether, chloroform, benzene, and carbon disulphide. It is permanent in the air.

Manufactured by Hoffmann-LaRoche Chemical Works.

Lipoiodine, N. N. R.—Ethyl diiodobrassidate, $C_{21}H_{39}I_2COO(C_2H_5)$, the ethyl ester of diiodobrassidic acid, $CH_3.(CH_2)_7.CI:CI.(CH_2)_{11}.COOH$, containing 41 per cent of iodine. The dose is from 5 to 15 grains (0.3 to 0.9 Gm.). Lipoiodine crystallizes in white, odorless, and tasteless needles, melting at 37° C. It is insoluble in water, slightly soluble in alcohol and very soluble in fatty oils, ether, and benzene. It is decomposed by exposure to direct light.

Manufactured by the Ciba Company, Inc., New York.

Oridine, N. N. R.—The calcium salt of the iodized fatty acids of cottonseed oil. It contains from 23 to 25 per cent of iodine in organic combination. Oridine is a light brown powder, almost odorless and tasteless. It is almost insoluble in water, benzene, ether, and alcohol; slightly soluble in chloroform and carbon tetrachloride.

It is used for the prophylaxis of goiter in doses of 0.01 to 0.03 Gm. per day until 40 doses have been taken.

Manufactured by Eli Lilly and Company.

Riodine, N. N. R.—A 66 per cent solution in oil of an iodine addition product of castor oil. Riodine contains about 17 per cent of iodine. Riodine is an oil-like liquid, light amber in color, having a faint alkaline reaction. It is insoluble in water; soluble in alcohol, chloroform, and ether. Dose, from 6 to 18 grains (0.4 to 1.2 Gm.).

Distributed by George J. Wallau, Inc.

Ferro-Sajodin, N. N. R.—*Ferioben*—Ferro-sajodin is a basic, ferric iodobehenate, approximate formula $Fe(OH)(C_{21}H_{42}ICOO)_2$, which contains at least 5 per cent of iron and at least 24 per cent of iodine. Ferro-sajodin has the actions of iodides and iron. It is claimed to be more stable and palatable than ferrous iodide, not to injure the teeth or to disturb the gastro-intestinal tract, and that it is free from a constipating tendency. Ferro-sajodin is a reddish-brown, odorless and tasteless powder; unctuous to the touch; insoluble in water or alcohol; slightly soluble in chloroform, ether, and warm fatty oils.

It is indicated in the conditions in which iron and iodides are employed, such as anemia, rickets, syphilis, chronic bronchitis, and arteriosclerosis with anemia in doses from 8 to 15 grains (0.5 to 1 Gm.) daily. For children from 4 to 8 grains (0.25 to 0.5 Gm.) three times daily. Ferro-sajodin is sold in the form of tablets only. These should be masticated before swallowing or crushed when administered to children.

Distributed by The Winthrop Chemical Company, Inc.

Iodeikon, N. N. R.—*Tetraiodophthalein Sodium*—The sodium salt of a dibasic dye, tetraiodophenolphthalein. It contains not less than 53 per cent of iodine. A dark blue, odorless, hygroscopic powder. It is soluble in water and in alcohol.

Tetraiodophthalein sodium is used for the roentgenologic examination of the gall bladder.

It is injected intravenously, 45 grains (3 Gm.) in two doses, a half hour apart, in the morning before breakfast. The solution for injection is made in 24 cc. of distilled water and the solution is sterilized by heat. Tetraiodophthalein sodium is also administered orally in the form of capsules or pills coated with salol. The average dose by this method is 75 grains (5 Gm.), administered in five capsules or pills of 15 grains (1 Gm.) each, during the evening meal.

Manufactured by the Mallinckrodt Chemical Works, St. Louis.

Iothion, N. N. R.—Iopropane; Di-iodo-hydroxy-propane; 1,3-di-iodopropane-2-ol; $CH_2I.CH(OH).CH_2I$—Iothion contains from 77 to 80 per cent of iodine. Used for the systemic effect of iodides by external application. Iothion is absorbed from the intact skin. It is claimed to be practically nonirritating to the skin in the concentrations ordinarily used, and to produce no discoloration.

It is used in the form of *Iothion Oil* (10 per cent), also in solution in alcohol or glycerin, or in the form of ointments containing from 5 to 20 per cent of iothion. It is supplied without friction, and the parts are not bandaged. Iothion is a yellowish, oily liquid having a faint but not unpleasant odor. It is insoluble in water; soluble in alcohol, ether, chloroform, carbon disulphide, glycerin, and oils. It is volatile at body temperature. It is decomposed by alkalies and weakly alkaline solutions.

Distributed by The Winthrop Chemical Company.

Siomine, N. N. R.—Hexamethylenamine tetraiodide $(CH_2)_6N_4I_4$—It contains 78.5 per cent of iodine. It is decomposed in the intestine with formation of hexamethylenamine and iodide, the rate of absorption and excretion being essentially the same as that of inorganic iodides. The administration of siomine provokes the luetin reaction. Hexamethylenamine is present only to render the substance insoluble.

Siomine is a red powder, having a slight, but characteristic odor and taste. When heated to 138° C., it decomposes with violence.

Siomine is slightly soluble in acetone, alcohol, chloroform, carbon disulphide, and ether (with partial decomposition). It is almost insoluble in water, but dissolves with decomposition in aqueous solutions of alkali iodides, of sodium thiosulphate, and in diluted hydrochloric acid. The dose is the same as that of potassium iodide.

Manufactured by Howard-Holt Company.

Another extensively used product not recognized by the N. N. R., is sold under the name *Calcidin*. It is claimed to be a chemical combination of iodine with starch and calcium salts, and contains approximately 15 per cent of available iodine.

It yields iodine readily in the presence of the gastric juice and is employed in catarrhal croup in ⅓ to ½ grain doses, in hot water, repeated every five to ten minutes until relief is obtained or until from 2 to 3 grains are administered. It is also recommended in other conditions in which iodine is indicated. It is manufactured by The Abbott Laboratories.

BITUMEN SULPHONATUM. N. F. Sulphonated Bitumen [Bitum. Sulph.]

Sulphonated Bitumen contains not less than 2.5 per cent of ammonia, not more than 8 per cent of ammonium sulphate, and not less than 10 per cent of total sulphur.

Sulphonated Bitumen belongs to a class of preparations containing as their essential constituents salts or compounds of a mixture of acids containing sulphur and designated by the group name "sulphoichthyolic acid" which are obtained from certain bituminous shales. Sulphoichthyolic acid is characterized by a high sulphur content, the sulphur existing largely in the form of sulphonates, sulphones and sulphides. The ammonium compound of this so-called sulphoichthyolic acid—first introduced as ichthyol—has been used most extensively. Compounds with sodium and other metals, with albumin, with formaldehyde, etc., have also been introduced.

Description and Physical Properties—A viscous fluid obtained by the destructive distillation of certain bituminous schists, sulphonating the distillate and neutralizing the product with ammonia.

Sulphonated Bitumen is reddish-brown to brownish-black in color with a strong, characteristic, empyreumatic odor. It is soluble in water and in glycerin, and is miscible with fixed oils and fats. It is partly soluble in alcohol or ether, and entirely soluble in a mixture of equal volumes of these solvents.

An aqueous solution (1 in 10) may be faintly acid or faintly alkaline to litmus paper. The addition of hydrochloric acid to this solution precipitates a dark resinous mass which is soluble in ether.

Tests for Identity and Purity—Upon boiling an aqueous solution with sodium hydroxide T.S., ammonia is evolved.

Upon incineration, the ash of sulphonated bitumen does not exceed 0.5 per cent.

Upon drying on a water bath to constant weight, sulphonated bitumen loses not more than 50 per cent.

Assay for Ammonia—Accurately weigh about 5 Gm. of Sulphonated Bitumen, dissolve in 100 cc. of water, transfer to a distillation flask, add an excess of sodium hydroxide solution and distil slowly; collect the distillate (about 50 cc.) in 15 cc. of normal sulphuric acid. When the distillation is completed, titrate the excess of sulphuric acid with tenth-normal sodium hydroxide, using methyl orange as indicator. Each cc. of tenth-normal sulphuric acid corresponds to 0.001703 Gm. of NH_3.

This assay is explained on page 1457.

Assay for Ammonium Sulphate—Accurately weigh about 1 Gm. of Sulphonated Bitumen, transfer to a 100-cc. beaker and add 25 cc. of alcohol. Stir thoroughly, filter, and wash the filter with a mixture of equal parts of ether and alcohol until the washings are clear and colorless. Dry the residue on the filter at 105° C., cool, and wash the filter with 200 cc. of warm water slightly acidulated with hydrochloric acid. Determine the sulphate in the solution by precipitation with barium chloride T.S., and after washing, drying, igniting, and weighing, calculate the results to ammonium sulphate.

Assay for Total Sulphur—Dry about 1 Gm. of Sulphonated Bitumen, on a watch glass, to constant weight at 105° C. Pulverize the dried material and transfer about 0.5 Gm., accurately

weighed, to a nickel crucible. Add about 9 Gm. of sulphur-free sodium peroxide, and mix thoroughly. Place the crucible carefully in a beaker containing cold distilled water which should reach about half way to the top. Ignite the dry mixture in the crucible by thrusting a red hot iron wire through a hole in the cover of the crucible. After complete combustion has taken place, tip the crucible and allow the fused mass to dissolve in the distilled water. Add hydrochloric acid in slight excess, heat to boiling and determine the sulphate in the solution by precipitation with barium chloride T.S., and after washing, drying, igniting, and weighing, calculate the results to sulphur. The total sulphur should not be less than 10 per cent.

These assays are explained on page 1480.

Preparations—Collodium Bitumenis Sulphonati; Petroxolinum Bitumenis Sulphonati; Unguentum Bitumenis Sulphonati.

Uses—The current estimate of the effects of sulphoichthyolic acid preparations is based largely on the use of ichthyol. The use of sulphoichthyolate preparations is still largely empiric. They are weakly antiseptic and emollient. Taken internally, they produce some gastro-intestinal irritation, with diarrhea, etc. Dose, three grains (0.2 Gm.).

They were formerly used locally under the supposition that they secure the absorption of swellings and effusions in contusions, burns, etc., and especially in gynecologic practice, and in various skin diseases. They have been tried internally in a great variety of conditions, but there is no evidence that they are of any therapeutic value when used in this way.

A number of more or less related compounds of sulphur have been introduced as substitutes for the sulphoichthyolates under such titles as *ammonium ichthyolate* (manufactured by the Meadows Chemical Company), *hirathiol* (sold by the Takamine Laboratory, Inc.), *ichthynat* (manufactured by the Heyden Chemical Company), *isarol* (manufactured by the Ciba Company), and *ichthyol* (manufactured by Merck and Co.).

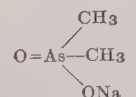
Arsenic and Arsenic Compounds

The N. N. R. (1925) presents the following interesting discussion of the complex arsenic compounds so largely used today in medicine:

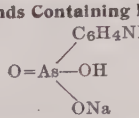
In some of the following compounds the arsenic is pentavalent; in others it is trivalent. A typical arsenic reaction results only from the trivalent arsenic, and in order to secure this action from those compounds containing pentavalent arsenic, their arsenic must be reduced to the trivalent form; this is done by the body, but the rate at which the reduction occurs varies greatly with the different compounds. In some cases, the desirable, as well as the undesirable, effects produced by these compounds are due to the arsenic which is slowly rendered active; in others the therapeutic effects may be due at least in part to the unaltered molecules. The diseases in which arsenic therapy has proved useful are particularly those caused by protozoa. Inorganic arsenic will kill protozoa, but it cannot be administered so as to reach the protozoa in fatal quantity. In the body the organic compounds are less toxic to mammals and more toxic to protozoan parasites. In this way they become available for combating trypanosomes, syphilis, spirillosis, and other protozoan infections.

Among the advantages claimed for, or known to be possessed by, these compounds the following may be mentioned: In those known to produce their effects through the liberation of arsenic, the arsenic is liberated slowly; some remain in the circulating blood for a much longer period than do inorganic arsenic compounds, and thus remain longer in contact with parasites which it is desired to kill; some are specifically etiotropic, that is, they have a much greater affinity for the parasites causing the disease than they have for the tissues of the host.

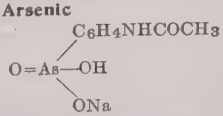
Compounds Containing Pentavalent Arsenic



sodium cacodylate



sodium arsanilate



sodium acetyl arsanilate

Arsanilic acid is derived from arsenic acid, $AsO.(OH)_3$ by replacing one hydroxyl by aniline (phenylamine) $C_6H_5NH_2$; related compounds are made by substituting derivatives of aniline.

The compounds containing pentavalent arsenic are comparatively non-toxic when introduced into the animal system until changes take place that liberate the arsenic. When they are slowly decomposed, they produce favorable effects. If the reduction takes place with greater rapidity, they may produce ordinary arsenic poisoning.

Sodium cacodylate is excreted partly unchanged and partly as cacodylic oxide, which gives a foul odor to the breath, perspiration, etc. Further changes yield products containing inorganic, trivalent arsenic, by which the therapeutic effects are produced.

Sodium arsanilate has been used chiefly against trypanosomes. This salt has no direct action on these parasites, but owes its effects to the products resulting from its reduction in the system. These products appear to be organic compounds containing the arsenic in the trivalent form. Artificial reduction products, which vary according to conditions, are much more active than the arsanilate.

Sodium arsanilate has also been recommended for the conditions which are influenced favorably by other forms of arsenic, but this salt seems to have no advantages over the official preparations of arsenic.

In poisonous doses or when excessive reduction occurs, sodium arsanilate may produce the ordinary toxic effects of arsenic. It acts with especial violence on the optic nerve, producing optic atrophy, frequently resulting in permanent blindness. This may occur unfortunately even with therapeutic doses.

Compounds Containing Trivalent Arsenic

According to Ehrlich's view, only trivalent arsenic is markedly toxic to spirochetes, trypanosomes, etc.; hence he introduced a number of such compounds. Of these only the arsphenamines, in which the toxicity is reduced or modified by the introduction into the molecules of certain groups, are listed below. These compounds have, according to Ehrlich, a special affinity to certain organisms, particularly spirochetes, while their toxicity for the higher animals is comparatively low. The exact fields of usefulness of these compounds and their limitations and also the best methods of administering them, are still under discussion.

The arsphenamines have a direct action on the protozoa and also on some bacteria (anthrax). This activity is enhanced by the presence of enzymes from the liver and especially from the blood.

The toxic actions of arsphenamine are ascribed to the arsenic component in some cases. In other cases the decomposition of the solution has been assigned as a cause. The presence of bacteria in the distilled water is believed to cause the febrile phenomena.

The ratio between etiotropic efficiency and toxicity is far more favorable in arsphenamine than in any of the other organic arsenic compounds thus far tested. Arsenic has been found in the parts infected with syphilis while absent from other localities, indicating that the efficient arsenical compounds combine with the spirochetes or their products in the tissues.

Arsphenamines are contraindicated or should be used with special caution in diseases of the eye of a nonsyphilitic character; in severe affections of the heart and blood vessels, the lungs and kidneys; and in advanced degenerative processes in the central nervous system. They should also be used with caution in infants.

In many cases of apparent toxic action of arsphenamine, the effect is due to improper technic of preparation and administration of the drug rather than to its inherent toxicity.

Arsphenamine and analogous preparations of arsenic used intravenously come under the National law covering serums, viruses, toxins and analogous products, and are subject to the same control.

ARSPHENAMINA. U. S. Arsphenamine

[**Arsphen.**—Diaminodihydroxyarsenobenzene Hydrochloride]

Arsphenamine [$HCl.NH_2.OH.C_6H_3As:AsC_6H_3.OH.NH_2HCl.2H_2O$] contains not less than 30 per cent of arsenic (As), and complies with the requirements of the United States Public Health Service.

Arsphenamine is prepared by reduction, generally with sodium hydrosulphite, of 3-nitro-4-hydroxy-phenyl-arsenic acid. The various modifications of the original method of manufacture deal with different means of obtaining this latter substance.

The manufacture of this product is under the control of the Public Health Service. Each lot manufactured must be approved by the Hygienic Laboratory before being marketed.

Description and Physical Properties—A light yellow powder. It is odorless or has a slight odor, and is hygroscopic. In the dry state or in solution it is oxidized by exposure to the air, becoming darker and more toxic.

Arsphenamine is soluble in water, alcohol, and glycerin, but only very slightly soluble in chloroform and in ether.

Tests for Identity—An aqueous solution of Arsphenamine (1 in 100) is acid to litmus paper (difference from *neoarsphenamine*).

Add sodium hydroxide T.S., drop by drop, to an aqueous solution of Arsphenamine (1 in 100). A precipitate is formed (difference from *neoarsphenamine*), which readily dissolves in an excess of the sodium hydroxide. Sodium carbonate T.S. or solution of sodium bicarbonate also produces a precipitate, but this is insoluble in an excess of the reagent. An aqueous solution of Arsphenamine (1 in 100) is precipitated by mercuric potassium iodide T.S. (difference from *neoarsphenamine*).

An aqueous solution of Arsphenamine (1 in 100) is unaffected by the addition of diluted hydrochloric acid, diluted nitric acid, or by acetic acid even after heating (difference from *neoarsphenamine*). With an excess of hydrochloric acid a precipitate is formed. Diluted sulphuric acid or solutions of alkali sulphates immediately produce a precipitate.

The addition of two drops of freshly prepared ferric chloride T.S. to 5 cc. of an aqueous solution of Arsphenamine (1 in 1000) produces a brownish, violet tinted color, rapidly changing to deep red.

Add 3 cc. of silver nitrate T.S. to 5 cc. of an aqueous solution of Arsphenamine (1 in 100). A red color is produced, but no precipitate is formed even after standing at ordinary room temperature for ten minutes (difference from *neoarsphenamine*). When a 6 cc. portion of silver nitrate T.S. is added to the same volume of solution, a precipitate is immediately formed which blackens on heating. On now adding 5 cc. of nitric acid, and again heating, the precipitate becomes white and dissolves in ammonia water.

The solution resulting from the following assay yields with hydrogen sulphide a yellow precipitate, soluble in ammonium carbonate T.S.

Assay—Place about 0.2 Gm. of Arsphenamine, accurately weighed, in a glass-stoppered, 200 to 300 cc., flask. Add 1 Gm. of finely powdered potassium permanganate and 5 cc. of diluted sulphuric acid, and allow to stand for ten minutes, rotating the contents of the flask during this time to insure thorough mixing. Add 10 cc. of concentrated sulphuric acid in portions of about 2 cc., rotating the flask after each addition. When the reaction has ceased, add sufficient hydrogen dioxide T.S. to dissolve completely the brown precipitate (about 5 to 7 cc.). Toward the end of the reaction the hydrogen dioxide is to be added, drop by drop, to avoid any great excess. Dilute with 25 cc. of distilled water, and boil gently over an asbestos wire gauze for from fifteen to twenty minutes, or until the excess of hydrogen dioxide is expelled. Dilute with 50 cc. of distilled water, and add tenth-normal potassium permanganate until the liquid is faintly pink, then discharge the pink color by the addition of a drop of tenth-normal oxalic acid. Cool the solution, add 2.5 Gm. of potassium iodide, stopper the flask tightly, and allow it to stand in a cool, dark place for one hour. Then titrate the liberated iodine with tenth-normal sodium thiosulphate without the use of starch

indicator. Make a blank test with the same quantities of the reagents, and correct the assay for the volume of tenth-normal sodium thiosulphate used in the blank. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.003748 Gm. of As.

This assay is explained on page 1466.

Preserve in sealed containers of colorless glass, from which the air has been excluded either by the production of a vacuum or by displacement with a non-oxidizing gas.

Uses—Arsphenamine is useful as a specific remedy for syphilis in all stages.

The drug is used in the spirillum affections, such as relapsing fever, frambesia, and in malaria; it is also said to be an available substitute for arsenic in the treatment of diseases of the skin and nerves, and in the anemias.

It has been employed successfully in various types of syphilitic disease of the eyes. Repeated injections should be given.

Dose—From 3 to 6 grains (0.2 to 0.4 Gm.), though 9 grains (0.6 Gm.) may be given, but the smaller doses are being more extensively used.

For children from 3 to 5 grains (0.2 to 0.3 Gm.). In infants doses of from $\frac{1}{3}$ to $1\frac{1}{2}$ grains (0.02 to 0.1 Gm.) may be used. The dose should be varied according to the strength and condition of the patient. The intravenous method is, on the whole, preferable and is especially to be recommended.

Arsphenamine is sold under various trade names such as *arsenobenzol* (Powers-Weightman-Rosengarten Company), *diarsenol* (Diarsenol Laboratories, Inc.), and *salvarsan*, or "606" (H. A. Metz Laboratories, Inc.). The technic for the preparation of the solution is given below.

An aqueous 0.5 per cent solution of arsphenamine, possessing the proper degree of alkalinity is prepared by E. R. Squibb and Sons. It is supplied in ampuls of 80 cc. and 120 cc. These ampuls should not be used after the date stamped on the label of each package or if the color has changed from a light lemon or light wine color to dark green or a blackish tint. The uses are the same as those of arsphenamine.

Solution arsphenamine-Squibb is prepared by dissolving arsphenamine in freshly distilled water, carefully alkalinizing with sodium hydroxide solution and sealing in ampuls under a partial vacuum, the concentration being adjusted so that 100 cc. of solution represents 0.5 Gm. of arsphenamine.

Solution arsphenamine-Squibb is a clear yellow liquid which varies from a light lemon or light wine color to a greenish-yellow.

The Preparation of Arsphenamine Solutions

The following details for the preparation of arsphenamine solutions for injection have been copied, by permission, from a report of a board of medical officers representing the Army, Navy, and Public Health Service:[1]

I. *Method of injection.*

Only the gravity method should be employed in administering arsphenamine.

II. *Materials required.*

A. Erlenmeyer flasks, 500 to 1000 cc. capacity.
B. Funnels, glass, 4-inch.
C. Cylinders, graduated, 500 to 1000 cc. capacity.
D. Gravity apparatus, consisting of—

1. Gravity graduated glass cylinders, 300 cc. capacity; long graduations at the 100 cc. marks; medium long graduations every 25 cc.; short graduations for each 5 cc.; the zero point to be at the top and the 300 mark to be at the bottom of the cylinder.

2. Rubber tubing, pure gum, heavy wall, inside diameter, five thirty-seconds inch (about 4 mm.), of lengths to limit height of the cylinder to 3 feet above the patient's arm.

Caution.—Before being used the first time the tubing should be filled with normal sodium hydroxide solution for not less than six hours. It then should be rinsed thoroughly in water, sterilized by boiling, and then be rinsed carefully with sterile water again just before using.

3. Needles with slip joint, 19 standard gauge, medium bevel, length of cannula $1\frac{1}{2}$ inches. While not necessary, the Fordyce type of needle is a great convenience. The correct gauge is highly important, as it influences the rate of flow. Proper care of the needles is important. They should be cleaned immediately after use and precautions taken to prevent rust. Just before sterilization the point should be freshened on a stone, if necessary. A dull needle tends to make a dissatisfied patient.

4. Glass tubing 6 mm. in diameter, for windows, which should be inserted in the rubber tubing so as to be a few inches from the lower end.

[1] U. S. Naval Medical Bulletin, Nov., 1922, page 847.

5. Adapters for attaching needles to end of tubing. These may be of metal or glass. If of glass, they will serve as extra windows as well as adapters.

6. Pinchcocks (Mohr's) for cutting off the flow to be applied a short distance above the needle.

E. Sterile gauze, cut in small squares for filtering solution.

F. Sterile freshly distilled water. This water should be distilled in a glass or block tin and should be sterilized immediately by autoclaving or boiling in Erlenmeyer flasks. These flasks should be stoppered with a gauze-wrapped cotton plug and capped with paper or tin foil. Preparation of the water should preferably be carried out on the day before use so that it will be fresh and cool at the time needed.

G. Sterile Salt Solution. This should be made with water prepared as above and chemically pure sodium chloride. Sterilization should be carried out as given above. The strength of the salt solution should be the usual 0.85 per cent. The use of salt solution in the place of distilled water for the dilution is considered a refinement which is not necessary in routine work, but it may have some advantages, since a solution of arsphenamine in distilled water is not isotonic.

H. Normal sodium hydroxide volumetric solution (U. S. P.). Enough of this can be prepared at one time to last for a month or longer, provided it is kept in a rubber-stoppered wax or paraffin lined bottle. There is danger of deterioration on account of absorption of CO_2 from the air and of reactions with the glass container. A wax-lined bottle can be prepared by placing wax or paraffin in a bottle, melting it with dry heat, and spreading the melted wax by rotation over the inside of the bottle as it is cooling. If precipitate is found in the alkali, it is probably an evidence of deterioration of the solution, which should be discarded.

I. Burette or Pipette. A graduated burette or pipette for accurately measuring the alkali.

All glassware mentioned above should be of chemical standard. All apparatus should be surgically clean, freshly sterilized, and cool at time of using. The apparatus should be sterilized by dry heat or autoclave with the exception of the tubing and the needles, which should be boiled.

III. *Inspection of drug.*

A. Note and record manufacturer, lot number, and particularly the dosage stated on the label.

B. Examine the ampuls critically and do not use any which are cracked or in which the powder is not freely mobile and is not of a pale yellow to a lemon yellow in color. Forward any suspected ampuls, with explanatory letter, directly to the Hygienic Laboratory, Washington, D. C., for examination.

C. The ampuls, having satisfactorily passed preliminary inspection, should be immersed in 95 per cent alcohol primarily to detect any minute cracks in the glass not visible on preliminary inspection, and also to cleanse the ampul. Lay ampuls on sterile towel to dry, or wipe off alcohol with sterile gauze.

IV. *Preparation of solution.*

A. The amount to be prepared at one time will depend on the number of patients, but unit quantities or more than 10 average doses should not be prepared.

B. Place in Erlenmeyer flasks about 10 cc. of freshly distilled sterile water for each decigram of arsphenamine to be used, *e.g.*, 100 cc. for 1 Gm. Open the ampul and sprinkle the powder gently over the surface of the water. The temperature of the water is of great importance. For all brands of arsphenamine, except for arsenobenzol, manufactured by the Dermatological Research Institute, the water should be at room temperature and, as a rule, the drug should go into solution with little or no agitation within a few minutes. A slight amount of shaking is permissible with any product, but always should be kept at a minimum.

Exception—The arsphenamine manufactured by the Dermatological Research Institute requires either hot water alone, or it can be dissolved in cold water, if powder first is moistened thoroughly with ethyl alcohol (about 1 cc. to 0.6 Gm.). This amount of alcohol is harmless.

When the arsphenamine has completely dissolved, forming a perfectly clear solution with an absence of any gelatinous particle when viewed by transmitted light, it is ready for alkalinization. If for any reason the arsphenamine fails to form a perfect solution it must be discarded.

C. *Correct alkalinization* is extremely important; failure to alkalinize properly causes more reactions than any other error connected with the use of arsphenamine.

1. The exact method consists in the addition, all at once, of 0.85 cc. normal sodium hydroxide solution for each 0.1 Gm. of arsphenamine used, *e.g.*, 8.5 cc. for 1 Gm. of drug. This is the correct amount necessary to form the disodium salt of arsphenamine, the form which is best tolerated by the patient.

2. Approximate method of alkalinization. An exception to the rate that only standardized normal alkali should be used may be made in case this is not obtainable. Under such circumstances, the exact concentration of alkali being unknown, the operator should keep in mind the following facts: Arsphenamine as it appears on the market is the dihydrochloride of the arsphenamine base which is soluble in water, but the solution is strongly acid and highly toxic. Upon the gradual addition of sodium hydroxide, a precipitate at once begins to form and then redissolves. This property of the drug, not understood by some physicians, has caused them to mistake the end point. This mistake is especially apt to occur when the operator thinks he is using a 15 per cent solution, when in reality the solution is only 4 or 5 per cent. The drug when injected in this still strongly acid state, the monohydrochloride, produces serious reactions and sometimes death.

When a little over one-fourth of the amount of alkali indicated under (1) has been added, the precipitate no longer redissolves. From this point on until there has been added almost three-fourths of the amount of alkali necessary to form the disodium salt, the precipitate remains and does not redissolve on shaking. But when three-fourths of the total amount necessary has been added the precipitate redissolves.

It is at this point, when just enough alkali has been added to dissolve the precipitate, that the solution very frequently has been injected. *This solution of the monosodium salt is the most frequent cause of reactions.* At this point 75 per cent of the correct amount of sodium hydroxide solution has been added and hence an additional one-third of the total amount of alkali used up to this point should now be added. This last addition is the remaining 25 per cent of the correct amount corresponding to a total of 0.85 cc. per 0.1 Gm. of standardized N/1 NaOH solution as mentioned under (1) above; *e.g.*, if 3.3 cc. of an unknown solution were required for completely clearing a solution containing 2 Gm. of arsphenamine, 1.1 cc. more should be added. With a thorough understanding of the above the operator may roughly standardize his alkali against the arsphenamine. No two brands of arsphenamine vary greatly in the amount of alkali required, while various alkali solutions vary in strength by several hundred per cent.

The pH of a proper solution is about 10, and it is impossible to buffer it to neutrality by common buffers without precipitation. Moreover, the alkaline solution is well tolerated if given slowly and well diluted.

3. "Haphazard method" of alkalinization, or drop method. This is mentioned only to condemn it. It is inconceivable that the operator will be unable to secure some sort of a graduated measuring device in order to measure the alkali instead of guessing at the amount. Numerous reactions from under-alkalinization have occurred with this method, particularly where several doses of the drug are prepared at one time. The alkali has been added with a dropper until clearing occurred, and then a few additional drops have been added regardless of whether the solution contained 1 or 10 doses. Less frequently over-alkalinization also has occurred. The injection of an over-alkalinized solution causes pain along the veins and thrombosis.

D. *Filtration and dilution to proper strength of the alkalinized solution*—With sterile forceps place four layers of sterile gauze in the funnel. Wash with sterile water. Pour alkaline solution through into a graduated cylinder and then rinse the filter with enough sterile distilled water to bring the total for each decigram of drug up to 25 cc.; *e.g.*, for 1 Gm. of arsphenamine 250 cc. of solution should be made. This washing the drug through the filter with the water insures full dosage. If a saline solution is desired, it is used at this point in place of the distilled water, at usual strength, 0.85 per cent.

E. *Time the solution should be allowed to stand*—*The properly alkalinized, filtered, and diluted* solution now should stand for at least thirty minutes before being injected, to allow complete stabilization of the reactions. The toxicity is considerably reduced by this delay. The solution may stand as long as three hours without undergoing any increase in toxicity, provided it is protected from the air, not shaken, and provided the temperature does not exceed 30° C. The solution is now ready for administration.

F. *Temperature*—30° C. is the correct temperature at which the drug should be introduced; in no case should it be warmed above this point.

G. *Dosage*—As a rule the initial dose should be small. The average dose used is about 0.4 Gm. for 150 pounds body weight, but no hard and fast rule can be laid down; each case should be considered individually by the clinician. When a radical cure is being sought and the patient tolerates the injection well, full doses should be given.

NEOARSPHENAMINA. U. S. Neoarsphenamine

[Neoarsphen.]

Neoarsphenamine is a product obtained by the action of sodium methanal sulphoxylate on arsphenamine, and consists partially of sodium 3-diamino-4-dihydroxyarsenobenzene methanal sulphoxylate [$NH_2.OH.C_6H_3As : AsC_6H_3.OH.NH(CH_2O)OSNa = 466.17$]. It contains not less than 19 per cent of As, and complies with the requirements of the United States Public Health Service. A sample from each lot of Neoarsphenamine, produced by a manufacturer, must be submitted to the Hygienic Laboratory and approved before it may be marketed.

Neoarsphenamine is distributed in sealed containers of colorless glass, from which the air has been excluded either by the production of a vacuum or by displacement with a non-oxidizing gas.

Neoarsphenamine is prepared by treating the arsphenamine base with sodium formaldehyde sulphoxylate.

Description and Physical Properties—A yellow powder. It is odorless or has a slight odor. In the dry state or in solution it is readily oxidized by exposure to the air, becoming darker and more toxic. Higher temperatures accelerate the oxidation.

It is very soluble in water, soluble in glycerin, slightly soluble in alcohol and almost insoluble in acetone, chloroform, and in ether.

Tests for Identity—An aqueous solution of Neoarsphenamine (1 in 100) is neutral or slightly alkaline to litmus paper (*difference from arsphenamine*).

An aqueous solution of Neoarsphenamine (1 in 100) is precipitated by diluted mineral acids (*difference from arsphenamine*), but yields no precipitate with solutions of alkali hydroxides or carbonates, and is not precipitated by mercuric potassium iodide T.S. (*difference from arsphenamine*).

The addition of two drops of freshly prepared ferric chloride T.S. to 5 cc. of an aqueous solution of Neoarsphenamine (1 in 1000) produces a purple or purplish-red color, changing to dark red.

Add 3 cc. of silver nitrate T.S. to 5 cc. of an aqueous solution of Neoarsphenamine (1 in 100): a brown precipitate is immediately formed, rapidly becoming black (*difference from arsphenamine*).

To 10 cc. of an aqueous solution of Neoarsphenamine (1 in 100) add 10 cc. of diluted hydrochloric acid, and heat: the odor of sulphur dioxide is perceptible.

The solution resulting from the assay for arsphenamine directed below yields with hydrogen sulphide a yellow precipitate soluble in ammonium carbonate T.S.

Add 5 cc. of distilled water to 0.5 Gm. of Neoarsphenamine in a test tube, and gently agitate the mixture: a complete solution results in five minutes.

Assay—Proceed as directed under *Arsphenamine*.

Preserve in the original sealed tubes in a cool place, preferably not above 10° C.

Caution—Solutions of Neoarsphenamine must be freshly prepared when required for use and the drug should be of normal color and freely soluble. If not normal reject it.

Uses—Neoarsphenamine is a modified soluble compound of arsphenamine; its actions and uses are those of arsphenamine. It is given in larger doses than arsphenamine because it contains less arsenic and is less toxic. The average dose for men is 12 grains (0.75 Gm.), with 9 grains (0.6 Gm.) and 14 grains (0.9 Gm.) as the usual minimum and maximum doses. For women 9 grains

(0.6 Gm.) is the average with 7 grains (0.45 Gm.) and 12 grains (0.75 Gm.) as minimum and maximum. Children may be given from 2½ grains (0.15 Gm.) to 5 grains (0.3 Gm.).

Neoarsphenamine may be administered by intravenous or intramuscular injection, the former being considered decidedly preferable; it must not be administered subcutaneously. For intravenous injections, 12.5 cc. of freshly distilled water should be used for each 0.1 Gm. of neoarsphenamine. For the intramuscular injections, 3 cc. of freshly distilled water should be used for each 0.15 Gm. of neoarsphenamine, this yielding an approximately isotonic solution.

Neoarsphenamine may be employed intravenously in concentrated solutions. For this purpose as high as 0.1 Gm. may be dissolved in 0.5 cc. of sterile freshly distilled water; the injection is made with a syringe instead of by gravity.

Neoarsphenamine is also sold under various trade names such as *neodiarsenol* (Diarsenol Laboratories, Inc.), *neosalvarsan* (H. A. Metz Laboratories, Inc.), and *novarsenobenzol* (Powers-Weightman-Rosengarten Company).

The following description of its preparation for administration is copied, with permission, from a report of a board of medical officers representing the Army, Navy, and Public Health Service.[1]

I. *Method of injection of neoarsphenamine.*

The use of the gravity method is strongly recommended, especially in clinics where a considerable number of doses are to be given. It was demonstrated in one clinic that the average time required to give 100 injections was reduced, without changing the personnel, when the gravity method was substituted for the syringe method and a high percentage of reactions due directly or indirectly to the syringe method also ceased to occur. With the gravity apparatus arranged to deliver a dose in about four minutes, one operator was able to run two tables much more easily than one table with the syringe method.

It is recognized, however, that there are circumstances in which the syringe method is indicated, as in the field where apparatus must be reduced to a minimum. Under these circumstances the use of neoarsphenamine by the syringe method is a valuable therapeutic measure. It fills a need, but technically is inferior to the gravity method and therapeutically either method is inferior to arsphenamine given by the gravity method.

II. *Apparatus required.*

A. When the gravity method is to be used:

1. Gravity apparatus (see *Arsphenamine*, page 868).
2. Erlenmeyer flasks, 50 to 300 cc.
3. Funnels, glass, 2-inch.
4. Sterile gauze.
5. Graduated glass cylinders, 100 to 500 cc.
6. Sterile distilled water (see Arsphenamine).
7. Saline 0.85 per cent prepared as under Arsphenamine, page 870.

B. When syringe method is to be used:

1. 20 to 50 cc. all-glass syringes.
2. Rubber tubing, short, with adapters connecting syringe and needle.
3. Needles, 25 standard gauge, medium bevel.

III. *Inspection of drug.*

An even more critical examination should be made than in case of arsphenamine, as neoarsphenamine occasionally decomposes in the ampul, even when no cracks are present. The powder should be freely mobile and canary yellow to orange red in color. When it approaches a red color, is distinctly lumpy or solidified, do not use, but forward samples to the Hygienic Laboratory for examination.

Immerse in alcohol the ampuls which have passed inspection to further eliminate the presence of cracks and to clean the ampul.

IV. *Preparation of solution.*

A. *Amount to be prepared at one time*—In marked contrast to the practice with arsphenamine, do not prepare any more solution at one time than can be administered within 20 minutes.

B. *Concentration*—Preferably 1 decigram should be dissolved in 12.5 cc. of water. This solution is then twice as concentrated as an arsphenamine solution. Concentrations as high as 1 decigram in 0.5 cc. of water can be used in the field or under other special circumstances. The highly concentrated solutions, however, should be given very slowly.

C. *Solution.*

1. Put in Erlenmeyer flask 12.5 cc. sterile distilled water for each decigram of neoarsphenamine. In the field the concentrated solution can be made in the ampul itself by using water supplied in another ampul.

Caution—The distilled water used must be at room temperature and not to exceed 30° C.

2. Open the ampul and sprinkle the powder gently over the surface of the water and by preference allow it to go into solution with no agitation whatever. Slight rotation of the flask is permissible. *Shaking the solution increases its toxicity and should be avoided.*

[1] U. S. Naval Medical Bulletin, Nov., 1922, page 854.

In case the solution does not form a perfectly clear and transparent solution it should under no circumstances be used. Whether it requires 1 minute or 10 minutes for the drug to form a perfect solution is unimportant, but it should not require more than 10 minutes. The important point is not the rate of solubility but the complete solubility of the drug.

3. As soon as the neoarsphenamine is in solution filter through washed gauze into tall, narrow cylinders and keep stoppered. It is preferable to use a size of cylinder which the solution will nearly fill. The smaller the air column over the solution the less danger of increased toxicity. The solution is now ready to inject and, in marked contrast to the arsphenamine solution, which should stand at least 30 minutes before its injection, the neoarsphenamine solution should be injected immediately, and in no case shall it be allowed to stand longer than 20 minutes.

4. *Dose*—The initial dose as a rule should be small. The average dose is about 0.6 Gm. for 150 pounds body weight, but no attempts to lay down a hard and fast rule in this regard are made. The patient must be individualized.

Unofficial Arsenic Compounds

Silver Arsphenamine, N. N. R.—*Argentum Arsphenamina*—Sodium Silver Arsphenamine.—The sodium salt of silver-diamino-dihydroxy-arseno-benzene (the exact molecular formula has not been established). It contains approximately 20 per cent of arsenic and approximately 15 per cent of silver.

Silver arsphenamine is prepared by treating the dihydrochloride of 3-diamino-4-dihydroxy-1-arsenobenzene (arsphenamine) with silver salts, converting the resulting compound to the disodium salt, and precipitating by means of alcohol, ether or acetone. The silver is not in an ionizable form.

Silver arsphenamine is a brownish-black powder, unstable in air; when properly dried it is free from lumps. It is readily soluble in water, yielding a dark brown solution (*distinction from arsphenamine, sodium arsphenamine and neoarsphenamine*), the solution has an alkaline reaction (*distinction from arsphenamine*).

For further tests see the N. N. R.

Uses—Silver arsphenamine has practically the same uses as those of arsphenamine (see page 869). Its claimed advantage over other arsphenamine preparations is said to be due to the introduction of the silver (non-ionizable form) as a component, thereby improving the chemo-therapeutic index, presumably because of the fact that silver and its compounds have a decided antisyphilitic influence.

Dose—From 0.1 Gm. to 0.3 Gm. for adults. The treatment should begin with an injection of 0.1 Gm., gradually increasing the dosage, at intervals of not less than four days, to 0.2 Gm. maximum in women and 0.3 Gm. in men. The larger doses are only indicated if the preparation is well tolerated by the patient. The dosages 0.2 to 0.25 Gm. may be given at regular intervals of four days and repeated until the desired therapeutic results have been achieved. Patients with disorders of the nervous system or those suffering from severe headaches should be given smaller initial doses, 0.05 and 0.075 Gm. When these amounts are well tolerated, larger doses may be employed, increasing very gradually.

In preparing the solution for injection, the ampul is first sterilized by immersion in alcohol for fifteen minutes; after opening the ampul, the contents are sprinkled on the surface of 5 cc. of cool (20–22° C.), sterile, distilled water, contained in a small sterile flask. The silver arsphenamine will go into solution rapidly; heating and shaking must be avoided. A quantity of cool sterile solution of sodium chloride, 0.4 per cent, is then added so that the final solution will approximate 20 cc. of liquid per decigram (0.1 Gm.) of the drug. *The solution must be administered promptly.*

Manufactured by the H. A. Metz Laboratories.

Sodium Arsphenamine, N. N. R.—*Sodiarsphenamina*—Sodium Arsenphenolamine. The sodium of 3-diamino-4-dihydroxy-1-arsenobenzene, $NaO.NH_2C_3H_3As : As.C_2H_3NH_2ONa$, with a stabilizing medium. The arsenic content of 3 parts sodium arsphenamine is equivalent to 2 parts of arsphenamine.

Sodium arsphenamine is a bright yellow powder, very unstable in air; when properly dried, it is free from lumps. It is readily soluble in water, yielding an orange-yellow solution; the solution has an alkaline reaction (*distinction from arsphenamine*).

For further tests see the N. N. R.

Uses—The same as those of arsphenamine; its advantage over arsphenamine is that it does not require addition of alkali before use.

Dose—From 0.45 to 0.9 Gm. for adults. As 3 parts sodium arsphenamine are equivalent to 2 parts arsphenamine, the amount of drug to be administered should be 50 per cent more than arsphenamine under the same conditions. In preparing the solution for injection, the sodium arsphenamine must be dissolved immediately after opening the ampul and everything except gentle shaking should be avoided in effecting solution. The quantity of sterile distilled water used for solution should be in the proportion of 20 cc. for each 0.1 Gm. of the drug. Heating must be avoided in the preparation of the solution; any difficultly soluble preparation should not be employed. *The solution must be administered promptly.*

Manufactured by the Diarsenol Laboratories, Inc.

Sulpharsphenamine, N. N. R.—*Sulpharsphenamina.*—The salt, disodium 3,3-diamino-4, 4'-dihydroxyarsenobenzene-*N*-dimethylenesulphonate, $NaOSO_2.CH_2.NH.OH.C_6H_3.As : As.C_6H_3OH.NH.CH_2.O_2SONa$, with inert salt. The product has an arsenic content of from 19 to 24 per cent. According to claims, it differs from neoarsphenamine in having two side chains instead of one and in that the sulphur has a valence of four (with an extra oxygen atom) and not two as in neoarsphenamine.

Sulpharsphenamine is an orange-yellow powder possessing an odor resembling that of sulphur dioxide and arsine. It is readily soluble in water yielding a yellow solution which is acid to litmus (*distinction from neoarsphenamine which is neutral and sodium arsphenamine which is alkaline*). On standing overnight, the solution darkens and a precipitate is formed.

For further tests see the N. N. R.

Uses—The same as those of neoarsphenamine over which it is claimed to have the advantage of a higher chemotherapeutic index, more prolonged or delayed action, lower toxicity, a somewhat greater stability of solution in the presence of air, and of permitting subcutaneous injection.

Dose—For intramuscular or subcutaneous use the drug is dissolved in sterile, freshly distilled water in the proportion of about 0.1 Gm. to 0.3 cc.; for intravenous use a greater dilution is desirable, about 0.1 Gm. to 2 to 3 cc.

Solarson, N. N. R.—A 1 per cent solution of ammonium heptenchlorarsonate ($CH_3(CH_2)_4CCl : CH.AsO.OH.ONH_4$), rendered isotonic by the addition of sodium chloride. Solarson contains from 0.255 to 0.275 Gm. of arsenic (As) in 100 cc.

Uses—It is claimed that solarson has an advantage over the cacodylates, in that its arsenic is better utilized, and over the arsenilates in that subcutaneous and intramuscular injections produce less pain and are less liable to produce toxic effects.

Solarson is used as a means of obtaining arsenic effects in the treatment of anemia, chlorosis, malaria, neuroses and dermatoses.

Dose: from 1 to 2 cc. subcutaneously or intramuscularly.

Manufactured by the Bayer Company, Inc.

Stovarsol, N. N. R.—Acetylaminohydroxyphenylarsonic Acid—$HO.CH_3CONH.C_6H_3.As : O : (OH)_2$—The acetyl derivative of 3-amino-4-hydroxyphenyl-1-arsonic acid—Stovarsol contains from 27.1 to 27.4 per cent of arsenic (As).

Stovarsol is a white, odorless powder, having a slightly acid taste. It is slightly soluble in water and alcohol; readily soluble in solutions of alkalies or alkaline carbonates. It is stable at ordinary temperatures.

Uses—Stovarsol has been reported to produce favorable effects in the treatment of amebic dysentery. It is claimed to yield satisfactory results both in the eradication of dysenterial cysts and encysted flagellates, and for general amebic dysentery. Stovarsol is not proposed for the treatment of syphilis, and its use is in amebic infections.

Dose—Orally, 0.25 Gm. for adults; two or three doses a day for a period of seven days has been reported to give satisfactory results.

Manufactured by Powers-Weightman-Rosengarten Company.

Tryparsamide, N. N. R.—Sodium N-phenylglycinamide-*p*-arsonate — $(NH_2COCH_2NH).C_6H_4.(AsO.OH.ONa)_2.H_2O$—Tryparsamide contains 24.6 per cent of arsenic in organic combination.

A colorless, odorless, crystalline powder (*distinction from arsphenamine compounds*). It is freely soluble in water, forming a solution neutral to litmus. It is insoluble or only slightly soluble in alcohol, ether, chloroform, and benzene.

Uses—Tryparsamide is primarily a trypanocidal agent and is proposed for use in the treatment of certain forms of trypanosomiasis (African sleeping sickness and *mal de caderas*). In the case of human trypanosomiasis due to T. gambiense it is relatively easy to sterilize the peripheral blood by a single dose of the drug, but relapses are likely to occur unless the treatment is continued for some time.

Dose—From 0.5 to 3.0 Gm. for adults, depending on the purpose for which the drug is used. In general, the dose should not exceed 0.04 to 0.05 Gm. per kilogram of body weight, and such doses should not be repeated at intervals of less than one week. Tryparsamide may be administered subcutaneously, intramuscularly or intravenously, though the intravenous administration is generally employed. The drug is dissolved in sterile water or physiological solution of sodium chloride. Tryparsamide should never be administered by mouth.

Manufactured by Powers-Weightman-Rosengarten Company.

Unofficial Antimony Compounds

Antimony Thioglycollamide, N. N. R.—The triamide of antimony thioglycollic acid $Sb(S.CH_2CO.NH_2)_3$. It contains not less than 30 per cent of antimony.

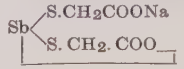
A white, crystalline, odorless powder. It is soluble in about 200 parts of water; somewhat soluble in alcohol; insoluble in ether.

Uses—Suggested for the treatment of human trypanosomiasis and in trypanosomic diseases of the larger animals. In the doses employed they were less toxic and less irritating than tartar emetic and the results obtained were decidedly more favorable.

Dose—The usual intramuscular or intravenous dose employed by Randall is 0.08 Gm., dissolved in 20 cc. of sterile water every second day until from 15 to 25 injections had been given. He recommends that at least 12 injections be given after the first healing has taken place to insure permanent cure. Its solutions are incompatible with solutions of the fixed alkalies.

Manufactured by Hynson, Westcott and Dunning.

Antimony Sodium Thioglycollate, N. N. R.—The compound formed by dissolving antimony trioxide in a solution of a mixture of sodium thioglycollate and thioglycollic acid.



It contains not less than 37 per cent of antimony.

A white or faintly pinkish powder; odorless or having a faint odor of mercaptan; very soluble in water; insoluble in alcohol.

Uses—The same as antimony thioglycollamide. It is more soluble than antimony thioglycollamide, and in higher dosages it appears to be less toxic.

Dose—From 1 to 2 grains (0.05 to 0.1 Gm.) dissolved in 10 to 20 cc. of sterile water every third or fourth day until from 15 to 25 injections have been given. Its solutions are incompatible with solutions of the fixed alkalis.

Manufactured by Hynson, Westcott and Dunning.

ORGANIC-SILVER COMPOUNDS

ARGENTO-PROTEINUM FORTE. U. S. Strong Silver-Protein

[**Arg.-Prot. Fort.**—STRONG PROTARGIN]

A compound of silver and protein, containing not less than 7.5 and not more than 8.5 per cent of silver (Ag).

In colloidal silver preparations, the silver does not exist, at least to any great extent, as free ions; therefore, it does not precipitate chlorides or proteins, and is noncorrosive, and, relatively or quite, nonastringent and nonirritant. Nevertheless, a considerable degree of antiseptic action is retained. This is not proportional to the total silver content, and varies for the different compounds; suggesting that the antiseptic action is due to the liberation of very low concentrations of silver ions, which vary for the different compounds.

Description and Physical Properties—A brown, odorless powder, usually somewhat hygroscopic.

Strong Silver-Protein is freely soluble in water, but almost insoluble in alcohol, chloroform, and ether.

Tests for Identity—Heat about 0.2 Gm. of Strong Silver-Protein in a porcelain crucible until all carbonaceous matter is burned off, warm the residue with 1 cc. of nitric acid, dilute with 10 cc. of distilled water, and add hydrochloric acid: a white precipitate is produced which dissolves in ammonia T.S.

The addition of 2 cc. of a 1 per cent aqueous solution of sodium chloride to 10 cc. of an aqueous solution of Strong Silver-Protein (1 in 100) causes no turbidity.

Ferric chloride T.S. added to its aqueous solution (1 in 100) discharges the dark color, and a precipitate is gradually produced. With mercuric chloride T.S. a white precipitate is formed, and the supernatant liquid becomes colorless or nearly so.

When tested by the method described below, Strong Silver-Protein permits abundant gas formation when 0.6 cc. of its aqueous solution (1 in 200) is added to 20 cc. of the yeast-sugar mixture, and at most only one bubble of gas is formed when 1.5 cc. of the same strength solution is added to 20 cc. of the yeast-sugar mixture. If the yeast is more active, as determined by the control with silver nitrate described below, a proportionately larger volume of the Strong Silver-Protein solution is required, or if the yeast is less active, a proportionately smaller volume of the Strong Silver-Protein solution is required.

Triturate an aqueous solution of sucrose (1 in 10) with 4 per cent of its weight of compressed yeast. Place four 20 cc. portions of this mixture in test tubes. To one test tube add 0.6 cc. of an aqueous solution of Strong Silver-Protein (1 in 200), mix well, immediately fill a small test tube with this mixture and invert it into the larger test tube, being careful that no air bubbles rise into the small test tube. To the second test tube add 1.5 cc. of an aqueous solution of Strong Silver-Protein of the same concentration; to the third tube add 0.6 cc. of an aqueous solution of silver nitrate (1 in 2000), and to the fourth tube add 1 cc. of the same silver nitrate solution. Fill smaller test tubes with each solution and proceed as directed for the first tube. Place all four of the test tubes in a bath at 38° C. and maintain this temperature for one hour. At the end of this period, the first and third of the smaller tubes should show abundant gas formation, the second smaller tube should show not more than a bubble of gas, and the fourth tube should show not more than about 1 cc. of gas. If the third tube shows no gas, repeat the tests reducing the concentration of all of the silver solutions to one-half, and if there should still be no gas formation in the third tube, again repeat the tests, reducing the concentration of all of the silver solutions by one-third. If the fourth tube in the first series of tests contains more than about 1 cc. of gas, repeat the tests, but increase the concentration of all of the silver solutions by one-third, and if this also produces more than 1 cc. of gas in the fourth tube, again repeat the tests, increasing the concentration of all of the silver solutions by one-half (*distinction from Mild Silver-Protein*).

Assay—Ignite about 2 Gm. of Strong Silver-Protein, accurately weighed in a porcelain crucible until all of the carbon is burned off. Transfer as much as possible of the residue to a beaker, add to the crucible 5 cc. of nitric acid, warm to dissolve any adhering silver, and transfer the solution to the beaker with the aid of a little distilled water. Cover the beaker, and heat on a water bath until all of the metallic silver is dissolved, adding a little more nitric acid, if necessary. Filter into a flask, wash the insoluble residue thoroughly with distilled water, cool, and dilute with distilled water, if necessary, to about 50 to 75 cc. Add 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01079 Gm. of silver.

This assay is explained on page 1462.

Preserve in well-closed containers, protected from light.

Caution—Solutions of Strong Silver-Protein should be freshly prepared and dispensed in amber-colored bottles.

Uses—The colloidal silver compounds are used mainly on mucous membranes, for antiseptic and germicidal effects. The strong silver-protein, or *protargin strong*, group is most effective in this respect, but is slightly irritant and stimulant. The *protargin mild* group acts also largely as a mucilaginous demulcent and protective; and as a detergent, by dislodging pus. Collargol acts locally like the mild silver-protein group, but is used mainly to produce systemic reactions.

The commercial preparations are for the most part produced by dissolving reduced silver or silver oxide, or some protein-silver precipitate, in an excess of a denatured protein, and drying *in vacuo*. This results in substances that dissolve very freely, although somewhat slowly, in water, yielding brown " colloid solutions " which contain so little of free silver ions that they do not readily precipitate chlorides or proteins. They consist of probably indefinite mixtures of metallic silver, silver oxide, and various silver-protein compounds, all in colloidal form. The proportions of these and the properties of the mixture vary according to the conditions under which they are produced. Although there are probably all kinds of gradations, most of the products on the market fall into a small number of fairly definite therapeutic groups:

(A) Strong Silver-Protein or Protargol Type.
(B) Mild Silver-Protein or Argyrol Type.
(C) Collargol Type.
(D) Electric Type.

The Strong Silver-Protein compounds contain the lowest percentage of silver (from 7 to 8.5 per cent), but have the strongest germicidal action, and are distinctly irritant. They are, therefore, therapeutically intermediate between silver nitrate and protargin mild. The following products belong to this group: *proganol*, *protargentum-Squibb*, and *protargol*.

The Mild Silver-Protein compounds contain from 19 to 30 per cent of silver, but are quite nonirritant. The following products belong to this group: *argyn*, *argyrol*, *cargentos*, *silvol*, *solorgentum-Squibb*, and *vargol*.

Collargol type contains a much higher percentage (78) of silver, said to be in the form of metallic silver, reduced to the colloidal form by chemical means, and " stabilized " by " a small percentage of egg albumin with products of oxidation". However, the albumin is denatured, since it does not precipitate on boiling; and it presumably constitutes the greater part of the 22 per cent that is not silver. Collargol, therefore, seems to differ from the preceding class in degree rather than in principle, containing a larger proportion of silver in the form of colloidal-metal and oxide, and a smaller proportion in the form of proteinate. Its therapeutic field has been somewhat different, namely, for intravenous and intramuscular injection.

In the *electric type* of silver compounds metallic silver is brought into colloidal solution electrically, *i. e.*, by forming an arc between silver electrodes under water. These solutions are, however, very dilute, and are not sufficiently stable for concentration. They are also likely to contain silver oxide, and sometimes ionized silver.

Dose—The concentrations for mucous membranes range from 0.1 to 10 per cent for strong silver-protein, from 5 to 50 per cent for mild silver-protein, and from 0.02 to 1 per cent for collargol. These are applied every two to four hours, if possible. Solutions should be recently prepared, and should be protected against light. Ointments and suppositories are used with the same concentrations as the aqueous solutions. Stains on linen are removed by a 1 in 1000 solution of mercuric chloride. Solutions are best prepared by dusting the powder on the surface of cold water, and allowing it to dissolve without stirring or shaking. This requires about ten minutes.

ARGENTO-PROTEINUM MITE. U.S. Mild Silver-Protein

[**Arg.-Prot. Mit.**—MILD PROTARGIN]

Silver rendered colloidal by the presence of or combination with protein. It contains not less than 19 per cent and not more than 25 per cent of silver (Ag).

The preparation and characteristics of Mild Silver-Protein are discussed under Strong Silver-Protein (see page 875).

Description and Physical Properties—Dark brown or almost black, shining scales or granules. It is odorless, and is frequently hygroscopic.

Mild Silver-Protein is freely soluble in water, but almost insoluble in alcohol, chloroform, and ether.

Tests for Identity—Heat about 0.1 Gm. of Mild Silver-Protein in a porcelain crucible until all carbonaceous matter is burned off, warm the residue with 1 cc. of nitric acid, dilute with 10 cc. of distilled water, and add hydrochloric acid: a white precipitate is produced which dissolves in ammonia T.S.

The addition of 2 cc. of an aqueous solution of sodium chloride (1 in 100) to 10 cc. of an aqueous solution of Mild Silver-Protein (1 in 100) causes no turbidity.

Ferric chloride T.S. added to its aqueous solution (1 in 100) discharges the dark color and a precipitate is gradually produced. With mercuric chloride T.S. a white precipitate is formed and the supernatant liquid becomes colorless or nearly so.

When tested by the method described under *Argento-Proteinum Fortius*, 0.8 cc. of an aqueous solution of Mild Silver-Protein (1 in 20) permits abundant gas formation (distinction from *Strong Silver-Protein*).

Assay—Proceed as directed under *Argento-Proteinum Fortius*, using about 1 Gm. of Mild Silver-Protein.

Preserve in well-closed containers, protected from light.

Caution—Solutions of Mild Silver-Protein should be freshly prepared and dispensed in amber-colored bottles.

Uses—See Strong Silver-Protein, page 875.

Other Colloidal Silver Compounds

Collargol, N. N. R.—*Collargolum*—Colloidal Silver—Argentum Colloidale—Argentum Credé—Colloidal silver and silver oxide, formed by reduction and stabilized by derived egg-albumin, with which it is possibly partly combined. It contains silver equivalent to approximately 78 per cent metallic silver of which about 2 per cent is ionized. It forms, with water, a fairly stable colloidal suspension.

Small, hard, brittle, bluish-black scales. With 20 parts of distilled water, it forms a colloidal suspension, black in incident light, and reddish-brown in transmitted light, which remains stable for months. The addition of albumin to collargol prevents or delays its precipitation by acids and salts. A sufficient amount of albumin to prevent its precipitation under ordinary conditions is, therefore, added to collargol during its manufacture. Hence, collargol, even when added to spring or well-water containing salts, undergoes no change. Whereas, colloidal silver containing no albumin precipitates on being boiled. Collargol solutions brought once to the boiling point present no macroscopic changes, though they do decrease in stability.

Uses—The intravenous injection of collargol is followed, after from two to four hours, by a chill, fever and leukocytosis. This reaction has been used, with variable results, against general and localized infections, similar to nonspecific protein therapy. Indeed, it is possible that the protein stabilizer may play the principal or sole part in the reaction. The direct antiseptic action is rather feeble, and probably due to contamination with free silver ions.

Dose—It is employed in carefully filtered solutions (colloidal suspensions) varying in strength according to the intended use; from 10 to 20 cc. of a 2 per cent solution for intravenous injections (the possible reaction of certain persons to egg protein should be considered); and from 0.02 to 1 per cent solution for washes. Collargol solution should not be sterilized by boiling, but sterile solution mediums should be used. Locally, it is used in the form of a 15 per cent ointment, from 30 to 60 grains (2 to 4 Gm.) being very thoroughly rubbed into the skin; in the form of 5 per cent dusting powder, prepared with finest clay; of bougies containing 3 grains (0.2 Gm.), and vaginal suppositories and tampons each containing ¾ grain (0.05 Gm.); for parenchymatous injections in from 0.5 to 1 per cent glycerin solutions. Internally, a solution (colloidal suspension) of from 1 in 500 to 1 in 100 is given freely in teaspoonful doses added to the food, in infectious gastric and intestinal diseases. It is also given in tablets, containing 1 grain (0.06 Gm.).

Collargol ointment is prepared by incorporating 15 parts of collargol with 5 parts of water, 10 parts of white wax, and 70 parts of benzoinated lard, taking care that the soluble silver shall not be transformed into metallic silver of the ordinary kind. This, it is asserted, is liable to occur unless great care is observed in the manipulation.

The natural color of collargol ointment is reddish-brown. The ointment is good as long as it colors the skin black.

Manufactured by the Heyden Chemical Company of America, Inc.

Lunosol, N. N. R.—*Argenti Chloridum Colloidale Saccharatum-Hille*—A preparation of colloidal silver chloride containing silver chloride, 10 per cent, and sucrose, 90 per cent.

A white, slightly hygroscopic, granular powder, odorless, having a sweetish, metallic taste. It is completely soluble in one half of its weight of water, forming an opalescent solution (colloidal suspension) which is bluish white in reflected light and reddish in transmitted light.

Uses—Lunosol has antiseptic and germicidal properties. It causes neither irritation of the mucous membranes nor coagulation of albumin even in concentrated solutions; it does not stain the skin.

Lunosol is intended for the prophylaxis against and treatment of infections of the accessible mucous membranes, such as the genito-urinary tract and the eye, ear, nose and throat.

Dose—It is generally used in solutions (colloidal suspensions) of from 1 to 25 per cent. In the male urethra, from 3 to 25 per cent solutions are used; for irrigation of the vagina, a 1 per cent solution is used, and on tampons, a 10 per cent solution; for irrigation of the bladder, a 0.1 to 1 per cent solution, and for irrigation of the rectum, a 1 to 5 per cent solution is used; in ophthalmia neonatorum, 25 to 50 per cent solutions are applied; in pyelitis, 3 to 10 per cent solutions are injected into the kidney pelvis; for application to the nose, eye and ear, the average concentration is 10 per cent.

Manufactured by Hille Laboratories, Inc.

Neo-Silvol, N. N. R.—Colloidal silver iodide compound—A compound of silver iodide with a soluble gelatin base containing 18 to 22 per cent of silver iodide in colloidal form.

Pale yellow granules. In concentration up to 50 per cent neo-silvol forms with water almost colorless, milky or opalescent solutions (colloidal suspensions). Neo-silvol is insoluble in fixed oils, but slowly soluble in glycerin. Solutions of neo-silvol are not precipitated in the cold by strong acids or sodium chloride.

Uses—Neo-Silvol, even in concentrated solutions, causes neither irritation of mucous membrane nor coagulation of albumin. It does not stain the skin.

It is claimed that neo-silvol in laboratory tests for germicidal value has been found as effective as phenol in its action on bacteria.

Neo-silvol is intended for the prophylaxis against, and treatment of infections of accessible mucous membranes and is claimed to be indicated in infections of the genito-urinary tract and of the eye, ear, nose and throat.

Dose—In the treatment of acute inflammations of the mucous membranes solutions of neo-silvol as strong as 50 per cent may be used. In inflammatory infections of the ear, nose and throat, 5 to 40 per cent solutions are used; for irrigating sinuses 2 to 5 per cent; for inflammatory conditions of the eye and conjunctival infections in strength of 10 to 40 per cent; in acute anterior urethritis, as an abortive measure, 20 per cent; for posterior urethritis or in the routine treatment of anterior urethritis, 10 per cent; in the genito-urinary tract of the female, from 10 to 50 per cent.

Solutions of neo-silvol are prepared by adding the substance to the required amount of water and agitating the mixture until solution occurs.

Manufactured by Parke, Davis and Company.

Unofficial Organic Mercury Compounds

The early methods of administering mercury were by mouth and by inunction. The oral method continues to be popular, but often causes troublesome gastro-intestinal symptoms. The inunction method obviates the digestive disturbances; but the amount of the drug absorbed cannot be well controlled, and it is often practically impossible to introduce an amount sufficient for syphilis.

In more recent years, the attempt to improve mercurial therapy has been mainly along two lines: the perfection of intramuscular usage and the introduction of the organic compounds.

The original practice of injecting mercuric chloride has not gained a wide endorsement because of the pain inflicted and because the necessity of daily injections was difficult to meet. It has been found that the pain is considerably lessened by the use of mercury combined with the amino-acids and their derivatives such as the succinimide.

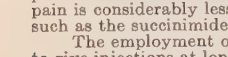
The employment of mercurial salts that are less soluble than the bichloride has enabled the physician to give injections at longer intervals and still ensure a daily absorption of the drug. These insoluble preparations, such as the salicylate and the benzoate, are injected into the muscle, but they are accompanied by no little pain.

The organic compounds of mercury, such as mercurol, are said to be less irritating to the gastro-intestinal tract than the inorganic salts. Further experience will be necessary to determine their real value.

Compounds of mercury are also used for preparation of antiseptic and germicidal solutions.

MERCURIC COMPOUNDS

Flumerin—(H. W. & D.), N. N. R.—Disodium-2-hydroxymercurifluorescein, $NaOOC.C_6H_4.C.C_6H_2.HgOH.ONa.C_6H_3O$. The disodium salt of 2-hydroxymercurifluorescein.



A red, odorless powder; somewhat hygroscopic. It is soluble in hot water (about 1 : 10); insoluble in alcohol, chloroform or ether. On incineration flumerin-H. W. & D. yields an ash containing sodium carbonate. Aqueous solutions of flumerin-H. W. & D. are deep orange-red in strong concentrations, but show a greenish-red fluorescence in very dilute solutions, the fluorescence being less intense than that of fluorescein in the same concentration. Aqueous solutions of flumerin-H. W. & D. are decomposed by acids, chlorides, bromides iodides and the salts of many alkaloids, and local anesthetics.

Uses—Flumerin-H. W. D., when injected intravenously, causes the disappearance of spirochetes from primary and secondary syphilitic lesions and will bring about resolution of the lesions and in about one-half the cases it will change a positive blood Wassermann reaction to negative, according to various reports.

Dose—From 0.002 to 0.005 Gm. per kilogram of body weight injected intravenously in 2 per cent aqueous solution. Flumerin-H. W. & D. is incompatible with acids, halides and the salts of many alkaloids. Therefore water and not physiologic solution of sodium chloride is used to prepare solutions. If solutions be made with sterile water they may be used during three days if kept in well-stoppered bottles in the dark.

Manufactured by Hynson, Westcott & Dunning.

Flumerin-H. W. & D. Tubes, 0.15 *Gm.*
Flumerin-H. W. & D. Tubes, 0.20 *Gm.*
Flumerin-H. W. & D. Tubes, 0.25 *Gm.*
Flumerin-H. W. & D. Tubes, 0.30 *Gm.*

Mercurialized Serum, N. N. R.—A solution of mercuric chloride in normal horse serum diluted with physiologic solution of sodium chloride. It is prepared by the method of C. M. Byrnes (*J. A. M. A.*, **63** : 2182 [Dec. 19] 1914).

Uses—Mercurialized serum is proposed for the treatment of syphilis, particularly of the cerebrospinal type. This is an attempt to produce a preparation which, while therapeutically active, is noncorrosive, has a low toxicity and slight local irritative action, does not coagulate serum albumin, and which consequently is adapted to intraspinal use and can be used intravenously without danger of phlebitis.

Dose—Intraspinally, 30 cc. of a solution, the dose containing the equivalent of $\frac{1}{20}$ grain (0.0013 Gm.) of mercuric chloride, after *first* withdrawing sufficient spinal fluid to reduce the pressure to 30 mm. (water). The dose may be increased, when tolerance is established, to 30 cc. of a stronger solution, the dose containing the equivalent of $\frac{1}{25}$ grain (0.0026 Gm.) of mercuric chloride. Intravenously, 2 cc. of solution, the dose containing the equivalent of $\frac{1}{12}$ grain (0.0055 Gm.) of mercuric chloride.

Mercuric Benzoate, N. N. R.—*Hydrargyri Benzoas*—Hydrargyrum Benzoicum.—$Hg(C_3H_5COO)_2 + H_2O$. The mereuric salt of benzoic acid.

A white, crystalline powder; slightly soluble in water, yielding a weakly acid solution; more soluble in an aqueous sodium chloride solution. It is insoluble in alcohol or ether. At 20° C., a 10 per cent solution of sodium benzoate dissolves 1 per cent of its weight of mercuric benzoate. With alcohol mercuric benzoate is decomposed into a basic salt having a yellow color.

Uses—The same as those of mercuric chloride.

Dose—Mercuric benzoate is used for intramuscular injections in syphilis and in treating gonorrhea. In urethral cases, the solution may be 1 : 2000 or 1 : 1000 with an equal quantity of sodium chloride. For intramuscular injection, mercuric benzoate is given in a 1 per cent solution by dissolving 0.3 Gm. of mercuric benzoate in 30 cc. of water, containing 1.5 Gm. of ammonium benzoate or given in 2 per cent solution with 2.5 per cent of sodium chloride, the average dose being about 24 or 12 minims, respectively ¼ grain (0.015 Gm.), every second day.

Prepared by Swan-Myers Company and the Intra Products Company, Denver.

Mercuric Cyanide, N. N. R.—*Hydrargyri Cyanidum*—Hydrargyrum Cyanatum—$Hg(CN)_2$—The mercuric salt of hydrocyanic acid.

In colorless or white, prismatic crystals, or white powder, odorless and having a bitter, metallic taste the salt is exceedingly poisonous). It is darkened on exposure to light; is soluble at 15° C. in 12.8 parts of water and in 15 parts of alcohol, in 3 parts of boiling water and in 6 parts of boiling alcohol, and is very sparingly soluble in ether.

Uses—Mercuric cyanide has been reported to be as actively antiseptic as mercuric chloride and to be less irritating; but this has been questioned. It is used locally and internally like mercuric chloride.

Dose—Internally, from $\frac{1}{12}$ to $\frac{1}{8}$ grain (0.004 to 0.008 Gm.); locally, solutions of from 1 : 4000 to 1 : 2000 may be used for applications to the eye or mucous membranes; from 25 to 35 minims of a 1 per cent solution may be used hypodermically without causing local irritation. Death has occurred from the use of a vaginal injection containing 0.9 Gm. (14 grains) of mercuric cyanide.

In diphtheria and croup, it is used in 0.01 per cent solution as a gargle or internally in doses of from 0.0077 to 0.0154 grain (0.0005 Gm. to 0.001 Gm.). In fibrinous rhinitis it is used on a tampon in 0.04 per cent solution.

Mercuric Oxycyanide, N. N. R.—*Hydrargyri Oxycyanidum*—Hydrargyrum Oxycyanatum—$Hg(CN)_2 HgO$—A basic mercuric salt of hydrocyanic acid, containing from 51.7 to 56.0 per cent of mercuric cyanide $[Hg(CN)_2]$ and from 44.3 to 48.0 per cent of mercuric oxide (HgO).

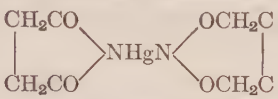
A white, or nearly white, microcrystalline powder, soluble in about 80 parts of water, yielding a solution alkaline to litmus.

Uses—Mercuric oxycyanide has been proposed as a substitute for mercuric chloride. Its antiseptic power is claimed to be greater and it is asserted to be less irritating than mercuric chloride because it does not act on albumin to the same extent. It has the advantage over mercuric chloride in that it does not corrode steel instruments.

Dose—Mercuric oxycyanide may be administered in the same doses as mercuric chloride. It may be applied locally in solutions of 1 : 5000 or somewhat stronger.

Prepared by the Gradwohl Laboratories, St. Louis.

Mercuric Succinimide, N. N. R.—*Hydrargyri Succinimidum*—$Hg[(CH_2.CO)_2N]_2$—The mercuric salt of succinic acidimide,



A white, crystalline powder; soluble in about 10 parts of cold water; soluble in about 5 parts of boiling water, and in 300 parts of alcohol. It is very stable in solution. The aqueous solution is not affected by albumin. Mercuric succinimide should be protected from light.

Uses—Mercuric succinimide has the action of other salts of mercury, but its solutions are said to be relatively non-irritating. The preparation is used like other compounds of mercury in the treatment of syphilis.

Dose—Mercuric succinimide is used mainly by hypodermic injection. The daily hypodermic dose is from ⅙ to ⅓ grain (0.01 to 0.02 Gm.) given in the form of a 2.5 per cent solution (from 8 to 16 minims (0.5 to 1 cc.) of such solution)—Mercuric succinimide may be given by the mouth in doses of from ⅙ to ¼ grain (0.01 to 0.15 Gm.).

Mercurochrome-220 Soluble, N. N. R.—$NaOOC.C_6H_4.C{:}C_6H_2Br{:}O.C_6HBr(ONa)(HgOH).3H_2O$.

—The disodium salt of 2 : 7-dibromo-4-hydroxymercurifluorescein, containing 23 to 24 per cent of mercury.

Mercurochrome-220 soluble occurs as iridescent, green scales or granules; odorless; permanent in the air. It is freely soluble in water; soluble in 65 parts of alcohol; insoluble in chloroform or ether.

Uses—Mercurochrome-220 soluble is a strong and rapidly acting germicide; it is active in urine, a 1 : 1000 solution killing *Bacillus coli* and *Staphylococcus aureus* in this medium in one minute. It penetrates the tissues readily. The drug is tolerated in a strength of 1 per cent by the bladder, renal pelvis and urethra; a 2.5 per cent solution applied to the anterior urethra causes only temporary discomfort. No systemic effects have been observed following its local application in the human. Mercurochrome-220 soluble has been used in cystitis and urethritis and in chancroidal ulcerations; also in affections of the eye and ear, such as ophthalmia neonatorum and otitis media. The drug has also been injected intravenously in the treatment of septicemias and of local infections (subcutaneous abscesses following severe injury, retroperitoneal abscess following bladder instrumentation, etc.). The drug seems to be particularly active against organisms of the colon group; although it has seemed to give good results in some cases of staphylococcus and streptococcus septicemia, it is often times without effect. The intravenous injection is usually but not invariably followed by a transient increase of temperature and vomiting and sometimes by a severe diarrhea.

Dose—A 1 per cent aqueous solution is used for bladder injections. In the treatment of acute anterior gonorrhea, a 2.5 per cent solution is used every three hours. In chancroidal ulcerations, the drug is applied as a moist dressing (1 per cent), or as a starch paste (5 per cent), or as an ointment (5 per cent). In ophthalmia neonatorum a 2.5 per cent solution is freely instilled in each eye several times a day. The dose by intravenous injection has usually been 0.005 Gm. per kilo of body weight. This dosage is administered in a one per cent solution, freshly prepared from recently distilled water and filtered before using. Solutions are self-sterilizing and should not be boiled. They should be made up from the drug itself, as the tablets are not suitable for this purpose.

Mercurochome-220 soluble is incompatible with acids, with the salts of most alkaloids and with most local anesthetics. The aqueous solution stains the skin red but the discoloration may be removed by a washing in a solution of sodium hypochlorite (solution of chlorinated soda).

Manufactured by Hynson, Westcott and Dunning.

Mercurol, N. N. R.—*Hydrargyri Nucleinas*—Mercury Nucleinate—An organic compound of mercury with nucleinic acid from yeast, containing 20 per cent of metallic mercury.

A brownish-white powder, soluble in water, especially in warm water, insoluble in alcohol. Its watery solution has a distinct metallic taste, a weak alkaline reaction, and is not precipitated by alkalies, nor by albuminous liquids.

The mercury in this preparation resists the action of hydrogen sulphide to a marked degree.

Uses—Mercurol does not coagulate albumin; it has marked bactericidal power and possesses the pharmacologic action of soluble mercury compounds.

It is said to be useful as a local antiseptic application and as an antisyphilitic remedy.

Dose—From ½ to 2 grains (0.03 to 0.12 Gm.).

Manufactured by Parke, Davis and Company.

Mercurosal, N. N. R.—Disodiumhydroxymercurisalicyloxyacetate—$(HOHg).NaOOC.C_6H_3.OCH_2COONa$—Mercurosal contains from 43.0 to 43.8 per cent of mercury in organic combination.

A white, amorphous powder. It is soluble in about 10 parts of water, insoluble in the usual organic solvents. Dilute aqueous solutions of mercurosal are quite stable when protected from air, but on prolonged standing may give rise to an insoluble compound. Mercurosal is decomposed by acids, strong reducing agents; salts of heavy metals, such as silver or lead, yield insoluble precipitates. From a 1 to 2 per cent aqueous solution of mercurosal, calcium chloride precipitates a calcium salt which dissolves on subsequent dilution with water. Mercurosal is faintly alkaline to phenolphthalein solution.

Uses—It is claimed that mercurosal is relatively free from irritant action, that it is eliminated without untoward effect on the kidney and that its toxicity is relatively lower than mercuric chloride and mercuric salicylate. Mercurosal is intended for the mercurial treatment of syphilis. It is administered either intramuscularly or intravenously.

Dose—The usual intramuscular dose is 0.05 Gm. dissolved in 2 cc. of sterile water, every fourth or fifth day for ten or twelve doses. The usual intravenous dose is 0.1 Gm. dissolved in 5 cc. of sterile water administered every second or third day for ten to twelve doses.

Manufactured by Parke, Davis and Company.

Mergal, N. N. R.—A mixture of 1 part of mercuric cholate and 2 parts of albumin tannate put up in capsules. Each capsule is said to contain approximately 2¼ grains (0.15 Gm.) of mergal, equivalent to ¾ grain (0.05 Gm.) of mercuric cholate and 1½ grains (0.1 Gm.) of albumin tannate. Mergal contains approximately 4.4 per cent of mercury.

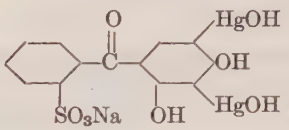
A yellowish-white, loose, somewhat light powder, insoluble in water and alcohol and almost insoluble in solution of sodium chloride.

Uses—Mergal is said to pass through the stomach without decomposition and to be decomposed into its constituents in the small intestine, where the mercury is quickly absorbed into the blood and excreted through the kidneys. It is said to be useful in all forms of syphilis and in the so-called parasyphilitic affections, such as tabes and general paralysis.

Dose—Onc capsule three times a day after meals, gradually increasing to two capsules, five or six times a day.

Manufactured by Riedel and Company, Brooklyn.

Meroxyl, N. N. R.—A mixture containing approximately 50 per cent of the sodium salt of 2,4-dihydroxy-3,5-dihydroxymercuribenzophenone-2′-sulphonic acid,



with foreign matter consisting of ammonium 2,4-dihydroxybenzophenone-2-sulphonate, sodium acetate and water.

A flesh colored or pink powder easily soluble in hot water up to 10 per cent. Solutions of 2.5 per cent or stronger gel or form a deposit on cooling. The color of the solution varies with concentration; a 0.5 per cent solution has a brownish-pink color with greenish fluorescence, the color becoming browner in more concentrated solutions. The solution produces no stain on skin or fabrics.

Uses—A local antiseptic and germicide recommended for superficial infections. It is used for wet dressings of wounds, and also for irrigation of wounds and of infected bladders.

Dose—For wet dressing of wounds and irrigation of infected wounds, a 0.1 per cent solution is used For prophylactic treatment of urinary infection, postoperative cystitis, acute gonorrhea, abscess and carbuncle, a 0.5 per cent solution is employed. Solutions of 2.5 per cent or greater strength gelatinize on standing.

Manufactured by Hynson, Westcott and Dunning.

Metaphen, N. N. R.—Bisacetoxymercuri-4-nitro-2-cresol. $(CH_3COOHg)_2$: $(C_6H.CH_3.OH.NO_2)$ — Metaphen contains from 58 to 60 per cent of mercury in organic combination.

A yellow, odorless and tasteless substance; insoluble in water, almost insoluble in methyl alcohol, acetone, ether and aqueous sodium carbonate and sodium bicarbonate solution; soluble in dilute aqueous sodium hydroxide solution and in ammonium hydroxide solution; soluble in boiling glacial acetic acid and in nitric acid at room temperature.

Uses—Metaphen is a germicide, more powerful than mercuric chloride and certain organic mercury compounds when tested on cultures of *Staphylococcus aureus* and *Bacillus typhosus*. It is stated to be relatively non-irritating when applied to mucous membranes or the skin and to be without deleterious action on metallic instruments or rubber. Metaphen is claimed to be relatively non-toxic.

Metaphen is proposed for use in the treatment of gonorrhea, infections of the eye, for skin sterilization, and for sterilization of instruments and rubber.

Dose—Solutions of metaphen in water are prepared with the aid of sodium hydroxide. For disinfection of instruments solutions of 1 :5000 to 1 : 1000; for application to the skin solutions of 1 : 5000 to 1 :1000; for ophthalmological use solutions of 1 : 10,000 to 1 : 5000 and for urethral irrigation solutions of 1 : 5000 to 1 : 10,000 are proposed.

Manufactured by The Abbott Laboratories.

Novasurol, N. N. R.—The double salt of sodium mercurichlorphenyl oxyacetate with diethylbarbituric acid (barbital)—$(NaOOCCH_2.O).Cl.C_6H_3.Hg[CO.NHCO.C(C_2H_5)_2.CONH]$—Novasurol contains 33.9 per cent of mercury.

A white, crystalline powder, odorless; soluble in cold water. The solution is slightly alkaline. Addition of strong acids to a solution of novasurol yields a precipitate consisting of diethyl barbituric acid, and the mercury derivative of chloro-phenyloxyacetic acid; on heating the solution the latter breaks up to mercuric chloride and chloro-phenyloxyacetic acid.

Uses—Novasurol was introduced originally as an antisyphilitic, but seems to be used chiefly as a diuretic. It has the advantage over mild mercurous chloride and other insoluble mercury compounds in that it is soluble and may be administered by intramuscular or intravenous injection.

As an antisyphilitic, novasurol has generally been injected intravenously mixed with one of the arsphenamines; this is considered by some to be the most satisfactory method of obtaining the combined action of arsenic and mercury. It is recommended, however, that this treatment be followed by the administration of mercury by one of the usual methods.

Dose—The dose as a diuretic ranges from 1 to 2 cc. of the 10 per cent solution injected intramuscularly or intravenously. It is recommended that 0.75 cc. be given first, in order to determine the patient's tolerance for mercury. If the drug is well borne, the dose can be increased to 1 cc. or up to 2 cc., according to the effect observed. The drug is given once or twice a week. Digitalis may be given as indicated.

The injections are said to be painless usually, or at least the pain and discomfort are slight and transient; induration at the site of injection is said to be of rare occurrence and of short duration.

The initial dose as an antisyphilitic is 0.75 cc. or 1 cc. of the 10 per cent solution injected intramuscularly once or twice weekly; later the dose may be increased to 2 cc. Recently it has been administered with arsphenamine; 1 cc. of the 10 per cent solution of the drug being mixed with a dose of the arsphenamine and injected intravenously: this is repeated about every five days until eight doses have been taken.

Manufactured by The Bayer Company, Inc.

Calomelol, N. N. R.—*Hydrargyri Chloridum Mite Colloidale*—Colloidal Calomel—A colloidal form of calomel, containing albuminoids.

A white-gray, odorless and tasteless powder, containing 80 per cent of mercurous chloride and 20 per cent of protein. With water, it forms an opalescent suspension insoluble in alcohol, ether and benzene. (In these suspensions, colloidal bodies are in such an extreme state of subdivision that they were formerly supposed to be in solution and are still so considered.) It is precipitated from its aqueous suspension by acids, the precipitate being redissolved by alkalies.

Uses—The action of calomelol is the same as that of calomel, but it is claimed that it is superior because of its power of forming colloidal suspension in water, acting more rapidly and efficiently, and that it is non-irritant. The indications for its use are the same as for calomel.

Dose—Internally, the same as calomel. Externally it is used as a dusting powder, mixed with an equal quantity of starch or of a mixture of starch and zinc oxide, or in the form of calomelol ointment. It should be protected from the light.

Manufactured by Heyden Chemical Company.

CHAPTER LXII

AMYLACEOUS AND MUCILAGINOUS PRINCIPLES AND THEIR PRODUCTS

STARCH has the same chemical composition as cellulose, $(C_6H_{10}O_5)n$, and is closely allied to it in some of its chemical properties. Starch is stored up in plant cells and is of future usefulness in the formation of their cell-walls, conversion into soluble carbohydrates, etc. It exists in the form of granules, the shape of which may be described as spherical, ellipsoidal, ovoid, lenticular polygonal, or irregular, and it is possible to identify the starches obtained from various plants, with the aid of the microscope, through the shape and size of the granules.

The granules consist of layers of different densities, arranged concentrically around a point termed the hilum, which is usually at one end of the granule. Corn starch is official in the U. S. P., and potato starch as a reagent in the assay of extract of malt.

AMYLUM. U.S. Starch

[**Amyl.**—CORN STARCH]

Starch consists of the granules separated from the grain of *Zea Mays* Linné (Fam. *Gramineæ*).

Starch contains but a trace of foreign organic matter and yields not more than 0.5 per cent of ash, and not more than 14 per cent of moisture.

Preparation—In making starch from corn, the germ must be separated mechanically and the cells then softened so as to permit the escape of the starch granules. This is generally done by permitting it to become sour and decomposed, stopping the fermentation before the starch is affected. Upon the small scale, starch may be made from wheat flour by making a stiff ball of dough and kneading it while a small stream of water trickles upon it. The starch is carried off with the water, while the *gluten* remains as a soft, elastic mass; the latter may be purified and used for various purposes to which gluten is applicable. The quality of commercial starch largely depends upon the purity of the water used in its manufacture. Starch may be made from potatoes by first grating them, and then washing the soft mass upon a sieve, which separates the cellular substances and permits the starch granules to be carried through. The starch must then be thoroughly washed by decantation, and the quality of this starch also depends largely upon the purity of the water that is used in washing it.

Description and Physical Properties—In irregular, angular white masses or in fine powder; consisting chiefly of polygonal, rounded or spheroidal starch grains from 0.003 to 0.035 mm. in diameter and usually with a lenticular or 3- to several-rayed central cleft; inodorous; taste characteristic, slight.

Starch is insoluble in cold water and in alcohol.

The individual grains of Starch are colored a deep blue by iodine T.S.

Tests for Identity—Boil 1 Gm. of Starch with 15 cc. of water: upon cooling, a translucent, whitish jelly forms.

Tests for Purity—Triturate about 0.5 Gm. of Starch with 5 cc. of distilled water: the mixture is neutral to litmus paper.

Add 10 cc. of distilled water to 1 Gm. of Starch, and acidify with 0.5 cc. of hydrochloric acid: the mixture should show no blue color within five minutes on the addition of three drops of potassium ferrocyanide T.S. (*iron*).

U. S. P. Preparation—Glyceritum Amyli. It is used as a diluent in powdered extracts.

N. F. Preparations—Pasta Resorcinolis Fortis; Pasta Resorcinolis Mitis; Pasta Zinci; Stilus Acidi Salicylici Dilubiles.

Starch is present in many drugs, and is an important constituent of many vegetable foods.

Starch, when moistened with diluted acids and heated, or through the action of diastase, or even when heated alone, is converted into *dextrin*, a substance resembling gum in appearance and properties. Dextrin is largely dissolved by water, hot or cold, and forms a viscous solution, from which it is precipitated by alcohol. Large quantities of dextrin are now made both in America and abroad, and used for various purposes in the arts, under the name of *artificial gum* or *British gum*. It is found in the market in the form of a white, brilliant powder, or in small masses or fragments resembling natural gum. It may be distinguished from gum arabic by the taste and the peculiar, harsh sensation when rubbed in the hand. It is official in the N. F. (see page 889).

Inulin, $(C_6H_{10}O_5)n$, is a substance closely allied to starch. It is found in some of the plants belonging to the family *Compositæ*, as Inula, Taraxacum, Pyrethrum, Lappa, etc. It has also been found, according to Kraus, in plants of the *Campanulaceæ*, *Goodeniaceæ*, *Lobeliaceæ*, and *Stylidaceæ*. It differs from starch in the following particulars: it is colored yellow by iodine, does not gelatinize with water, and is not found in plants in the form of granules having concentric layers like starch.

Uses—Starch is used in a number of official preparations chiefly because of its absorbent properties; also used as a filler or diluent in tablets and, in the latter, as a disintegrator (see page 1706). It is used externally as an absorbent, and is applied to the skin by dusting. It is also used to make pastes for applying in skin diseases.

Unofficial Amylaceous Substances and Derivatives

Acorn	From the genus *Quercus*. Acorns contain besides starch a peculiar saccharine substance, *quercite*
Bean	From *Faba vulgaris* and *Phaseolus vulgaris*
Barley	*Hordeum vulgare*. Contains 60 to 68 per cent of starch, glutin, gum, and sugar
Canna	From the rhizome of *Canna edulis*. Fam. Marantaceæ, Cannæ. Indigenous to Peru and Brazil. The starch granules are very large, and exhibit a glistening or satiny appearance. It forms a cloudy but very tenacious jelly with boiling water
Cassava, Tapioca, Manioc	From the root of *Manihot utilissima*. Fam. Euphorbiaceæ. Habitat, Tropical America. The starch granules are about half the size of the potato starch granules. *Pearl* or *flake tapioca* occurs in somewhat translucent pieces, inodorous, having an insipid taste
Curcuma, Turmeric	From the rhizome of *Curcuma longa*. Fam. Zingiberaceæ. Habitat, Southern Asia. The starch granules are rather larger than those of maranta
Maranta Arrowroot	From the rhizome of *Maranta arundinacea*. Fam. Marantaceæ. Indigenous to West Indies and tropical America. Prepared by removing the scales from the rhizome, mashing and grinding in a mill until reduced to a pulp, then suspending this in water and separating the fibrous portion, either by hand or sieve; lastly, washing thoroughly, and drying with a gentle heat. The yield is from 13 to 20 per cent of fecula. It forms an opaque jelly with concentrated hydrochloric acid
Oats	From *Avena sativa*. Fam. Gramineæ. Habitat, Asia, cult. The grain contains 64 to 66 per cent of starch, besides protein compounds, fat, salts, etc.
Pea	From *Pisum sativum*. It yields about 37 per cent of starch
Potato	(See U. S. P. Reagents, Chapter XCII).
Sweet Potato	From *Convolvulus Batatas*. The yield of starch is about 16 per cent
Rice	From *Oryza sativa*. Prepared by heating rice with weak soda-lye, which dissolves the nitrogenous impurities and leaves pure starch, then adding a solution of borax to facilitate the separation of the starch from the gluten. The yield is about 88 per cent
Rye	From *Secale cereale*. The yield of starch is about 64 per cent
Sago	From the pith of *Metroxylon Rumphii* and *M. læve*. Fam. Palmæ. Prepared by powdering the pith of the tree, washing with water to remove woody tissue and other impurities; lastly, drying carefully and granulating
Wheat	From *Triticum vulgare*. Fam. Gramineæ. Formerly official, now replaced by corn starch

MALTUM. U. S. Malt

Malt is the grain of one or more varieties of *Hordeum vulgare* Linné (Fam. *Gramineæ*), partially germinated artificially, and containing amylolytic enzymes.

Description and Physical Properties—Yellowish or amber-colored grains. Malt is crisp when broken, the interior surface being nearly white. It has an agreeable, characteristic odor and a sweet taste, due to the conversion of the starch of the seed into maltose through the action of the diastase. Malt floats on cold water.

For the subsequent tests prepare an infusion as follows: Mix 10 Gm. of Malt, in coarse powder, with 100 cc. of distilled water, and maintain the mixture at a temperature of from 50° to 55° C. for one hour, occasionally stirring. Place it upon a filter, and, when the liquid has passed through, wash the contents of the filter with distilled water, in small portions, until the combined infusion and washings measure 200 cc.

Tests for Purity—The weight of the solid soluble constituents of Malt, obtained by evaporating to dryness on a water bath an aliquot portion of the freshly prepared, aqueous infusion, and drying the residue for one hour at 100° C. is not less than 70 per cent of the Malt taken.

The acidity of Malt, determined by titrating an aliquot portion of the freshly prepared infusion with tenth-normal sodium hydroxide, using phenolphthalein T.S. as indicator, does not exceed 0.3 per cent calculated as lactic acid.

Preserve protected from heat and moisture.

U. S. P. Preparation—Extractum Malti.

Preparation—When barley is steeped for two or three days in water, it swells, becomes somewhat tender, and the water is colored reddish-brown. If the water is drained off, and the barley is spread about two feet thick upon a floor (a stone floor is generally used), it heats spontaneously, and germination begins, the radicle making its appearance first. The growth of the grain is partially stopped at this stage by spreading it more thinly, and turning it over for two days. It is then raked into heaps and allowed to stand a day, when it becomes hot, and is subsequently thoroughly dried in a kiln by a slow, regulated moderate heat. The resulting product is called *malt*, and it differs in quality according as it is more or less soaked, drained, germinated, dried, or baked. It is distinguished by its color, being pale, amber, brown, or black malt, according to the degrees of heat used in drying it. The object of converting grain into malt is to bring about the development of an enzyme called *diastase*. The effect of this enzyme during the process of *malting*, as the operation is called, is to change the *starch* naturally present in the grain into *maltose*, a peculiar kind of sugar, and dextrin. The diastase which is developed is capable of converting into maltose much more starch than is contained in the grain in which it is produced; hence, if good malt is added to a certain quantity of unmalted grain, the starch in the latter may be also converted into maltose. Malt seldom contains diastase in larger proportion than two parts in a thousand. Diastase is separated from malt by bruising the malt, adding about half its weight of water, expressing strongly, treating the viscid liquid thus obtained with sufficient alcohol to destroy its viscidity, then separating the coagulated albuminous and gummy matter, and adding a large excess of alcohol, which precipitates the diastase in an impure state. To render it pure, it must be redissolved in water, and reprecipitated by alcohol. Although malt has been manufactured in large quantities for centuries for brewing purposes and for converting starches into sugars for the purpose of manufacturing alcohol therefrom by fermentation, it is now also employed in medicine, in the form of extracts of malt, malt foods, etc. Its usefulness in this connection is due to the fact that the amount of diastase present in good malt has the power of *rendering soluble starchy substances which are taken into the stomach as food* and a good extract of malt is not only an easily digested food product, but also actively aids in the digestion of starchy foods. Some of the commercial malt extracts are practically valueless, as they consist of glucose colored with caramel and slightly flavored with extract of malt.

Malt is used as a nutrient, digestant flavoring, and emulsifying agent.

Unofficial Preparation

DIASTASUM. U. S. P. IX. Diastase

Although no longer official diastase is sometimes used or prescribed. The formerly official description and tests were as follows:

A mixture containing amylolytic enzymes obtained from an infusion of malt. It converts not less than 50 times its weight of potato starch into sugars.

Preparation—It is prepared by adding alcohol to an infusion of malt at a temperature not exceeding 60° C., collecting and purifying the precipitate.

Another form of diastase known by the proprietary name of *taka diastase* is the product of the growth of a fungus, *aspergillus oryzæ*, upon steamed rice. It is not identical with malt diastase either in composition or digestive properties. Malt diastase acts upon gelatinized starch at a temperature of 45° to 55° C. with the result that the starch is transformed first into *amylodextrin*, *erythrodextrin*, *achroödextrin* and finally into maltose.

Description—It occurs as a yellowish-white amorphous powder or in translucent scales. It converts starch into dextrin and maltose.

Odor and Taste—Odorless and tasteless.

Diastase gradually loses its amylolytic power on keeping; this power is destroyed by heating its solutions above 85° C. (185° F.) or by the addition of much acid and is diminished by the presence of acids or alkalies.

Solubility—Diastase is soluble in water, the solutions being more or less turbid; almost insoluble in alcohol.

Assay—Mix a quantity of potato starch, purified as directed under *Pancreatinum*, equivalent to 5 Gm. of dry starch, in a beaker with 10 cc. of cold distilled water. Add 140 cc. of boiling distilled water, and heat the mixture on a water bath with constant stirring for two minutes, or until a translucent, uniform paste is obtained. Cool the paste to 40° C. in a water bath previously adjusted to this temperature. Prepare a fresh solution of 0.1 Gm. of Diastase in 10 cc. of distilled water at 40° C. and add it to the paste. Mix them well and maintain the same temperature for exactly thirty minutes, stirring frequently; a thin, nearly clear liquid is produced. Add at once 0.1 cc. of this liquid to a previously made mixture of 0.2 cc. of tenth-normal iodine V.S. and 60 cc. of distilled water; no blue or reddish color is produced.

Preserve it in well-closed containers, protected from light, heat and moisture.

Uses—It is used as a digestant for starchy foods in doses of one to eight grains (0.06-0.5 Gm.). As it is not active in acid media, it should be given about a half hour after beginning a meal while the stomach is yet alkaline.

Gums and Mucilaginous Substances

The natural gums and mucilaginous principles of plants were formerly thought to be carbohydrates. They are probably of a glucosidal nature as upon hydrolysis they yield sugars and characteristic acids of high molecular weight.

Gums are amorphous and transparent or translucent. They are all insoluble in alcohol. Some dissolve completely in water, giving viscid solutions, others merely swell in water to form a paste or jelly, a few are almost insoluble. Soluble gums yield levorotatory solutions which are precipitated by basic lead acetate solution or normal lead acetate solution.

Upon hydrolysis gums yield *galactose* and *pentoses* as *arabinose* or *xylose*.

Upon oxidation with nitric acid gums yield *mucic*, ($C_6H_{10}O_8$), *saccharic*, ($C_6H_{10}O_8$), and *oxalic*, ($C_2H_2O_4$), *acids*. The true gums are usually found in combination with potassium, calcium, or magnesium.

In the classification of gums the following distinctive types are recognized: *arabin*, which is completely soluble in water; *bassorin* and *cerasin*, which are partially soluble or swell in contact with water; *mucilages* and *pectins*, which merely swell to form jellies. Many gums are complex mixtures of several of these types. When the unqualified word *gum* is used in the enumeration of plant constituents it has no definite meaning.

ACACIA. U. S. Acacia

[Acac.—Gum Arabic]

Acacia is the dried gummy exudation from the stems and branches of *Acacia Senegal* Willdenow, or of some other species of *Acacia* (Fam. *Leguminosæ*).

Acacia yields not more than 1 per cent of water-insoluble residue, and not more than 15 per cent of moisture.

Description and Physical Properties—In roundish tears of various sizes, or broken into angular fragments, with a glass-like, sometimes iridescent fracture, opaque from numerous fissures, but transparent and nearly colorless in thin pieces; nearly inodorous; taste insipid, mucilaginous; insoluble in alcohol, but soluble in about twice its weight in cold water, forming a thick, mucilaginous liquid. The *powder* should be white and free from foreign particles.

For further description and tests see the U. S. P. X.

U. S. P. Preparations—Mucilago Acaciæ; Emulsum Olei Morrhuæ; Emulsum Olei Terebinthinæ; Pilulæ Phosphori; Pulvis Cretæ Compositus.

N. F. Preparations—Emulsum Olei Morrhuæ cum Hypophosphitibus; Emulsum Olei Ricini; Emulsum Petrolati; Mistura Copaibæ; Mistura Copaibæ et Opii; Pilulæ Ferri Iodidi; Trochisci Eucalypti Gummi.

This valuable gum consists mainly of arabic acid, or arabin, combined with lime, potassium, or magnesium, and hence it may be called calcium, potassium, or magnesium arabate. It is bleached by exposure to the sun.

One hundred parts of diluted alcohol containing 22 per cent of alcohol by volume dissolve fifty-seven parts of gum; diluted alcohol containing 40 per cent of alcohol takes up ten parts, while 50 per cent alcohol dissolves only four parts. A knowledge of these solubility figures will enable the pharmacist to determine the possibility of precipitation in extemporaneous mixtures when both acacic and alcoholic liquids are present.

Uses—In pharmacy, acacia is extensively used for the suspension of insoluble substances in water, and for the formation of pills and troches. Two kinds of powdered acacia are used, one a coarse powder called *granulated*, the other *finely dusted*. The granulated dissolves more readily in water, because it has lost during desiccation only a part of its moisture, while in preparing the "finely dusted" powder, the high heat necessarily used to dry it thoroughly drives off nearly all of the water. Its easy solubility and its absence of tendency to form "lumps" cause the coarse powder to be preferred for solutions, emulsions, etc. Acacia is used as a binding agent in emulsions, pills, troches, etc. (See official preparations and the Chapter on Colloids.)

It is used for its demulcent action in inflammations of the throat or stomach.

TRAGACANTHA. U. S. Tragacanth

[Trag.—Gum Tragacanth]

Tragacanth is the dried gummy exudation from *Astragalus gummifer* Labillardière, or other Asiatic species of *Astragalus* (Fam. *Leguminosæ*).

Description and Physical Properties—In narrow or broad bands, more or less curved or contorted, marked by parallel lines or ridges, white or faintly yellowish, translucent, horn-like, tough. Rendered more easily pulverizable by a heat of 50° C.; inodorous; taste insipid, mucilaginous. (For further description and tests see the U. S. P. X.)

Powdered Tragacanth—White, angular fragments of mucilage with circular or irregular lamellæ; starch grains from 0.003 to 0.025 mm. in diameter, spherical to elliptical, with occasional 2- to 4-compound grains, many of the grains being swollen and more or less altered. The powder shows few or no fragments of lignified vegetable tissue (*Indian gum*).

U. S. P. Preparations—Mucilago Tragacanthæ; Pilulæ Ferri Carbonatis; Trochisci Acidi Tannici; Trochisci Ammonii Chloridi.

N. F. Preparations—Emulsum Olei Morrhuæ cum Malto; Glyceritum Tragacanthæ; Stili Acidi Salicylici Dilubiles; Syrupus Trifolii Compositus; Trochisci Eucalypti Gummi; Trochisci Ulmi.

This gum consists of bassorin, and a soluble gum (not arabin). Introduced into water, it absorbs a certain proportion of that liquid, swells very much, and forms a soft adhesive paste, but does not dissolve. If agitated with an additional quantity of water, this paste forms a uniform mixture; but in the course of one or two days the greater part separates, and is deposited, leaving a portion dissolved in the supernatant fluid. Tragacanth is wholly insoluble in alcohol. A common adulteration is *Indian Gum*, and the Pharmacopœia has introduced several tests to detect its presence.

Uses—Tragacanth, in the form of a glycerite, affords an excellent pill excipient; the powder itself is often used to stiffen a pill mass and render it adhesive. It is also largely employed as an emulsifying agent and a small amount of potassium bitartrate added to the powdered tragacanth, greatly increases its emulsifying properties. It is sometimes used as a demulcent in sore throat.

AGAR. U.S. Agar

[**Agar-agar**—Chinese or Japanese Gelatin (Isinglass)]

Agar is the dried mucilaginous substance extracted from *Gelidium corneum* (Hudson) Lamouroux and other species of *Gelidium* and closely related algæ (Class *Rhodophyceæ*).

Agar contains not more than 1 per cent of foreign organic matter, and yields not more than 1 per cent of acid-insoluble ash, and not more than 16 per cent of moisture.

Description and Physical Properties—Usually in bundles from 3 to 6 dm. in length, consisting of thin, translucent, membranous, agglutinated pieces 4 to 10 mm. in width; externally yellowish-white or brownish-white, tough when damp, brittle when dry, with a slight odor and a mucilaginous taste. It is also obtainable commercially in the form of powder and also in threads.

For additional description and tests, see the U. S. P. X.

Uses—It is used in culture media for bacteriological work (see Diagnostical Reagents, Chapter XCIII); also administered internally, in doses of two to three drachms (8 to 12 Gm.), to give moisture and bulk to the intestinal contents in chronic constipation.

It is also popularly employed as an emulsifying agent for liquid petrolatum, frequently accompanied with phenolphthalein in the form of *petrolatum-agar emulsions.*

Unofficial Agar Preparation

Phenolphthalein-Agar—Agar impregnated with phenolphthalein, 100 Gm. containing 3 Gm. of phenolphthalein.

Actions and Uses—Phenolphthalein-agar is claimed to have the properties of agar augmented by the action of phenolphthalein.

Dose—Fifteen grains (1 Gm.), twice daily, after breakfast and supper, increased or diminished according to requirements.

Manufactured by the Reinschild Chemical Company.

ULMUS. U.S. Elm

[Elm Bark, Slippery Elm, Slippery Elm Bark, Red Elm, Indian Elm, Sweet Elm, American Elm]

Elm is the dried inner bark of *Ulmus fulva* Michaux (Fam. *Ulmaceæ*).

Description and Physical Properties—In flat pieces, varying in length and width, about 3 mm. thick, tough, pale brownish-white, the inner surface finely ridged; fracture fibrous and mealy; the transverse section delicately checkered; odor slight, peculiar; taste mucilaginous, insipid.

For further description and tests, see the U. S. P. X.

N. F. Preparation—Trochisci Ulmi.

This bark contains a mucilage which is capable of being precipitated from its aqueous solution by alcohol and lead acetate. It is much used as a demulcent.

ALTHÆA. U.S. Althea

[Marsh Mallow Root, Marshmallow]

Althea is the dried root of *Althæa officinalis* Linné (Fam. *Malvaceæ*), deprived of the brown, corky layer and small roots.

Description and Physical Properties—In cylindrical or somewhat conical pieces, from 10 to 15 cm. long, 10 to 15 mm. in diameter, deeply wrinkled; deprived of the brown, corky layer and small roots; externally white, marked with a number of circular spots, and of a somewhat hairy

appearance from the loosened bast-fibers; internally whitish and fleshy. It breaks with a short, granular, and mealy fracture, has a faint, aromatic odor, and a sweetish, mucilaginous taste.

For further description and tests, see the U. S. P. X.

U. S. P. Preparations—Massa Hydrargyri; Pilulæ Ferri Carbonatis.

N. F. Preparations—Species Pectorales; Syrupus Althææ.

This root, which is generally imported from Europe, contains a large quantity of mucilage associated with *asparagin*, sugar, and starch. It is used as a demulcent and as a filler for pill masses (see the official preparations above). The leaves are official in the N. F.

LINUM. U.S. Linseed

[Flaxseed]

Linseed is the dried ripe seed of *Linum usitatissimum* Linné (Fam. *Linaceæ*).

Linseed contains not more than 2 per cent of other seeds or foreign organic matter, and yields not less than 30 per cent of non-volatile, ether-soluble extractive, at least 98 per cent of which is saponifiable.

Description and Physical Properties—About 4 or 5 mm. long, oblong-ovate, flattened, obliquely pointed at one end, brown, glossy, covered with a transparent, mucilaginous epithelium, which swells considerably in water; the embryo whitish or pale greenish, with two large, oily, plano-convex cotyledons, and a thin perisperm; inodorous; taste mucilaginous, oily and bitter.

For further description and tests, see the U. S. P. X.

Linseed Meal—Yellow with numerous brown fragments; the fragments of both seed-coat and kernel mostly very coarse and with the same cellular tissues as those of the powder.

N. F. Preparation—Species Emollientes.

Linseed contains 15 per cent of mucilage in the epithelium, and from 20 to 35 per cent of fixed oil in the nucleus, besides resin, sugar, wax, etc. The mucilage is soluble in water, but more readily in hot water, forming a thick, viscid liquid. Alcohol and lead subacetate precipitate it from its aqueous solution. The mucilage is an important constituent; the seed is used in its unground state for making a demulcent infusion. Ground flaxseed is very useful to the pharmacist for making lutes, and medicinally, it is valuable for making poultices. Whole linseed is occasionally used for its laxative effect. The fixed oil is very valuable in the arts because of its drying properties. (See Oleum Lini.)

ALTHÆA FOLIA. N.F. Althea Leaves

[Alth. Fol.—Marsh Mallow Leaves]

Althea Leaves consist of the dried leaves of *Althæa officinalis* Linné (Fam. *Malvaceæ*).

Althea Leaves contain not more than 5 per cent of stems and fruits or other foreign organic matter.

Description—Crumpled or matted; gray-green or yellowish gray-green; densely and finely tomentose throughout; petioles 1 to 6 cm. long; blades 3 to 15 cm. long and 3 to 10 cm. wide, thin, cordate or rhomboidal-ovate in outline, rounded, or nearly truncate at the base, acute at the apex; margin doubly serrate-dentate, the principal teeth from 1 to 3 pairs, the lowest almost large enough to be regarded as lobes, the secondary very irregular, triangulate, acute, broader than long, the sinuses acute; 2 to 6 principal veins originating with the midrib in the petiole, prominent underneath, terete; branches of midrib arising at a wide angle; nearly straight, each terminating in a marginal tooth. Odor slight, scarcely characteristic; taste mucilaginous.

For further description see the N. F. V.

N. F. Preparation—Species Emollientes.

Uses—Used as a demulcent, emollient and protective in doses of about thirty grains (2 Gm.).

AVENA SATIVA. N.F. Oat

[Aven. Sat.]

Oat is the grain of *Avena sativa* Linné (Fam. *Gramineæ*).

Oat contains not more than 5 per cent of other seeds or of foreign organic matter.

Descriptions and Tests—See N. F. V.

Uses—In the form of meal, known as *oatmeal*, it affords a nutritious, bland food, which from its somewhat laxative tendency, is often preferable to other amylaceous preparations.

To prepare *oatmeal gruel*, boil an ounce of the meal with three pints of water and strain. Sugar and lemon may be added.

Preparations—Elixir Hydrastis Compositum, Fluidextractum Avenæ Sativæ.

Dose—60 grains (4 Gm.).

CHONDRUS. N. F. Chondrus
(U. S. P. IX)

[Chondr.—Irish Moss, Carrageen]

Chondrus is the dried bleached plant of *Chondrus crispus* (Linné) Stackhouse or of *Gigartina mamillosa* (Goodenough et Woodward) J. Agardh (Fam. *Gigartinaceæ*).

Chondrus contains not more than 2 per cent of foreign organic matter.

Description—Entire plants matted together, consisting of a slender stalk from which arises a series of dichotomously branching, more or less flattened segments, emarginate or deeply cleft at the tips; from 5 to 15 cm. in length and 1 to 10 mm. in width; yellowish-white; translucent, frequently coated with a calcareous deposit which effervesces with hydrochloric acid; sometimes with fruit bodies or sporangia embedded near the apex of the segments (in *C. crispus*) or with sporangia borne on short tuberculated projections or stalks, more or less scattered over the upper portion of the segments (in *G. mamillosa*); somewhat cartilaginous. Odor slight, seaweed-like; taste mucilaginous, saline.

For further description see the N. F. V.

N. F. Preparation—Mucilago Chondri.

This alga grows in the Atlantic Ocean. It contains 70 per cent of a mucilaginous principle, which has been termed *carrageenin*. This differs from ordinary *gums* by not precipitating with alcohol, from *starch* by not becoming blue upon the addition of iodine, and from *pectin* by not being precipitated by lead subacetate.

Uses—Chondrus is used principally as an emulsifying agent for liquid petrolatum (see page 889) and for cod liver oil, the mucilage being used, and to form a "sick diet" jelly, one part being sufficient to form a jelly with sixty parts of water. It should be previously soaked in a small quantity of water, to dissolve adherent salts, and this water thrown away.

Chondrus Gelatin of the N. F. IV was prepared by washing 100 Gm. of chondrus, with cold water, then placing it in a suitable vessel, adding 5000 cc. of hot water, and heating on a water bath for fifteen minutes, frequently stirring. The decoction must then be strained while hot, through a strong muslin strainer, the strained, mucilaginous liquid returned to the water bath, evaporated to a semi-fluid consistence, then transferred to shallow, flat-bottomedt rays, and evaporated at a temperature not exceeding 90° C. so that the product may be detached in scales. It is used as a demulcent and nutritive.

DEXTRINUM ALBUM. N. F. White Dextrin
[Dext. Alb.]

A mixture of soluble carbohydrates, amylodextrin, achroödextrin, erythrodextrin and maltodextrin, together with a variable amount of unconverted starch, obtained by the incomplete hydrolysis of starch by the action of an acid.

Description and Physical Properties—White Dextrin occurs as a white, glistening, non-hygroscopic, amorphous powder, producing a peculiar and characteristically harsh sensation when rubbed in the hand; odorless and having a sweetish taste.

Only partly soluble in cold water, but completely soluble in three parts of water on boiling.

Tests for Identity—An aqueous solution prepared in the cold and filtered is colored wine-red by iodine T.S.; an aqueous solution prepared with boiling water is colored blue by iodine T.S.

Alkaline cupric tartrate solution is not changed by a solution of White Dextrin in the cold, but is reduced on boiling.

Tests for Purity—Separate portions of a freshly prepared, filtered solution in cold water do not become turbid on the addition of calcium chloride T.S., or of calcium hydroxide T.S. (*oxalic acid*).

Not more than 5 per cent of White Dextrin is soluble in boiling alcohol (*dextrose*). Dry White Dextrin at 110° C.: it loses not more than 10 per cent in weight (*moisture*).

Separate portions of a filtered aqueous solution of White Dextrin (1 in 20) are not immediately precipitated by lead acetate T.S., or by basic lead acetate T.S., but upon the addition of a few drops of ammonia water to the mixtures, precipitation occurs (difference from *natural gums*).

A solution of White Dextrin does not darken on the addition of hydrogen sulphide T.S. even when supersaturated with ammonia water (*metals*).

White Dextrin yields not more than 0.5 per cent of ash.

N. F. Preparations—Pasta Dextrinata; Stili Acidi Salicylici.

Uses—Used as the basis for dermatological pastes and commercially, on a large scale, for the making of *library paste* also for making the adhesive coating for gummed labels, envelope flaps, postage stamps, etc.

This product is known as *artificial gum* or *British gum*.

FUCUS. N. F. Fucus
[Bladderwrack]

Fucus is the dried thallus of *Fucus vesiculosus* Linné, *Fucus serratus* Linné, *Fucus Nodosus* Linné, or *Fucus siliqnosus* Linné Fam. *Fucaceæ*).

Fucus contains not more than 3 per cent of foreign organic matter and yields not more than 4 per cent of acid-insoluble ash.

Description—Sometimes a meter in length, but usually in shorter pieces, from 0.5 to 4 cm. in width, dichotomously branched, brownish-black, or slightly reddish, usually with a slight, whitish incrustation; flat, smooth, entire-margined, having a stout midrib throughout, along which are irregularly disposed pairs of air-vesicles which vary in diameter from 5 to 15 mm.; apex of thallus occasionally swollen, ovate or elliptical, about 5 mm. in diameter and bearing numerous receptacles. Odor strongly seaweed-like; taste saline and nauseous.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Fuci.

Uses—It is popularly employed as an "antifat" remedy but is probably of little value. Dose, ten grains (0.6 Gm.).

GALEGA. N. F. Galega
[Galeg.—European Goat's Rue]

Galega is the dried flowering herb of *Galega officinalis* Linné (Fam. *Leguminosæ*).

Galega contains no stems over 4 mm. in diameter and not more than 3 per cent of foreign organic matter.

Description—Stem smooth, erect, branched, when entire from 15 to 45 cm. long, commonly cut and broken; leaves oddly-pinnate with from 6 to 8 pairs of leaflets; stipules lanceolate, sagittate on one side; leaflets bright green, smooth or slightly hairy, short petioled, lanceolate or ovate-lanceolate, obtuse, slightly mucronate, from 2 to 5 cm. long and from 2 to 6 mm. in width; flowers small, white to violet, in axillary racemes. Odor indistinct; taste mucilaginous, slightly bitter and astringent; it colors the saliva yellowish-green.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Galegæ.

Uses—It is used as a diaphoretic and galactagogue in doses of sixty grains (4 Gm.).

MALVÆ FOLIA. N. F. Mallow Leaves
[Malv. Fol.]

Mallow Leaves consist of the dried leaves of *Malva sylvestris* Linné and of *Malva rotundifolia* Linné (Fam. *Malvaceæ*).

Mallow Leaves contain not more than 10 per cent of other parts of plants yielding the drug and not more than 5 per cent of foreign organic matter.

Description and Physical Properties.

Unground Mallow Leaves—Leaves of *Malva sylvestris*, petiolate with petioles up to 10 cm. in length, orbicular or reniform, slightly truncate or cordate at the base, from 10 to 11 cm. in length, and from 15 to 20 cm. in width, with 3 to 7 shallow, angular or rounded lobes, venation palmate, margins crenate-dentate, pubescent, on both sides. Leaves of *Malva rotundifolia*, with petioles up to 20 cm. in length, orbicular, up to 8 cm. in width, base deeply cordate, 5 to 7 shallow rounded lobes, venation palmate, margins with rounded blunt teeth, pubescence more scant than in *M. sylvestris*. Intermixed with the leaves are frequently found dark purple flowers and glabrous reticulated carpels (*M. sylvestris*) or pale bluish flowers and pubescent rounded carpels (*M. rotundifolia*). Inodorous; on chewing it becomes very mucilaginous, taste bland.

N. F. Preparation—Species Emollientes.

Uses—It is used as an emollient and demulcent.

SASSAFRAS MEDULLA. N. F. Sassafras Pith
[Sassaf. Med.]

Sassafras Pith is the dried pith of *Sassafras variifolium* (Salisbury), O. Kuntz (Fam. *Lauraceæ*).

Sassafras Pith contains not more than 1 per cent of foreign organic matter and yields not more than 0.5 per cent of acid-insoluble ash.

Description and Physical Properties—In sub-cylindrical, often curved or coiled pieces, from 2 to 10 cm. in length and from 2 to 5 mm. in diameter; very light in weight, externally whitish, occasionally with small fragments of adhering wood; fracture short. Odor slight, sassafras-like; taste mucilaginous.

Tests for Purity and Identity—Macerate 0.5 Gm. of Sassafras Pith with 25 cc. of cold distilled water for several hours and filter it through purified cotton: a mucilaginous solution is obtained which does not give a precipitate upon the addition of an equal volume of alcohol; if an excess of alcohol is added precipitation takes place.

For further description see the N. F. V.

N. F. Preparation—Mucilago Sassafras Medullæ.

Uses—The pith contains a delicate mucilage which is not precipitated from its aqueous solution by alcohol. The mucilage is principally employed as an eye wash.

VERBASCI FLORES. N.F. Mullein Flowers

[Verbasc. Flor.]

Mullein Flowers consist of the dried corollas, with adhering stamens, of *Verbascum phlomoides* Linné, or of *Verbascum thapsiforme* Schraeder (Fam. *Scrophulariaceæ*).

Mullein Flowers contain not more than 2 per cent of foreign organic matter. Flowers which have become brown should not be used.

Description and Physical Properties—Corolla light yellow, the outer surface grayish with a fine, soft, wooly indumentum, the inner surface sparsely hairy and finely veined; tube of the corolla 1 or 2 mm. in length and almost equally broad, the limb from 14 to 30 mm. in width, between wheel-shaped and saucer-shaped, obscurely two-lipped, the unequal lobes rounded, obovate. Stamens five, borne on the base of the corolla, shorter than the corolla, two of them longer than the other three, the filaments thick and fleshy, more or less pilose, especially the three shorter ones, usually orange-colored. Stamen-hairs, cylindrical, uni-cellular, non-branching, surface minutely reticulate, apex rounded, frequently enlarged. Pollen grains smooth, triangular and more or less rounded, from 0.025 to 0.035 mm. in diameter. Odor peculiar, agreeable; taste mucilaginous, not agreeable.

Tests for Purity and Identity—The flowers impart a yellow color to boiling water, and a rather permanent green color with dilute sulphuric acid, the latter color becoming brown upon the addition of alkalies.

N. F. Preparation—Species pectorales.

Uses—As a demulcent and expectorant. Dose, two drachms (8 Gm.).

VERBASCI FOLIA. N.F. Mullein Leaves

[Verbasc. Fol.]

Mullein Leaves are the dried leaves of *Verbascum Thapsus* Linné (Fam. *Scrophulariaceæ*).

Mullein Leaves contain not more than 2 per cent of foreign organic matter and yields not more than 4 per cent of acid-insoluble ash.

Description and Physical Properties.

Unground Mullein Leaves—Obovate with narrowed base, or varying to oblong or oblong-lanceolate, without a true petiole, obtuse or tending toward acuteness at the summit, from 1 to 6 dm. in length and from 3 to 15 cm. in width; very thick, rather tough when damp, brittle when dry, light yellowish-gray or greenish-gray, densely long-tomentose, with numerous, multicellular, branching, non-glandular hairs. Nearly odorless; taste mucilaginous and slightly bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Verbasci Foliorum.

Uses—As a demulcent and expectorant. Dose, one drachm (4 Gm.).

Unofficial Mucilaginous Substances

Bael-fruit	The dried, half ripe fruit of *Ægle Marmelos*. Fam. Aurantiaceæ. Habitat, Himalaya Mountains. Used principally in dysentery. Dose of fluidextract, 1 to 2 fluidrachms
Baobab	From *Adansonia digitata*. Fam. Sterculiaceæ. Habitat, Tropical Africa. Used as a tonic
Benne Leaves	From *Sesamum Indicum*. Fam. Pedaliaceæ. Habitat, India. Used as a stimulant
Blue-weed	From *Echium vulgare*. Habitat, Europe. Used chiefly as an emollient and protective
Borage	From *Borago officinalis*. Fam. Boraginaceæ. Habitat, Southern Europe. Used chiefly as an emollient and protective
Cashew-nut	From *Anacardium occidentale*. Fam. Terebinthaceæ. Habitat, Tropical America. Used externally and as a vermifuge
Comfrey-root	The root of *Symphytum officinale*. Fam. Boraginaceæ. Habitat, Europe. Used as a demulcent and astringent
Cydonium, Quince Seed	The seed of *Cydonia vulgaris*. Fam. Rosaceæ. Used for *Mucilago Cydonii*, 2 per cent quince seed, 98 per cent water
Evening Primrose	From *Ænothera biennis*. Fam. Onagraceæ. Habitat, North America

Unofficial Mucilaginous Substances—*Continued*

Fenugreek	The seeds of *Trigonella Fœnum-græcum*. Fam. Leguminosæ. Habitat, Western Asia. Used as an emollient, and in condition powders
Hog Gum	From *Rhus metopium*. Habitat, South America. Used as a demulcent
Hound's Tongue	From *Cynoglossum officinale*. Habitat, Europe and United States. Used as an emollient and protective
Jujube Berries	The fruit of *Zizyphus vulgaris*. Fam. Rhamnaceæ. Habitat, Asia Minor. Used as a laxative
Laminaria	From *Laminaria Cloustonia*. Fam. Algæ. Habitat, North Atlantic Ocean
Lungwort	From *Pulmonaria officinalis*. Habitat, Europe
Maidenhair	The fronds of *Adiantum Capillus-Veneris*. Fam. Filices. Used as a demulcent and stimulant
Mezquite Gum	From *Algarobia glandulosa*. Habitat, Texas
Okra	From *Hibiscus esculentus*. Habitat, Africa
Psyllium Fleawort Flea seed	The seed of *Plantago Psyllium*. A small, reddish-brown, shining, inodorous, and nearly tasteless seed. It becomes mucilaginous when chewed: It is recommended for administration in chronic constipation, as it absorbs moisture, becomes mucilaginous, gives bulk to the intestinal content, and aids in maintaining the regularity of the bowel movements. It is usually taken with a cereal, several tablespoonfuls or more being added.
Salep	From the tubers of *Orchis mascula*. Is very mucilaginous, only four grains being sufficient to make one fluidounce of water gelatinous
Virginia Lungwort	From *Pulmonaria Virginica*. Habitat, United States
Willow Herb	From *Epilobium angustifolium*. Fam. Onagraceæ. Used as a tonic and demulcent

CHAPTER LXIII

SUGARS AND SACCHARINE SUBSTANCES

The general classification of carbohydrates includes sugars, starches, gums and celluloses, all of which are of great importance in the life of the plant. Sugars are distinguished by sweetness of taste and solubility in water. The classification of sugars is based upon their chemical constitution and behavior toward hydrolytic agents such as mineral acids or enzymes.

There are a number of naturally occurring sugars containing five and six carbon atoms that cannot be split up any further by hydrolysis—these are called *monosaccharides* (or *monoses*), example, *dextrose* ($C_6H_{12}O_6$). Other sugars are known to split up under the influence of hydrolysis into two molecules of monosaccharides. Such sugars are known as *disaccharides*, example sucrose ($C_{12}H_{22}O_{11}$), which splits up according to the following equation:

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + \underset{\text{water}}{H_2O} = \underset{\text{dextrose}}{C_6H_{12}O_6} + \underset{\text{levulose}}{C_6H_{12}O_6}$$

Still other sugars upon hydrolysis yield three, four, or more *monosaccharides*. These are termed respectively *trisaccharides*, *tetrasaccharides*, etc.

Starch and cellulose bear a close chemical relationship to the sugars and by hydrolytic change can be converted into sugars. They are therefore termed *polysaccharides*.

The following synopsis gives an idea of the foregoing relationships:

I. Sugars
- Monosaccharides
  - Trioses ($C_3H_6O_3$), glycerose
  - Tetroses ($C_4H_8O_4$), erythrose
  - Pentoses ($C_5H_{10}O_5$), arabinose, xylose, rhamnose; ($C_6H_{12}O_5$), fucose, quinovose
  - Hexoses ($C_6H_{12}O_6$), dextrose, levulose, sorbose, galactose, mannose
- Disaccharides
  - $C_{12}H_{22}O_{11}$, sucrose, mactose, maltose, isomaltose, trehalose, cellobiose, gentiobiose, melibiose
  - $C_{11}H_{20}O_{10}$, glucoxylose, primeverose, vicianose
- Trisaccharides ($C_{18}H_{32}O_{16}$), raffinose, gentianose, melezitose
- Tetrasaccharides ($C_{24}H_{42}O_{21}$), stachyose
- Artificial sugars belonging to the former groups and also to higher groups have been synthesized.

II. Non-sugars or Polysaccharides
- ($C_6H_{10}O_5$)n, starches, dextrin, inulin, glycogen, galactosane, mannosane
- Gums (a) natural gums and pentosanes
  (b) mucilages and pectic compounds
- Celluloses ($C_6H_{10}O_5$)n.

It will be seen that isomerism is a common phenomenon in the carbohydrates and especially in the sugars. Sugars are characterized by their optical activity, and the polariscope is an instrument used in their quantitative determination. Sugars are sometimes classified as *reducing sugars* or *non-reducing sugars*. The reagent used is Fehling's Solution or one of the similar alkaline copper solutions. The reduction is evidenced by a visible change in which the blue cupric solution loses its color, and cuprous oxide is formed as a red precipitate. This is used as a quantitative as well as a qualitative test (see Chapter on Urinalysis, page 1440).

Phenylhydrazine (see Reagents, page 1538) is used as a reagent for identifying and differentiating sugars, a series of compounds known as *ozazones* being produced.

GLUCOSUM. U.S. Glucose

[**Glucos.**—Syrupy Glucose, Liquid Glucose, Corn Syrup, Grape Sugar (when solid)]

A product obtained by the incomplete hydrolysis of starch. It consists chiefly of dextrose (d-glucose) [$C_6H_{12}O_6$ = 180.13], maltose, dextrins, and water.

Preparation—Glucose is obtained commercially by the action of very weak sulphuric acid or hydrochloric acid on starch.

The process for the manufacture of glucose is as follows: The starch, usually from corn, is mixed with five times its weight of water containing less than one per cent of hydrochloric acid, the mixture is heated to about 45° C., and then transferred to a suitable lead-lined vessel into which steam is passed under pressure until the temperature reaches 120° C. The temperature is maintained at this point for about an hour, or until tests show the complete disappearance of starch. The mass is then heated to volatilize most of the hydrochloric acid, sodium carbonate or calcium carbonate is added to neutralize the remaining traces of acid, the liquid is filtered, then decolorized in charcoal or bone-black filters, as is done in sugar refining, and finally concentrated in vacuum to the desired consistence.

If the crystallizable "*grape sugar*" (called *bread sugar* or *cerelose*) is desired, the conversion temperature is higher and the time of conversion longer. The term glucose as customarily used in chemical or pharmaceutical literature usually refers to dextrose ($C_6H_{12}O_6$), the crystallizable product. Syrupy glucose contains about thirty to forty per cent of dextrose mixed with about an equal proportion of dextrin, together with small amounts of other carbohydrates. Dextrose can be obtained as a hydroxide in small and laminated crystals from aqueous solution, and in anhydrous form in hard crystalline masses either from alcoholic solution or from very concentrated aqueous solution. It is less sweet than cane sugar. It is also less soluble in water, and much more soluble in alcohol. It has the specific gravity 1.54 to 1.57 when anhydrous. Strong mineral acids hardly act on dextrose, but destroy cane sugar with facility. On the other hand, grape sugar is destroyed by alkalies, with which cane sugar forms definite compounds. Dissolved in water and subjected to prolonged ebullition, dextrose undergoes very little alteration. Its solution rotates the plane of polarization of polarized light to the right, and is capable of undergoing the vinous fermentation directly, without passing through any intermediate state. It is characterized, also, in boiling solution, by reducing alkaline cupric tartrate (see Alkaline Cupric Tartrate Volumetric Solution), producing a reddish precipitate.

The name grape sugar is sometimes applied to the solid commercial form of dextrose because the principal sugar of the grape is dextrose, although the fruit has never been used as a source of the commercial supply. The term *starch sugar* and *corn sugar* have also been applied to it, and the corresponding terms *starch syrup* and *corn syrup* to the syrupy form, commonly called glucose. The official description of syrupy glucose is as follows:

Description and Physical Properties—A colorless or yellowish, thick, syrupy liquid. It is odorless, or nearly so, and has a sweet taste.

Glucose is very soluble in water, but is sparingly soluble in alcohol.

Tests for Identity—Add a few drops of an aqueous solution of Glucose (1 in 20) to 5 cc. of hot alkaline cupric tartrate T.S.: a copious red precipitate of cuprous oxide is produced (*distinction from sucrose*).

Tests for Purity—Introduce about 0.5 Gm. of Glucose into a wide-mouthed, tared weighing-bottle, weigh accurately, add 2 cc. of distilled water, evaporate at about 70° C., and dry the residue to constant weight at 90° C.: the loss in weight of the Glucose does not exceed 21 per cent (*water*).

Ash: not more than 0.5 per cent.

A solution of 5 Gm. of Glucose in 15 cc. of distilled water, mixed with 5 drops of phenolphthalein T.S., requires not more than 0.6 cc. of tenth-normal sodium hydroxide to produce a pink color (*free acid*).

Dissolve about 2 Gm. of Glucose in 50 cc. of distilled water, boil the solution for one minute, and cool: the addition of one drop of tenth-normal iodine to this solution produces no blue color (*starch*). On now adding a few drops of starch T.S. to the solution, a blue color is produced (*limit of sulphur dioxide*).

An aqueous solution of Glucose meets the requirements of the test for *heavy metals*, page 1519. If the solution of Glucose is not colorless, comparison must be made with 10 cc. of the same solution, to which a volume of distilled water, equal to that of the hydrogen sulphide T.S., has been added.

Dissolve 1.5 Gm. of Glucose in 5 cc. of distilled water, add 5 cc. of diluted sulphuric acid and 1 cc. of bromine T.S. and heat for five minutes on a water bath. Then add 0.5 Gm. of potassium iodide and five drops of stannous chloride T.S., cool, and test the solution for *arsenic*, page 1512. The stain, if any, is not greater than that produced in a test made with the same quantities of the reagents and 2 cc. of the standard arsenic test solution.

U. S. P. Preparations—Extractum Belladonnæ (Pilular); Extractum Hyoscyami; Extractum Stramonii (Pilular).

N. F. Preparation—Extractum Conii.

Uses—It is used officially as a diluent in pilular extracts (see official preparations above) and commercially it has replaced glycerin in many pharmaceutical preparations. It is sometimes given per rectum as a food in cases where feeding by stomach is impossible. It should not be used in the place of dextrose for intravenous injection (see below).

DEXTROSUM. U.S. Dextrose

[**Dextros.**—D-Glucose]

A sugar [$C_6H_{12}O_6.H_2O$ = 180.13] usually obtained by the hydrolysis of starch. The method employed for the preparation of dextrose is described under glucose (page 894).

Description and Physical Properties—A white, crystalline powder, or white granules. It is odorless, and has a sweet taste.

One Gm. of Dextrose is soluble in 1 cc. of water, and in 59 cc. of alcohol, at 25° C. It is more soluble in boiling water and in boiling alcohol.

Tests for Identity—An aqueous solution of Dextrose (1 in 20) is neutral to litmus paper and is dextrorotatory.

The specific rotation $[\alpha]_D$ of Dextrose determined at 25° C. in an aqueous solution containing in each 100 cc. 10 Gm. of Dextrose, previously dried to constant weight at 100° C. and using a 200 mm. tube, is not less than +52.5° and not more than +53.0°. The solution must be allowed to stand twenty-four hours before observing the rotation, page 1524.

Add a few drops of its aqueous solution (1 in 20) to 5 cc. of hot alkaline cupric tartrate T.S.: a copious red precipitate of cuprous oxide is formed (*difference from sucrose*).

Tests for Purity—Dextrose loses not more than 10 per cent when dried to constant weight at 105° C.

Ash: not more than 0.1 per cent.

One Gm. of finely powdered Dextrose dissolves completely on boiling with 15 cc. of alcohol under a reflux condenser (*dextrin, lactose*).

Add 1 drop of iodine T.S. to a solution of 1 Gm. of Dextrose in 10 cc. of distilled water: the liquid is colored yellow (*soluble starch, sulphite*).

Its aqueous solution (1 in 20) meets the requirements of the test for *heavy metals*, page 1519.

Dissolve 1.5 Gm. of Dextrose in 5 cc. of distilled water, add 5 cc. of diluted sulphuric acid and 1 cc. of bromine T.S., and heat for five minutes on a water bath. Add 0.5 Gm. of potassium iodide, follow with five drops of stannous chloride T.S., cool, and test for *arsenic*, page 1512. The stain produced, if any, is not greater than that produced in a test made with the same quantities of reagents and 2 cc. of the standard arsenic solution, page 1512.

Two Gm. portions of Dextrose show no more *chloride* than 0.5 cc. of fiftieth-normal hydrochloric acid, and no more *sulphate* than 0.5 cc. of fiftieth-normal sulphuric acid, page 1520.

Preserve in well-closed containers.

Uses—Dextrose is a readily absorbed food. It may be administered in the form of enemas. It is also useful for parenteral alimentation, by hypodermic and intravenous injection. Such injections also supply fluid, sustain the blood volume temporarily, and produce diuresis. They have been proposed for use in infectious diseases, and may have some value as food and as a means of introducing fluid, although they do not directly influence the course of the

infection. It may be added to the acacia solutions which are used in hemorrhage and shock. Dextrose is used in the determination of sugar tolerance.

Dose—Six ounces (180 Gm.) daily. Intravenously, from 250 to 300 cc. of a 10 to 15 per cent solution in water or, physiological solution of sodium chloride, sterilized by boiling or in an autoclave. As an enema, from a 5 to 12 per cent solution is used.

SUCROSUM. U. S. Sucrose

[**Sucros.**—Saccharum U. S. P. IX, Sugar, Cane Sugar, Beet Sugar]

A sugar [$C_{12}H_{22}O_{11}$ = 342.24] obtained from *Saccharum officinarum* Linné (Fam. *Gramineæ*) and other sources.

Preparation—Sucrose or sugar is prepared commercially from the sugar cane, beet root, and sorghum. Formerly, sugar cane was the only source; but at present the root of *Beta vulgaris* is largely used in Europe, and to an increasing degree in this country, for making sucrose. From the rapid growth of this industry there is a prospect of its supplanting all others. Sucrose was formerly prepared as follows: The sugar cane was crushed, and the juice, amounting to about 80 per cent, expressed; this was then heated, a little lime and calcium bisulphite added, strained, and the liquid quickly evaporated, cooled, and stirred. The thick liquid was transferred to casks perforated at the bottom, and the crystals drained. Sugar made in this way was called "open pan" sugar. It is now almost completely displaced by "vacuum pan" sugar.

In the production of *raw sugars* by the vacuum pan process, the juice, after "defecation" with lime and removal of excess of lime by carbonic acid gas, is run into vacuum pans for concentration and the saccharine juice is evaporated in this until it begins to crystallize. After the crystallization is complete, the warm mixture of crystals and syrup is run into centrifugals, in which the crystals of raw sugar are drained and dried. The syrup resulting as a by-product from raw sugar is known as molasses. Raw beet sugar is made by a similar process, but is more troublesome to purify than that made from sugar cane.

The refined sugar from either raw cane or beet sugar is prepared by dissolving the raw sugar in water, clarifying, filtering, and finally decolorizing the solution by passing it through bone black filters. The water-white solution is finally evaporated under reduced pressure to the crystallizing point and then forced to crystallize in small granules which are collected and drained in a centrifuge.

The best sugar for pharmaceutical uses is known technically as "granulated". A sugar of very high purity, obtained by crystallizing the first runnings from the charcoal filters, is now largely used in preparing pharmaceutical syrups. It is sold under various trade names as *Druggists' Standard*, *Special Standard Granulated*, and *Confectioner's Granulated* and produces a syrup which is practically free from yellow tint (see Syrups, page 261). *Loaf-sugar* or *lump sugar* is generally pure, but if kept in a damp atmosphere, it is liable to absorb moisture, and if kept in a very dry air, will lose weight. For making troches, *lozenge sugar* or *"XXXX sugar"* a very pure, finely powdered sugar, is now generally available. *"Pulverized sugar"*, as it is called, is unfitted for such a purpose.

When sugar is crystallized in regular, large, monoclinic prisms, it is called *rock-candy*, and has the specific gravity 1.606. The official test excludes sugar which contains ultramarine; this was formerly added by refiners to save the expense of using bone-black. A sugar blued by ultramarine is readily detected, for the syrup is slightly yellow, and a sediment is deposited.

Sugar in dilute aqueous solution is converted into alcohol, carbon dioxide, and eventually acetic acid, if exposed to warm, dust laden air.

Sucrose may be distinguished from grape sugar by Trommer's test, which consists in the use of copper sulphate and caustic potash. If a solution of cane sugar is mixed with a solution of copper sulphate, and potassium hydroxide added in excess, a deep blue liquid is obtained, which on being heated deposits, after a time, a little red powder. A solution of grape sugar, similarly treated, yields, by heat, a copious greenish precipitate, which rapidly changes to scarlet, and eventually to dark red. When heated to 185° C., cane sugar melts into a viscid, colorless liquid, which on being suddenly cooled forms a transparent amorphous mass, called *barley sugar*. At a higher temperature, between 204.4° and 215.5° C., it loses two molecules of water, and is converted into a very thick, black liquid, called *caramel*, which is used largely for coloring aqueous or hydro-alcoholic liquids and is now official in the N. F. (see page 844). At a still higher heat it yields combustible gases, carbonic acid, empyreumatic oil, and acetic acid, and there remains about one-fourth of its weight of charcoal, which burns without residue.

The valuation of sugars and syrups is made through the use of the polariscope (see the U. S. P. test).

There are no tests by which cane sugar and beet sugar can be distinguished from each other in the refined product.

Description and Physical Properties—White, hard, dry crystals or blocks, or a white, crystalline powder. It is odorless, has a sweet taste, and is stable in the air.

One Gm. of Sucrose is soluble in 0.5 cc. of water and in 170 cc. of alcohol, at 25° C. One Gm. is soluble in slightly more than 0.2 cc. of boiling water. It is insoluble in chloroform and in ether.

Tests for Identity and Purity—The specific rotation $[\alpha]_D$ of Sucrose determined at 20° C. in an aqueous solution containing in each 100 cc. 26 Gm. of Sucrose, previously dried to constant weight at 105° C. and using a 200 mm. tube, is not less than +65.9°, page 1524.

An aqueous solution of Sucrose (1 in 20) is neutral to litmus paper.

Ash: not more than 0.05 per cent.

An aqueous solution of Sucrose (1 in 1) is colorless or at most only faintly yellow when viewed horizontally against a white background through a vertical cylinder of colorless glass having an inside diameter of about 25 mm. When kept in large, well-closed, and completely filled bottles, the solution deposits no sediment on prolonged standing (*insoluble salts, ultramarine or Prussian blue*).

Its aqueous solution (1 in 10) is not affected by the addition of an equal volume of hydrogen sulphide T.S. (*heavy metals*). Ten cc. portions of the solution (1 in 10), remain clear for at least one minute after the addition of 1 cc. of silver nitrate T.S. (*chloride*) or of ammonium oxalate T.S. (*calcium*).

A 5 Gm. portion of Sucrose shows no more *sulphate* than corresponds to 0.3 cc. of fiftieth-normal sulphuric acid, page 1520.

Dissolve 20 Gm. of Sucrose in enough distilled water to make 100 cc. and filter the solution if necessary. To 50 cc. of the clear liquid, contained in a 250 cc. beaker, add 50 cc. of alkaline cupric tartrate solution, heat the mixture at such a rate that approximately four minutes are required to bring it to the boiling point, and boil for exactly two minutes. Add 100 cc. of cold, recently boiled distilled water, and collect and weigh the precipitated cuprous oxide in the following manner:

Prepare a Gooch crucible with an asbestos layer. Thoroughly wash the asbestos with distilled water, followed successively by 10 cc. of alcohol and 10 cc. of ether, dry at 100° C. for thirty minutes, and weigh the prepared crucible. Filter the precipitated cuprous oxide through the crucible thus prepared, thoroughly wash the residue on the filter with hot distilled water, then with 10 cc. of alcohol, and finally with 10 cc. of ether, and dry it at 100° C. The weight of the cuprous oxide does not exceed 0.155 Gm. corresponding to not more than 0.5 per cent of invert sugar.

U. S. P. Preparations—Used in preparing syrups and also in Ferri Carbonatis Saccharatus; Massa Ferri Carbonatis; Pilulæ Ferri Carbonatis; Pulvis Cretæ Compositus; Pulvis Glycyrrhizæ Compositus; Syrupus; Trochisci Acidi Tannici; Trochisci Ammonii Chloridi.

N. F. Preparations—Confectio Rosæ; Confectio Sennæ; Dentifricium; Elixirs; Ferri Oxidum Saccharatum; Infusum Rosæ Compositum; Lac Fermentatum; Misturæ; Oleosacchara; Pilulæ Ferri Iodidi; Pulvis Cretæ Aromaticus; Stili Acidi Salicylici Dilubiles; Tabellæ; Tinctura Vanillæ; Troches.

Uses—Sucrose is used principally in pharmacy for making syrups, troches, masses, confections, etc., as already noted.

Aromatic sugars may be prepared by pouring an alcoholic tincture of the spice drugs—cinnamon, cloves, etc.,—over granulated sucrose, and drying the product by exposing it to the air.

LACTOSUM. U.S. Lactose

[Lactos.—Saccharum Lactis U.S.P. IX., Milk Sugar, Sugar of Milk]

A sugar [$C_{12}H_{22}O_{11}.H_2O = 360.25$] obtained from cow's milk.

Preparation—Sugar of milk is prepared by the addition of diluted hydrochloric acid to skim milk to precipitate the casein. After the removal of the casein by filtration, the remaining albuminous matter is coagulated by heating; this is filtered out and the liquid set aside to crystallize. Animal charcoal is used to decolorize the solution in a manner similar to that used in purifying sucrose.

Description and Physical Properties—White, hard, crystalline masses, or a white powder, producing a gritty sensation on the tongue. It is odorless, and has a faintly sweet taste. It is stable in the air, but readily absorbs odors.

One Gm. of Lactose is soluble in 4.9 cc. of water at 25° C., also in 2.6 cc. of boiling water. It is very slightly soluble in alcohol; insoluble in chloroform and in ether.

Tests for Identity—The specific rotation $[\alpha]_D$ of Lactose determined at 25° C. in an aqueous solution containing in each 100 cc. 10 Gm. of Lactose, previously dried to constant weight at 80° C., and using a 200 mm. tube, is not less than +52.2° and not more than +52.5°, page 1524. The solution must be allowed to stand overnight before observing the rotation.

Add an equal volume of sodium hydroxide T.S. to 5 cc. of a hot, saturated, aqueous solution of Lactose, and gently warm the mixture; the liquid turns yellow and finally brownish-red. On the subsequent addition of a few drops of cupric sulphate T.S., a precipitate of cuprous oxide forms.

Tests for Purity—An aqueous solution of Lactose (1 in 20) is neutral to litmus paper.

Ash: not more than 0.1 per cent.

A solution of 3 Gm. of Lactose in 10 cc. of boiling distilled water is clear, colorless, and odorless.

Add 20 cc. of 70 per cent (by volume) alcohol to 2 Gm. of finely powdered Lactose, shake the mixture frequently during half an hour at 15° C., and filter: a 10 cc. portion of the filtrate remains clear after mixing with an equal volume of dehydrated alcohol (*dextrin*), and this liquid upon evaporation on a water bath leaves not more than 0.03 Gm. of residue (*sucrose or glucose*).

An aqueous solution of Lactose (1 in 20) meets the requirements of the test for *heavy metals*, page 1519.

Boil 1 Gm. of powdered Lactose with 50 cc. of distilled water, cool, and add a drop of iodine T.S.: no blue color is produced (*starch*).

Preserve in tightly-closed containers.

U. S. P. Preparations—Ferri Carbonas Saccharatus; Pulvis Ipecacuanhæ et Opii; Triturations.

N. F. Preparation—Pepsinum Saccharatum.

Uses—Lactose, more commonly known as sugar of milk, is a useful diluent, and is largely used in medicine and pharmacy. The hardness of the crystals has been used as an assistance in securing thorough admixture of the ingredients in compound powders, by necessitating prolonged trituration, but today the powder is almost always used.

MEL. U.S. Honey

[Replacing Mel Depuratum U.S.P. IX, Clarified Honey]

A saccharine substance, gathered mostly from the nectaries of flowers, and deposited in the honeycomb by the bee, *Apis mellifera* Linné (Fam. *Apidæ*). It must be free from foreign substances such as parts of insects, leaves, etc.

The nectaries of flowers contain a sweet substance, which is extracted by the bees and stored up in the hive in what are known as the honeycombs, which are composed of beeswax (see yellow wax, page 1191). Large quantities of honey are obtained from California, the Southern States, and the West Indies. Before the passage of the Food and Drugs Act, large amounts of artificial honey were manufactured from glucose by flavoring and coloring, but the rigid enforcement of this law has practically eliminated the spurious article from the market.

Description and Physical Properties—A thick, syrupy liquid of a light yellowish or yellowish-brown color. It is translucent when fresh, but frequently becomes opaque and granular from crystallization of dextrose. It has a characteristic odor and a sweet, faintly acrid taste.

Tests for Identity and Purity—Honey is lævorotatory at 20° C. and is slightly acid to litmus paper.

Diluted with twice its weight of water, Honey is only moderately turbid, is not stringy, and has a specific gravity of not less than 1.099 at 25° C.

Incinerate about 2 Gm. of Honey, accurately weighed, at a low temperature in a platinum crucible, in small portions at a time: not more than 0.3 per cent of ash remains.

A solution of 10 Gm. of Honey in 50 cc. of distilled water requires not more than 0.5 cc. of normal sodium hydroxide for neutralization, phenolphthalein T.S. being used as indicator.

Ten cc. portions of a filtered aqueous solution of Honey (1 in 10) show no more *chloride* than corresponds to 0.2 cc. of fiftieth-normal hydrochloric acid and no more *sulphate* than corresponds to 0.2 cc. of fiftieth-normal sulphuric acid, page 1520.

Boil about 2 Gm. of Honey with 20 cc. of water, cool, and add two drops of iodine T.S.: no blue, green, or reddish color is produced (*starch or dextrins*).

The color of an aqueous solution of Honey (1 in 2) is not immediately changed when mixed with an equal volume of ammonia T.S. (*foreign coloring matter*), and a 5 cc. portion does not at once acquire a red or rose color on the addition of a few drops of hydrochloric acid (*azo dyes*).

Triturate about 1 Gm. of Honey with 20 cc. of ether in a mortar, filter into a porcelain dish or crucible, allow the ether to evaporate, and add to the residue one drop of resorcinol T.S. At most only a pink color is produced, which disappears in half a minute, but not an orange, cherry or brown-red color (*artificial honey or added invert sugar*).

For many years the Pharmacopœia included a process for clarifying honey which consisted of mixing the crude honey with paper pulp, heating to 70° C., removing the scum from the surface, adding water to restore the volume, straining, and finally mixing with 5 per cent of glycerin. The Food and Drugs Act requirements have ensured the production of ample quantities of pure, high-grade honey, mostly separated from the comb by centrifuging so that the heating process is no longer required.

History—Honey is one of the oldest of food and medicinal products and has been in use as a vehicle for disguising medicines since before the days of Tut-ank-Amen. Many curious theories were held as to its origin. It was credited with many medicinal virtues of its own during the sixteenth and seventeenth centuries when it was recommended as a cure for almost everything from baldness to worms.

U. S. P. Preparations—Hydrargyrum cum Creta; Massa Ferri Carbonatis; Mel Rosæ.

N. F. Preparations—Confectio Rosæ; Elixir Manacæ Compositum; Gargarisma Guaiaci Compositum; Mel Sodii Boratis; Oxymel Scillæ; also as an excipient in pills.

MANNA. U. S. Manna

Manna is the dried exudation of *Fraxinus Ornus* Linné (Fam. *Oleaceæ*).

Manna yields not less than 75 per cent of anhydrous alcohol-soluble extractive, when extracted with boiling 90 per cent alcohol, by volume.

Description and Physical Properties—In irregular, more or less elongated, flattened, 3-sided pieces; externally yellowish-white; friable; internally nearly white, porous and crystalline in appearance; odor slight, but characteristic; taste sweet, slightly bitter, and faintly acrid. Also in irregular masses, consisting in part of brittle or soft fragments from yellowish-white to yellowish-gray in color. The quantity of these yellowish-white fragments must not be less than 40 per cent of the whole.

Assay—Proceed as directed under alcohol-soluble extractive, page 1523 using boiling 90 per cent alcohol, by volume, and filter rapidly through purified cotton while hot, washing the cotton with boiling alcohol.

N. F. Preparations—Infusum Sennæ Compositum; Syrupus Mannæ.

This substance, which is found in commerce of varying quality, is, when pure, soluble in three parts of cold water and in its own weight of boiling water. It separates in crystalline masses from a boiling, saturated, aqueous solution. It is partially soluble in alcohol. The assay is based upon the solubility of mannite in 90 per cent alcohol.

Mannite, the principal constituent, is white, inodorous, crystallizable in semi-transparent needles, of a sweetish taste, soluble in five parts of cold water, scarcely soluble in cold alcohol, but readily dissolved by that liquid when hot, and deposited when it cools. Its composition is $C_6H_{14}O_6$, and it is considered

as belonging to the class of *hexatomic alcohols*. Mannite is found in many plants, and may be converted by oxidation into mannose, a fermentable sugar.

Uses—Manna is used as a laxative, and often added to senna leaves to make a cathartic infusion. The dose is from one-half to two ounces (15.5 to 62 Gm.).

GLYCYRRHIZA. U.S. Glycyrrhiza

[**Glycyrrh.**—Licorice, Liquorice Root, Sweetwood, Italian Juice Root, Liquorice Root, Spanish Juice Root]

Glycyrrhiza is the dried rhizome and roots of *Glycyrrhiza glabra* Linné var. *typica* Regel et Herder, known in commerce as Spanish Licorice, or of *Glycyrrhiza glabra* Linné var. *glandulifera* Regel et Herder, known in commerce as Russian Licorice, or of other varieties of *Glycyrrhiza glabra* Linné yielding a yellow and sweet wood (Fam. *Leguminosæ*).

Glycyrrhiza yields not more than 2.5 per cent of acid-insoluble ash.

Description and Physical Properties—*Unground Spanish Licorice*—Nearly cylindrical, the upper portion more or less knotty; usually in pieces from 14 to 20 cm. or more in length and from 5 to 20 mm. in thickness; externally yellowish-brown or dark brown, longitudinally wrinkled, the thinner rhizomes often having prominent alternate buds, the thicker rhizomes having distinct corky patches; fracture coarsely fibrous; internally yellow, radiate; odor distinctive; taste sweetish and slightly acrid.

Unground Russian Licorice—Nearly cylindrical, somewhat tapering, sometimes split longitudinally, from 15 to 30 cm. in length and from 1 to 5 cm. in diameter; when deprived of the outer corky layer, it is externally pale yellow; fracture coarsely fibrous; internally pale yellow; wood radially cleft; odor distinct; taste sweetish.

For further description see the U. S. P. X.

U. S. P. Preparations—Extractum Glycyrrhizæ; Extractum Glycyrrhizæ Purum; Fluidextractum Cascaræ Sagradæ Aromaticum (from Extract); Fluidextractum Glycyrrhizæ; Massa Hydrargyri; Mistura Glycyrrhizæ Composita (from Fluidextract); Pulvis Glycyrrhizæ Compositus; Syrupus Sarsaparillæ Compositus (from Fluidextract); Trochisci Ammonii Chloridi.

N. F. Preparations—Elixir Glycyrrhizæ Aquosum (from Fluidextract); Elixir Taraxaci Compositum (from Fluidextract); Fluidglyceratum Cascaræ Sagradæ Aromaticum; Fluidglyceratum Glycyrrhizæ; Fluidextractum Trifolium Compositum; Fluidextractum Sarsaparillæ Compositum; Pilulæ Ferri Iodidi; Species Pectorales; Syrupus Glycyrrhizæ (from Fluidglycerate); Tinctura Aloes; Tinctura Aloes et Myrrhæ; Tinctura Rhei Dulcis.

This well-known root contains the sweet principle *glycyrrhizin*, or *glycyrrhizic acid*, $C_{44}H_{63}O_{18}N$. This was found by Roussin to exist in the root in combination with ammonia. The amount present in glycyrrhiza varies greatly and no official standard or assay has been adopted.

The following assay method has been suggested by Percy A. Houseman and is modeled after the method of Parry:

Assay—Dissolve 2 Gm. of Glycyrrhiza in 10 cc. of hot water, in a centrifuge tube. After cooling add 20 cc. of 80 per cent alcohol, and then gradually 50 cc. of 95 per cent alcohol. After standing two hours centrifuge the contents of the tube, stir the residue twice with 80 per cent alcohol, and again in centrifuge. Pour off the liquid, and evaporate to dryness on a water bath in a vacuum. Transfer the evaporated residue, with 30 cc. of water, to a small Erlenmeyer flask, cool at 15° C., and precipitate the glycyrrhizin with 3 cc. of dilute sulphuric acid (10 cc. of acid to 300 cc. of water). After standing for two hours, cool the contents of the beaker for half an hour on ice, and pour the clear liquid through a small filter. Wash the glycyrrhizic acid with ice water four times by decantation and transfer the precipitated acid remaining in the flask and on the filter to a tared dish, by dissolving it in diluted alcohol to which has been added two drops of 5 per cent ammonia water to neutralize traces of sulphuric acid. Evaporate to constant weight and weigh.

There is present in Glycyrrhiza an oleoresinous substance to which its slight acridity is due. If alcohol or an alkali is used as a menstruum for the root and the preparation not treated to deprive it of acridity, it will have a disagreeable after-taste. For this reason the U. S. P. has adopted boiling water for its extraction in both the extract and the fluidextract.

Uses—Glycyrrhiza is valuable in pharmacy chiefly on account of the sweet principle. It is one of the most efficient substances known for masking the taste of bitter substances, like quinine. Acids precipitate the glycyrrhizin and should not be added to mixtures in which glycyrrhiza is intended to mask the disagreeable taste. It is used in a number of official preparations (see page 900).

Average dose—30 grains (2 Gm.).

Unofficial Glycyrrhiza Preparation

GLYCYRRHIZINUM AMMONIATUM. U. S. P. IX **Ammoniated Glycyrrhizin**

A sweet principle, combined with ammonia, obtained from glycyrrhiza.

Ammoniated Glycyrrhizin was official for many years, but although a valuable flavor it was rarely prescribed, the extract or fluidextract being preferred. It is made by percolating 500 Gm. of ground glycyrrhiza, with a mixture of 175 cc. of water and 25 cc. of ammonia water, and then with water, to obtain 500 cc. of percolate. Sulphuric acid is then added slowly to the percolate until completely precipitated. This precipitate of glycyrrhizin is then washed with cold water, again dissolved in ammonia water, diluted with an equal volume of water, and the solution spread upon plates of glass, so that when dry, the product may be obtained in scales.

Physical Description—Dark brown or brownish-red scales, without odor, and having a very sweet taste. It is freely soluble in water and soluble in alcohol.

Uses—This compound is useful in elixirs, syrups, etc., whenever the flavor of glycyrrhiza is desired. It is especially valuable when mixed with bitter or disagreeable powders to mask their taste.

TRITICUM. N. F. **Triticum**

(U. S. P. IX)

[**Tritic.**—Couch Grass, Dog Grass]

Triticum consists of the dried rhizome and roots of *Agropyron repens* (Linné) Beauvois (Fam. *Graminæ*).

Triticum contains not more than 2 per cent of foreign organic matter and yields not more than 3 per cent of acid-insoluble ash.

Description—Rhizome; usually in pieces from 4 to 12 mm. in length and from 1 to 2.5 mm. in diameter; externally light yellow or yellowish-brown, longitudinally furrowed, smooth, lustrous, nodes with circular leaf-scars, a few root-scars and occasional slender roots; fracture tough, fibrous internally lemon-yellow and with a large, hollow pith. Roots filiform, irregularly branching, attaining a length of about 5 cm. and not more than .05 mm. in thickness, light-brown or yellowish-brown, frequently covered with long root hairs. Odor slight, aromatic; taste sweetish.

For further description see the N. F. V.

U. S. P. Preparation—Fluidextractum Tritici.

N. F. Preparations—Elixir Sabal et Santali Compositum; Fluidextractum Tritici.

Triticum is usually found in the market cut into small sections. It contains triticin, a principle resembling inulin, also glucose, levulose, etc.

Uses—It is used in inflammatory conditions of the urinary organs in the dose of two and one-half drachms (10 Gm.), usually administered in the form of an infusion.

CHAPTER LXIV

ALCOHOLS AND THEIR DERIVATIVES INCLUDING A DISCUSSION OF YEAST, FERMENTATION, AND ENZYMES

The influence of minute amounts of chemical substances in accelerating the speed of reactions has long been known in inorganic chemistry, such compounds being called catalysts. The use of manganese dioxide in hastening the liberation of oxygen from potassium chlorate is an example, as is also the use of platinum black in the contact process for making sulphuric acid.

Catalysis has been defined by Ostwald as "the acceleration of a chemical change by the presence of some foreign substance".

In animal and plant physiology similar catalytic changes are known, and the catalytic substances are called *enzymes.*

Many enzymes have been identified and studied. The phenomena commonly called fermentation and putrefaction are examples of changes produced by enzymes.

Formerly these two terms were used loosely and unscientifically. A clarification of the nomenclature has been accomplished by classifying such catalytic changes as affect carbohydrates as *fermentation,* while the changes produced in proteins are called *putrefaction.* The enzymes as a class, however, are frequently referred to as ferments. Formerly ferments were classified as *organized* and *unorganized* and the latter were called "*cryptolytes*" but no such distinction is made any longer.

The classification of enzymes is very comprehensive and includes the following groups:

Hydrolytic enzymes

a. Fat-splitting enzymes (esterases), as *lipase.*
b. Carbohydrate-splitting enzymes (carbohydrases), as *invertase, maltase, lactase, amylase* (*diastase*), *inulase, pectinase,* and *cytase.*
c. Glucoside-splitting enzymes, as *emulsin, myrosin,* and *phytase.*
d. Protein-splitting enzymes (proteases) as *pepsin, trypsin, erepsin, bromelin,* and *papain.*
e. Urea-splitting enzymes, as *urease.*

Fermenting enzymes

a. Producing alcoholic fermentation, as *zymase.*
b. Producing lactic fermentation, as *lactic acid-forming* bacteria.
c. Producing butyric fermentation, as *butyric acid-forming* bacteria.

Coagulating enzymes

a. Milk-curdling enzymes, as *rennin.*
b. Blood-coagulating enzymes, as *thrombin.*
c. Pectin-coagulating enzymes, as *pectase.*

Oxidizing enzymes

a. Converting alcohol to acetic acid, as *mycoderma aceti.*
b. Liberating oxygen from peroxides as *catalase* or *peroxidase.*

Enzymes are sometimes described in general terms as *amylolytic, proteolytic,* etc. The correctness of such terms has been questioned and as substitutes the terms *amyloclastic, proteoclastic,* etc., have been suggested.

It will be readily appreciated that many important physiological processes in plants as well as in animals are dependent upon enzyme action. The industrial applications of enzyme action are very numerous, as in the production of such important substances as alcohol, acetic acid, etc.

The chemical constitution of enzymes is unknown, as none has yet been isolated in a pure state.

Enzymes as a rule are very sensitive to heat and light. All enzymes are destroyed at 100° C. and many are affected at as low a temperature as 60° C. Most enzymes are colloidal in character.

The action of many enzymes is retarded or destroyed by the presence of antiseptics. The production of alcohol by the action of zymase upon sugar may be represented by chemical reactions which are apparently very simple, but which in reality are very complex.

Sucrose is not directly fermentable. It must first be changed to monosaccharides by invertase, by the following reaction:

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + \underset{\text{water}}{H_2O} = \underset{\text{dextrose}}{C_6H_{12}O_6} + \underset{\text{levulose}}{C_6H_{12}O_6}$$

The monosaccharides, dextrose and levulose, are then acted upon by zymase according to the following reaction:

$$\underset{\text{dextrose}}{C_6H_{12}O_6} = \underset{\text{alcohol}}{2C_2H_5OH} + \underset{\text{carbon dioxide}}{2CO_2}$$

Both invertase and zymase occur in yeast.

The intermediate changes that occur in the latter reaction are very complex, and the following substances are reported as being produced at different stages of the process: *glyceric aldehyde*, *dihydroxyacetone*, *methyl glyoxal*, *pyruvic acid*, *acetic aldehyde*, and *glycerol* (glycerin).

If starchy substances are used as the starting point for alcoholic fermentation, the starches must first be gelatinized and then hydrolyzed to sugars by the action of an amylase, such as malt diastase, as in the following reaction:

$$\underset{\text{starch}}{C_6H_{10}O_5} + \underset{\text{water}}{H_2O} = \underset{\text{dextrose}}{C_6H_{12}O_6}$$

Here again the condensed reaction does not begin to show the actual changes that take place, for among the intermediate products formed are *dextrins* (*amylodextrin*, *erythrodextrin*, and *achroödextrin*) and maltose.

If a liquid in which alcoholic fermentation has occurred is not properly preserved or if the alcoholic content is very low, subsequent fermentation of a different character ensues in which the alcohol is converted into acetic acid through the influence of the microscopic organism known as *mycoderma aceti*.

This reaction is also expressed in a simple form as:

$$\underset{\text{alcohol}}{C_2H_5OH} + \underset{\text{oxygen}}{O_2} = \underset{\text{acetic acid}}{CH_3COOH} + \underset{\text{water}}{H_2O}$$

Here also intermediate reactions take place—*aldehyde* being one of the products formed.

The most important derivative of sugar through the action of a ferment is alcohol. This is usually obtained from whisky or from fermented molasses, by distillation.

The distilled product of vinous liquors forms the different ardent spirits of commerce. When obtained from wine, it is called *brandy* from the German *branntwein* (*burned wine*); from fermented molasses, *rum*; from malted barley,

rye, corn, wheat or other grains, *whisky*, from the Gaelic *usquebaugh*; from malted barley and rye-meal, with hops, and rectified from juniper berries, *gin*; and from fermented rice, *arrack*. These spirits are of different strengths—that is, they contain different proportions of alcohol—and have various peculiarities by which they are distinguished, chiefly the odor and taste. The manufacture and dispensing of these alcoholic liquors is only permitted under the regulations of the Internal Revenue Department and the National Prohibition or Volstead Act (see page 1261).

The compounds derived from sugars will be considered under the following sub-heads: 1. Ethyl hydroxide and oxide and their preparations. 2. Preparation of the esters of the ethyl, methyl, and amyl series. 3. Aldehyde, its derivatives and preparations.

Yeast is official in the N. F. for the making of fermented milk (see page 1182). It is described as follows:

CEREVISIÆ FERMENTUM COMPRESSUM. N. F. **Compressed Yeast**
[Cerev. Ferm. Compr.]

Compressed yeast consists of the moist, living cells of *Saccharomyces cerevisiæ* Meyen or of other species of *Saccharomyces*, (Fam. *Saccharomycetaceæ*) combined with a starchy or absorbent base.

Yeast contains at least two enzymes. Invertase changes sucrose to monosaccharides and zymase converts monosaccharides to alcohol. Yeast also contains an abundance of vitamin C.

Official Description—White or yellowish-white, soft and easily broken masses, having a characteristic, slightly sour odor, and not more than a faintly acid reaction to litmus.

When examined under the microscope, numerous oidium and mycoderma cells and starch grains are visible.

Compressed yeast must not be used unless fresh, and free from mildew and musty or foul odors.

N. F. Preparation—Lac Fermentatum.

Uses—Yeast has a laxative action. It is also supposed to increase the resistive powers of the body against infections and is used in acne, boils, etc.

Ethyl Hydroxide and Oxide and Their Preparations

ALCOHOL DEHYDRATUM. U. S. **Dehydrated Alcohol**
[Alcohol Dehyd.—Alcohol Absolutum, Dehydrated Ethanol]

Dehydrated Alcohol contains not less than 99 per cent by weight of C_2H_5OH (88.12).

Preparation—The natural sources of alcohol are starch and sugar as they exist in various plants, and alcohol, if pure, is the same from whatever source it is derived. It is generally made by distilling a crude grain spirit as in making whisky, and redistilling and rectifying the distillate in a special apparatus. The yield of alcohol, sp. gr. 0.835, obtained from good whisky is about 58 per cent by volume. The principal impurity is *fusel oil*, or amylic alcohol. Alcohol may be deprived of odor by treating it with potassium permanganate and redistilling. *Absolute alcohol* is the name formerly given to the strongest alcohol which can be distilled, and the name implies absolute freedom from water. This is an impossible achievement and the most appropriate name for this product is not absolute alcohol, but dehydrated alcohol. Owing to the very strong affinity existing between alcohol and water, the strongest alcohol that can be made by simple distillation contains about fifteen per cent of water, by volume. At 78° C. alcohol forms a constant boiling mixture with water which distils at the above concentration. An alcohol of greater strength may be obtained by the use of a column and still (see page 144), but in order to free it from the last 5 to 8 per cent of water it is necessary to use some substance

having a still stronger affinity for water. This is found in recently burned lime, and the method employed is to percolate the strongest and purest alcohol attainable through the lime, out of contact with air, and then to redistil the percolate *in vacuo*. In this way alcohol may be obtained having a specific gravity as low as 0.79355 at 15.56° C. (60° F.). (Squibb.) The official description for dehydrated alcohol of not less than 99 per cent strength is as follows:

Description and Physical Properties—A transparent, colorless, mobile, and volatile liquid, having a characteristic odor, and a burning taste. It is very hygroscopic.

Tests for Identity and Purity—Specific gravity: not above 0.798 at 15.56° C. (the U. S. Government standard temperature for Alcohol).

Shake 10 cc. of Dehydrated Alcohol in a stoppered tube with about 0.5 Gm. of powdered anhydrous cupric sulphate: the latter does not become blue (*water*).

In other respects dehydrated Alcohol has the properties of and complies with the tests for purity under *Alcohol*.

Preserve in well-closed containers, in a cool place, remote from fire.

N. F. Preparation—Liquor Phosphori.

ALCOHOL. U. S. Alcohol
[Ethanol]

Alcohol contains not less than 92.3 per cent by weight, corresponding to 94.9 per cent by volume, at 15.56° C., of C_2H_5OH (88.12).

Alcohol burns with a pale flame without residue, the products being carbon dioxide and water.

Alcohol is official in three forms: dehydrated alcohol, sp. gr. 0.798 at 15.56° C., 0.790 at 25° C.; alcohol, sp. gr. 0.816 at 15.56° C., 0.810 at 25° C.; diluted alcohol, sp. gr. 0.935 to 0.937 at 15.56° C., 0.930 to 0.932 at 25° C. The temperature at which the specific gravity of alcohol is taken for official preparations is exceptional, the old temperature 15.56° C. (60° F.) being retained because the United States Internal Revenue Department uses this temperature for its standards.

Deodorized alcohol was the official title in 1890 for the quality of alcohol now official. The description of alcohol, U. S. P., is as follows:

Description and Physical Properties—A transparent, colorless, mobile, and volatile liquid. It has a slight, characteristic odor, and a burning taste. It is inflammable.

Alcohol is miscible with water without any trace of cloudiness; also miscible with ether and with chloroform.

Tests for Identity and Purity—Specific gravity: not above 0.816 at 15.56° C. (the U. S. Government standard temperature for Alcohol).

Alcohol is readily volatilized even at low temperatures and boils at about 78° C.

Alcohol diluted with an equal volume of distilled water does not affect the color of blue or red litmus paper previously moistened with water.

Evaporate 40 cc. of Alcohol in a platinum or porcelain dish on a water bath, and dry at 100° C.: the residue does not exceed 0.001 Gm.

Mix 10 cc. of Alcohol with 5 cc. of distilled water and 1 cc. of glycerin, and allow the mixture to evaporate spontaneously from clean, odorless blotting paper: no foreign odor is perceptible when the last traces of the Alcohol leave the paper (*fusel oil constituents*).

Allow 25 cc. of Alcohol to evaporate spontaneously in a porcelain dish carefully protected from dust, until the surface of the dish is barely moist: no red or brown color is produced upon the addition of a few drops of sulphuric acid (*amyl alcohol or non-volatile, carbonizable organic impurities, etc.*).

On mixing 10 cc. of Alcohol in a test tube with 5 cc. of potassium hydroxide T.S., the liquid does not at once assume a yellow color (*aldehyde or oak tannin*).

Shake 20 cc. of Alcohol in a clean, glass-stoppered bottle with 1 cc. of silver nitrate T.S. and allow the mixture to stand in diffused daylight for 6 hours: the mixture does not become more than faintly opalescent, or acquire more than a faint brownish tint (*organic impurities, aldehyde, etc.*).

Dilute Alcohol with water to contain about 5 per cent by volume of ethyl alcohol. To 5 cc. of this dilute alcohol contained in a test tube of 20 cc. capacity, add 0.5 cc. of phosphoric acid and 2 cc. of a 3 per cent aqueous solution of potassium permanganate, and allow the mixture to stand for ten minutes. Add 1 cc. of an aqueous 10 per cent solution of oxalic acid, and allow to stand until the liquid is a transparent brown. Now add 5 cc. of a diluted and cooled sulphuric acid, prepared by mixing 3 volumes of distilled water and 1 volume of sulphuric acid, add 5 cc. of freshly prepared fuchsin-sulphurous acid T.S., mix well, and allow to stand for ten minutes. At the

end of this time the solution, when observed against a white background, may have a reddish or pale green tint, but not a distinct blue or violet color (*methanol*).

A mixture of 5 cc. of Alcohol, 2 cc. of sodium hydroxide T.S. and five drops of a freshly prepared aqueous solution of sodium nitroprusside (1 in 50), rendered slightly acid with acetic acid, shows no violet tint within one minute (*acetone*).

Alcohol, diluted with an equal volume of water, does not respond to the tests for *alkaloids*, *diethylphthalate*, *formaldehyde*, *isopropyl alcohol*, and *phenols* described under *Spiritus Frumenti*.

Preserve in well-closed containers, in a cool place, remote from fire.

U. S. P. Preparations—Acidum Sulphuricum Aromaticum; Alcohol Dilutum; Collodium; Elixirs; in the preparation of Spirits, Tinctures, Extracts, Fluidextracts, Liniments, Resins, etc.

N. F. Preparations—Used as in the U. S. P. for many pharmaceutical operations, also in Lavatio Ori; Acetum Aromaticum, Liquor Antisepticus; Liquor Antisepticus Alkalinus.

History—The term alcohol is of Arabic origin, the word *Al-Kohl* being applied to the black antimony sulphide employed by the harem beauties to darken their eyebrows and eyelashes. The word in its original significance meant finely divided and is still used in this way in the term *alcoholized iron* which simply means finely divided iron.

Distillation was first practiced shortly after the beginning of the Christian Era in Alexandria, but no definite record occurs of strong alcoholic liquids prepared by distillation until Arnold of Villanova who wrote in the latter part of the thirteenth century and who called such a product *aqua vini* or *aqua vitæ* and extolled its virtues as "it strengthens the body and prolongs life". It is said that when Henry II invaded Ireland in the twelfth century the inhabitants were making and drinking a strongly alcoholic liquid which they called *uisge-beatha* (from the first half of which we get the name whisky) which is Gaelic for "water of life".

Uses—Alcohol is used in pharmacy principally for its solvent powers (see page 239). It is also used as the starting point in the manufacture of many important compounds, like ether, chloroform, iodoform, etc. A specially fine brand of alcohol can now be obtained which is rectified particularly for perfumers' use; it is known as *cologne* spirits. It is said to be made by diluting the cologne spirit with sufficient water to bring it to about the strength of diluted alcohol, passing this through bone black, and then redistilling and concentrating it again to the proper strength in a rectifying column and still. All alcohol for perfumery must be denatured (see page 1227). Alcohol is also largely used as a fuel, chiefly in the form of denatured alcohol (see page 94).

ALCOHOL DILUTUM. U.S. Diluted Alcohol

[Alcohol Dil.—Diluted Ethanol]

Diluted Alcohol contains not less than 41 per cent and not more than 42 per cent by weight, corresponding to not less than 48.4 per cent and not more than 49.5 per cent by volume, at 15.56° C., of C_2H_5OH.

	Metric	Alternative
Alcohol	**500 cc.**	1 pint
Distilled Water	**500 cc.**	1 pint

Measure the alcohol and water at the same temperature, and mix them. If the two liquids are measured at the temperature of 25° C., the mixture when cooled to the same temperature will measure about 970 cc.

Diluted Alcohol may also be prepared in the following manner:

	Metric	Alternative
Alcohol	**408 Gm.**	40 oz. av. 350 gr.
Distilled Water	**500 Gm.**	50 oz. av.

When equal volumes of alcohol and water are mixed together, a rise in temperature and a contraction of about 3 per cent in volume take place. In

small operations the contraction is generally disregarded, in larger operations it is very apparent. If 50 gallons of official alcohol are mixed with 50 gallons of water, the product will not be 100 gallons of diluted alcohol, but only 96¼ gallons, a contraction of 3¾ gallons. United States *Proof Spirit* differs from diluted alcohol and is stronger; it contains 50 per cent, by volume, of absolute alcohol at 15.56° C. (60° F.). This corresponds to 42.5 per cent by weight, and has a specific gravity of 0.9341 at the same temperature.[1] If spirits have a specific gravity lighter than that of "proof spirit" (0.9341) they are said to be "*above proof*" if heavier, "*below proof*".

Tests for Identity and Purity—Diluted Alcohol has a specific gravity of from 0.935 to 0.937 to 15.56° C. (the U. S. Government standard temperature for alcohol).

It complies with the purity tests under *Alcohol*, allowance being made for the difference in strength and the presence of water, the boiling point being omitted.

Preserve in well-closed containers, in a cool place, remote from fire.

Uses—Diluted alcohol is used as a menstruum in making tinctures, fluidextracts, extracts, etc. Its properties have been already fully described in connection with the various preparations. Its value consists not only in antiseptic properties, but also in its possessing the solvent powers of both water and alcohol.

Denatured Alcohol—An act of Congress of June 7, 1906, authorized the withdrawal of alcohol from bond, without the payment of the internal revenue tax, for certain clearly defined uses in the industries and arts, provided such alcohol had been mixed, under the prescribed conditions, with denaturing substances which rendered it unfit for beverage purposes.

Subsequent acts of Congress, especially since the passage of the Volstead Act, have increased the number of methods for denaturing and the uses to which the product may be applied, so that ether and chloroform are now made from suitably denatured alcohol and one of the authorized denaturing processes consists of the U. S. P. formulas for tincture of iodine and liniment of soft soap. The actual denaturing may be conducted only under Government supervision in specially licensed establishments.

Special formulas for denatured alcohol applicable to specific manufacturing operations are permitted under government supervision.

Ethyl alcohol may be sold by retail dealers holding permits to use and sell intoxicating liquors, and who have paid the tax, if the quantities do not exceed one pint, and if medicated by one of the following formulas and labeled "Poison". Its use must also be understood to be other than for internal administration.

1. Formaldehyde, 2 parts; glycerin, 2 parts; alcohol, 96 parts. 2. Carbolic acid, 1 drachm; tannic acid, 1 drachm; alcohol, 1 pint; water, 1 pint. 3. Alum, ½ ounce; formaldehyde, 2 drachms; camphor, 1 ounce; alcohol and water, each 1 pint. 4. Liquor cresolis comp. (U. S. P.), 10 cc.; alcohol, 1000 cc.

Information may be obtained from the office of the Bureau of Internal Revenue, at Washington, D. C., concerning other specially denatured alcohols

---

[1] The U. S. P. VIII gave the following rules for making an alcohol of any required lower percentage from an alcohol of any given higher percentage: I. By Volume—Designate the volume percentage of the stronger alcohol by *V*, and that of the weaker alcohol by *v*.

Rule—Mix *v* volumes of the stronger alcohol with distilled water to make *V* volumes of product. Allow the mixture to stand until full contraction has taken place, and until it has cooled, then make up the deficiency in the *V* volumes by adding more distilled water.

Example—An alcohol of 30 per cent by volume is to be made from an alcohol of 94.9 per cent by volume —Take 30 volumes of the 94.9 per cent alcohol, and add enough distilled water to produce 94.9 volumes.

II. By Weight—Designate the weight-percentage of the stronger alcohol by *W*, and that of the weaker alcohol by *w*.

Rule—Mix *w* parts by weight of the stronger alcohol with distilled water to make *W* parts by weight product.

Example—An alcohol of 50 per cent by weight is to be made from an alcohol of 92.3 per cent by weight —Take 50 parts by weight of the 92.3 per cent alcohol, and add enough distilled water to produce 923 parts by weight.

for use in the industries. Many such are permitted but authorization to use them is only granted through a special permit and under carefully regulated conditions. (See page 1261.)

The U. S. P. IX has provided alcohol tables which are useful to the pharmacist in determining the alcoholic per cent of unknown liquids. Since the Food and Drugs Act requires a statement of the alcoholic per cent of pharmaceuticals it is often necessary to determine this factor. By using the distillation method for alcoholic determination (see below) and then referring the specific gravity of the liquid to the tables on the following pages, the actual per cent of alcohol present in the liquid may readily be determined.

Alcohol Determination. U. S.

Place 25 cc. of the preparation, measured at any definite temperature between 15° and 30° C., in a distilling flask of about 200 cc. capacity, provided with a high side tube connected with a suitable condenser; add 50 cc. of distilled water, distil into a 50 cc. graduated flask, at such a rate that about 48 cc. of distillate will be received in a half hour; if volatile products other than alcohol are known to be absent, bring to the original temperature and dilute to 50 cc. with water of the same temperature.

Determine the specific gravity of the distillate at any definite temperature between 15° and 30° C. by means of a pycnometer, and find the per cent of absolute alcohol by volume by reference to the alcoholometric table (page 909), and multiply by the dilution factor to find the per cent of alcohol in the original preparation.

If the preparation is thought to contain less than 25 per cent of alcohol, 50 cc. should be used for analysis; if it is believed to contain over 50 per cent of alcohol, 10 cc. should be taken. In either case the volume of the distillate should be made up to 50 cc. as directed above.

If the preparation contains iodine, treat it with zinc dust before distilling. (Sodium thiosulphate may be used instead of zinc dust, in which case several drops of sodium hydroxide T.S. should be added to prevent sulphur compounds from distilling over.) If volatile acids are present, neutralize with sodium hydroxide T.S.; if volatile bases are present, neutralize with diluted sulphuric acid; if both volatile acids and volatile bases are present, neutralize with diluted sulphuric acid and distil about 50 cc., neutralize this distillate with sodium hydroxide T.S., add 25 cc. of distilled water, and distil once more in the manner directed above and dilute to 50 cc.

If camphor, chloroform, ether, volatile oils, or other volatile products are known or believed to be present, transfer the first distillate to a separatory funnel and saturate it with sodium chloride, add 15 cc. of petroleum benzin and shake the mixture for one or two minutes.

If glycerin is present, dilute the liquid with sufficient distilled water to insure not more than 50 per cent of glycerin remaining in the liquid left in the flask after distilling. After the liquids have completely separated, draw off the lower alcoholic salt solution into a second separator, and repeat the extraction with 15 cc. of petroleum benzin; draw off the lower alcoholic salt solution into a distilling flask of about 200 cc. capacity, wash the combined petroleum benzin solutions with about 25 cc. of saturated sodium chloride solution, and add the washings to the distilling flask. Distil into a 50 cc. graduated flask at such a rate that about 45 to 48 cc. of distillate are received within a half hour. Bring to the original temperature, dilute with water of the same temperature to 50 cc. and determine the specific gravity and alcoholic per cent as directed above.

Alcoholometric Table

Temperature 15.56° C.

Percentage by Volume					Percentage by Weight				
Per cent vol. ‖	Corresponding per cent wt.	Sp. gr. app. * in air $\frac{15.56°}{15.56°}$	Corr. † of sp. gr. for barometer (100 mm.)	Fractional ‡ per cent	Per cent wt.	Corresponding per cent vol.	Sp. gr. app. * in air $\frac{15.56°}{15.56°}$	Corr. † of sp. gr. for barometer (100 mm.)	Fractional ‡ per cent
§0	0.000	1.00000	0.000000	0.0667	0	0.000	1.00000	0.000000	0.0532
1	0.795	0.99850	0.000000	0.0680	1	1.257	0.99812	0.000000	0.0543
2	1.593	0.99703	0.000000	0.0690	2	2.510	0.99628	0.000000	0.0565
3	2.392	0.99558	0.000001	0.0714	3	3.758	0.99451	0.000001	0.0588
4	3.194	0.99418	0.000001	0.0730	4	5.002	0.99281	0.000001	0.0610
5	3.998	0.99281	0.000001	0.0746	5	6.243	0.99117	0.000001	0.0641
6	4.804	0.99149	0.000001	0.0781	6	7.479	0.98961	0.000001	0.0671
7	5.612	0.99021	0.000001	0.0813	7	8.712	0.98812	0.000002	0.0680
8	6.422	0.98898	0.000002	0.0833	8	9.943	0.98665	0.000002	0.0700
9	7.234	0.98778	0.000002	0.0840	9	11.169	0.98523	0.000002	0.0719
10	8.047	0.98659	0.000002	0.0855	10	12.393	0.98384	0.000002	0.0746
11	8.862	0.98542	0.000002	0.0877	11	13.613	0.98351	0.000003	0.0769
12	9.679	0.98428	0.000002	0.0901	12	14.832	0.98120	0.000003	0.0775
13	10.497	0.98317	0.000003	0.0917	13	16.047	0.97991	0.000003	0.0800
14	11.317	0.98208	0.000003	0.0943	14	17.259	0.97866	0.000003	0.0820
15	12.138	0.98102	0.000003	0.0943	15	18.469	0.97744	0.000004	0.0840
16	12.961	0.97996	0.000003	0.0962	16	19.676	0.97625	0.000004	0.0833
17	13.786	0.97892	0.000003	0.0990	17	20.880	0.97505	0.000004	0.0826
18	14.612	0.97791	0.000004	0.1000	18	22.081	0.97384	0.000004	0.0813
19	15.440	0.97691	0.000004	0.1020	19	23.278	0.97261	0.000004	0.0806
20	16.269	0.97593	0.000004	0.1000	20	24.472	0.97137	0.000005	0.0794
21	17.100	0.97493	0.000004	0.0990	21	25.662	0.97011	0.000005	0.0781
22	17.933	0.97392	0.000004	0.0980	22	26.849	0.96883	0.000005	0.0769
23	18.768	0.97290	0.000004	0.0962	23	28.032	0.96753	0.000005	0.0752
24	19.604	0.97186	0.000005	0.0952	24	29.210	0.96620	0.000005	0.0740
25	20.443	0.97081	0.000005	0.0943	25	30.388	0.96485	0.000006	0.0719
26	21.285	0.96974	0.000005	0.0926	26	31.555	0.96346	0.000006	0.0694
27	22.127	0.96866	0.000005	0.0909	27	32.719	0.96202	0.000006	0.0667
28	22.973	0.96756	0.000005	0.0893	28	33.879	0.96052	0.000006	0.0649
29	23.820	0.96644	0.000005	0.0877	29	35.033	0.95898	0.000007	0.0633
30	24.670	0.96530	0.000005	0.0862	30	36.181	0.95740	0.000007	0.0613

* Barometer 760 mm. Air one-half saturated with moisture.

‖ If temperature of observation is above 15.56° C., look for percentage correction in the following table.

† Correction subtractive if barometer is above, additive if below, 760 mm. If barometer readings are in inches reduce to millimeters by multiplying by 25.4

‡ Corresponding with a difference in specific gravity of 0.0001.

§ The figures on this line across the page are for fractional percentages below 1.

Note: The figures of these alcoholometric tables are based on tables issued by the U. S. Bureau of Standards.

Alcoholometric Table—*Continued*

Percentage by Volume					Percentage by Weight				
Per cent vol.	Corresponding per cent wt.	Sp. Gr. app. in air $\frac{15.56°}{15.56°}$	Corr. of sp. gr. for barometer (100 mm.)	Fractional per cent	Per cent wt.	Corresponding per cent vol.	Sp. gr. app. in air $\frac{15.56°}{15.56°}$	Corr. of sp. gr. for barometer (100 mm.)	Fractional per cent
31	25.524	0.96414	0.000006	0.0820	31	37.323	0.95577	0.000007	0.0595
32	26.382	0.96292	0.000006	0.0787	32	38.459	0.95409	0.000007	0.0578
33	27.242	0.96165	0.000006	0.0775	33	39.590	0.95236	0.000007	0.0565
34	28.104	0.96036	0.000006	0.0752	34	40.716	0.95059	0.000008	0.0556
35	28.971	0.95903	0.000006	0.0725	35	41.832	0.94879	0.000008	0.0546
36	29.842	0.95765	0.000007	0.0704	36	42.944	0.94696	0.000008	0.0538
37	30.717	0.95623	0.000007	0.0685	37	44.050	0.94509	0.000009	0.0521
38	31.596	0.95477	0.000007	0.0668	38	45.149	0.94317	0.000009	0.0515
39	32.478	0.95326	0.000007	0.0649	39	46.242	0.94123	0.000009	0.0508
40	33.364	0.95172	0.000007	0.0633	40	47.328	0.93926	0.000010	0.0498
41	34.254	0.95014	0.000008	0.0617	41	48.407	0.93725	0.000010	0.0488
42	35.150	0.94852	0.000008	0.0600	42	49.480	0.93520	0.000010	0.0485
43	36.050	0.94687	0.000008	0.0588	43	50.545	0.93312	0.000011	0.0476
44	36.955	0.94517	0.000009	0.0578	44	51.605	0.93102	0.000011	0.0474
45	37.865	0.94344	0.000009	0.0565	45	52.658	0.92891	0.000011	0.0469
46	38.778	0.94167	0.000009	0.0552	46	53.705	0.92678	0.000012	0.0467
47	39.697	0.93986	0.000009	0.0541	47	54.746	0.92464	0.000012	0.0461
48	40.622	0.93801	0.000010	0.0526	48	55.780	0.92247	0.000012	0.0461
49	41.551	0.93611	0.000010	0.0518	49	56.808	0.92030	0.000013	0.0457
50	42.487	0.93418	0.000010	0.0510	50	57.830	0.91811	0.000013	0.0455
51	43.428	0.93222	0.000011	0.0503	51	58.844	0.91591	0.000013	0.0446
52	44.374	0.93023	0.000011	0.0498	52	59.851	0.91367	0.000014	0.0444
53	45.326	0.92822	0.000011	0.0488	53	60.854	0.91142	0.000014	0.0444
54	46.283	0.92617	0.000012	0.0483	54	61.850	0.90917	0.000014	0.0442
55	47.245	0.92410	0.000012	0.0478	55	62.837	0.90691	0.000015	0.0441
56	48.214	0.92201	0.000012	0.0474	56	63.820	0.90464	0.000015	0.0441
57	49.187	0.91990	0.000013	0.0463	57	64.798	0.90237	0.000015	0.0441
58	50.167	0.91774	0.000013	0.0457	58	65.768	0.90010	0.000016	0.0437
59	51.154	0.91555	0.000013	0.0452	59	66.732	0.89781	0.000016	0.0435
60	52.147	0.91334	0.000014	0.0446	60	67.690	0.89551	0.000016	0.0433
61	53.146	0.91110	0.000014	0.0439	61	68.641	0.89320	0.000017	0.0431
62	54.152	0.90882	0.000014	0.0437	62	69.586	0.89088	0.000017	0.0431
63	55.165	0.90653	0.000015	0.0435	63	70.523	0.88856	0.000017	0.0427
64	56.184	0.90423	0.000015	0.0429	64	71.455	0.88623	0.000018	0.0426
65	57.208	0.90190	0.000015	0.0426	65	72.380	0.88388	0.000018	0.0426
66	58.241	0.89955	0.000016	0.0420	66	73.299	0.88153	0.000019	0.0426
67	59.279	0.89717	0.000016	0.0410	67	74.211	0.87918	0.000019	0.0426
68	60.325	0.89477	0.000016	0.0408	68	75.117	0.87683	0.000019	0.0422
69	61.379	0.89232	0.000017	0.0407	69	76.016	0.87446	0.000020	0.0422
70	62.441	0.88986	0.000017	0.0403	70	76.909	0.87206	0.000020	0.0418

Alcoholometric Table—*Continued*

Percentage by Volume					Percentage by Weight				
Per cent vol.	Corresponding per cent wt.	Sp. gr. app. in air $\frac{15.56°}{15.56°}$	Corr. of Sp. gr. for barometer (100 mm.)	Fractional per cent	Per cent wt.	Corresponding per cent vol.	Sp. gr. app. in air $\frac{15.56°}{15.56°}$	Corr. of sp. gr. for barometer (100 mm.)	Fractional per cent
71	63.511	0.88738	0.000018	0.0395	71	77.794	0.86970	0.000021	0.0417
72	64.588	0.88485	0.000018	0.0392	72	78.672	0.86730	0.000021	0.0417
73	65.674	0.88230	0.000019	0.0389	73	79.544	0.86490	0.000021	0.0417
74	66.768	0.87973	0.000019	0.0385	74	80.410	0.86250	0.000022	0.0413
75	67.870	0.87713	0.000019	0.0380	75	81.269	0.86008	0.000022	0.0413
76	68.982	0.87450	0.000020	0.0376	76	82.121	0.85766	0.000022	0.0413
77	70.102	0.87184	0.000020	0.0370	77	82.967	0.85524	0.000023	0.0412
78	71.234	0.86914	0.000021	0.0365	78	83.805	0.85281	0.000023	0.0403
79	72.375	0.86640	0.000021	0.0362	79	84.636	0.85033	0.000024	0.0408
80	73.526	0.86364	0.000021	0.0357	80	85.459	0.84788	0.000024	0.0403
81	74.686	0.86084	0.000022	0.0352	81	86.275	0.84540	0.000024	0.0402
82	75.858	0.85800	0.000022	0.0350	82	87.083	0.84291	0.000025	0.0402
83	77.039	0.85514	0.000023	0.0344	83	87.885	0.84042	0.000025	0.0398
84	78.233	0.85223	0.000023	0.0337	84	88.678	0.83791	0.000025	0.0394
85	79.441	0.84926	0.000024	0.0331	85	89.464	0.83537	0.000026	0.0392
86	80.662	0.84624	0.000024	0.0326	86	90.240	0.83282	0.000026	0.0391
87	81.897	0.84317	0.000025	0.0322	87	91.008	0.83026	0.000027	0.0386
88	83.144	0.84006	0.000025	0.0314	88	91.766	0.82767	0.000027	0.0377
89	84.408	0.83688	0.000026	0.0307	89	92.517	0.82502	0.000028	0.0380
90	85.689	0.83362	0.000026	0.0300	90	93.254	0.82239	0.000028	0.0372
91	86.989	0.83029	0.000027	0.0291	91	93.982	0.81970	0.000028	0.0367
92	88.310	0.82685	0.000027	0.0282	92	94.700	0.81697	0.000029	0.0362
93	89.652	0.82330	0.000028	0.0272	93	95.407	0.81421	0.000029	0.0358
94	91.025	0.81963	0.000028	0.0262	94	96.103	0.81142	0.000030	0.0353
95	92.423	0.81581	0.000029	0.0252	95	96.787	0.80859	0.000030	0.0348
96	93.851	0.81184	0.000030	0.0240	96	97.457	0.80572	0.000030	0.0342
97	95.315	0.80769	0.000030	0.0229	97	98.117	0.80280	0.000031	0.0334
98	96.820	0.80333	0.000031	0.0214	98	98.759	0.79981	0.000031	0.0328
99	98.381	0.79865	0.000031	0.0200	99	99.386	0.79676	0.000032	0.0322
100	100.000	0.79365	0.000032		100	100.000	0.79365	0.000032	

Temperature Corrections

For volume per cent of Alcohol by the foregoing Alcoholometric Table

Temp. C. 15.56°	Observed per cent—Alcohol by volume											
	1	2	3	4	5	6	7	8	9	10	12	14
	Subtract from observed per cent of Alcohol											
16	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.08
17	0.14	0.14	0.16	0.16	0.16	0.17	0.17	0.19	0.20	0.21	0.24	0.29
18	0.25	0.25	0.27	0.27	0.27	0.29	0.31	0.33	0.35	0.37	0.42	0.49
19	0.36	0.36	0.38	0.39	0.40	0.43	0.45	0.48	0.51	0.54	0.61	0.69
20	0.48	0.48	0.50	0.52	0.54	0.57	0.60	0.64	0.67	0.71	0.80	0.91
21	0.60	0.61	0.63	0.65	0.68	0.71	0.75	0.80	0.84	0.89	0.99	1.12
22	0.73	0.75	0.77	0.79	0.83	0.86	0.91	0.97	1.02	1.07	1.19	1.35
23	0.86	0.89	0.91	0.94	0.98	1.02	1.08	1.14	1.20	1.26	1.40	1.58
24	1.00	1.04	1.06	1.10	1.14	1.20	1.25	1.32	1.38	1.45	1.61	1.81
25		1.19	1.22	1.26	1.30	1.36	1.41	1.49	1.57	1.65	1.82	2.04
26		1.35	1.38	1.43	1.47	1.54	1.60	1.68	1.76	1.85	2.04	2.28
27		1.52	1.55	1.61	1.65	1.73	1.79	1.88	1.96	2.06	2.27	2.52
28		1.69	1.73	1.78	1.84	1.91	1.99	2.08	2.17	2.28	2.50	2.76
29		1.87	1.91	1.96	2.03	2.10	2.19	2.28	2.38	2.50	2.73	3.00
30			2.09	2.15	2.22	2.30	2.39	2.49	2.60	2.72	2.97	3.25
31			2.27	2.34	2.41	2.50	2.60	2.70	2.82	2.85	3.21	3.51
32			2.45	2.54	2.61	2.71	2.82	2.92	3.05	3.18	3.46	3.77
33			2.63	2.74	2.81	2.92	3.04	3.15	3.28	3.42	3.71	4.03
34			2.82	2.95	3.02	3.14	3.27	3.39	3.52	3.66	3.96	4.29
35				3.16	3.24	3.36	3.49	3.63	3.76	3.91	4.22	4.55

Temp. C. 15.56°	Observed per cent—Alcohol by volume											
	16	18	20	22	24	26	28	30	32	34	37	40
	Subtract from observed per cent of Alcohol											
16	0.10	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.19	0.19	0.18
17	0.33	0.38	0.42	0.46	0.50	0.54	0.57	0.59	0.60	0.60	0.59	0.58
18	0.56	0.65	0.73	0.79	0.84	0.89	0.95	0.99	1.00	1.01	1.00	0.98
19	0.80	0.91	1.02	1.11	1.19	1.27	1.33	1.39	1.40	1.41	1.41	1.39
20	1.04	1.18	1.32	1.44	1.54	1.64	1.72	1.79	1.81	1.82	1.81	1.79
21	1.28	1.45	1.61	1.76	1.88	2.00	2.10	2.18	2.21	2.22	2.22	2.19
22	1.53	1.73	1.91	2.07	2.21	2.35	2.47	2.57	2.60	2.63	2.63	2.59
23	1.78	2.00	2.21	2.39	2.55	2.71	2.84	2.95	3.00	3.03	3.03	3.00
24	2.04	2.28	2.51	2.71	2.88	3.06	3.21	3.34	3.40	3.44	3.44	3.40
25	2.29	2.56	2.81	3.03	3.22	3.41	3.58	3.73	3.80	3.84	3.85	3.80
26	2.55	2.83	3.11	3.35	3.56	3.77	3.95	4.11	4.20	4.25	4.26	4.21
27	2.80	3.11	3.41	3.68	3.91	4.13	4.32	4.50	4.59	4.65	4.67	4.62
28	3.06	3.38	3.71	4.00	4.25	4.49	4.70	4.88	4.99	5.05	5.07	5.02
29	3.32	3.66	4.01	4.33	4.60	4.85	5.06	5.26	5.38	5.46	5.48	5.43
30	3.58	3.94	4.31	4.65	4.94	5.21	5.43	5.64	5.77	5.86	5.89	5.84
31	3.85	4.22	4.61	4.97	5.28	5.56	5.80	6.01	6.16	6.26	6.29	6.24
32	4.12	4.51	4.92	5.30	5.62	5.91	6.16	6.39	6.54	6.65	6.70	6.65
33	4.40	4.80	5.22	5.62	5.95	6.26	6.50	6.76	6.92	7.04	7.10	7.05
34	4.67	5.09	5.54	5.94	6.29	6.62	6.90	7.13	7.30	7.44	7.51	7.46
35	4.94	5.39	5.86	6.27	6.63	6.97	7.26	7.50	7.67	7.83	7.91	7.86

Temperature Corrections—*Continued*

For volume per cent of Alcohol by the foregoing Alcoholometric Table

Temp. C. 15.56°	Observed per cent—Alcohol by volume											
	43	46	49	52	55	58	61	64	67	70	72	76
	Subtract from observed per cent of Alcohol											
16	0.18	0.18	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.14
17	0.57	0.56	0.55	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.45
18	0.97	0.95	0.93	0.90	0.88	0.86	0.85	0.83	0.82	0.80	0.79	0.76
19	1.37	1.34	1.30	1.27	1.25	1.22	1.19	1.17	1.14	1.12	1.11	1.08
20	1.76	1.72	1.68	1.64	1.61	1.57	1.54	1.51	1.48	1.45	1.42	1.39
21	2.15	2.11	2.06	2.02	1.98	1.94	1.90	1.85	1.82	1.79	1.75	1.70
22	2.55	2.50	2.44	2.39	2.34	2.29	2.24	2.20	2.16	2.12	2.07	2.02
23	2.94	2.89	2.82	2.76	2.71	2.66	2.60	2.55	2.50	2.46	2.39	2.33
24	3.34	3.28	3.21	3.14	3.07	3.01	2.95	2.90	2.84	2.79	2.72	2.65
25	3.74	3.67	3.60	3.52	3.44	3.37	3.31	3.24	3.18	3.13	3.05	2.97
26	4.14	4.07	3.98	3.89	3.81	3.74	3.67	3.59	3.53	3.47	3.38	3.29
27	4.55	4.47	4.37	4.27	4.18	4.10	4.02	3.95	3.87	3.80	3.71	3.62
28	4.95	4.86	4.76	4.65	4.56	4.48	4.39	4.31	4.22	4.14	4.04	3.95
29	5.35	5.26	5.15	5.04	4.93	4.84	4.75	4.66	4.57	4.48	4.38	4.27
30	5.75	5.66	5.53	5.41	5.30	5.20	5.11	5.01	4.91	4.82	4.71	4.59
31	6.15	6.06	5.92	5.79	5.67	5.57	5.48	5.37	5.27	5.17	5.05	4.93
32	6.56	6.46	6.32	6.19	6.05	5.95	5.84	5.73	5.62	5.51	5.39	5.26
33	6.96	6.85	6.72	6.57	6.43	6.32	6.20	6.09	5.97	5.86	5.73	5.59
34	7.36	7.25	7.12	6.96	6.81	6.69	6.56	6.44	6.32	6.21	6.07	5.92
35	7.76	7.65	7.51	7.35	7.19	7.06	6.93	6.80	6.68	6.56	6.41	6.25

Temp. C. 15.56°	Observed per cent—Alcohol by volume										
	79	82	84	86	88	90	92	94	96	98	100
	Subtract from observed per cent of Alcohol										
16	0.13	0.13	0.13	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.08
17	0.44	0.42	0.41	0.41	0.39	0.38	0.36	0.33	0.31	0.27	0.24
18	0.74	0.71	0.70	0.69	0.66	0.63	0.60	0.56	0.52	0.46	0.40
19	1.04	1.00	0.98	0.96	0.93	0.89	0.85	0.79	0.73	0.65	0.57
20	1.34	1.30	1.28	1.24	1.20	1.15	1.09	1.02	0.94	0.85	0.74
21	1.66	1.60	1.57	1.53	1.47	1.42	1.34	1.26	1.16	1.05	0.92
22	1.97	1.90	1.86	1.82	1.75	1.69	1.60	1.50	1.39	1.26	1.09
23	2.27	2.20	2.15	2.10	2.03	1.96	1.86	1.75	1.61	1.46	1.27
24	2.58	2.50	2.45	2.39	2.31	2.23	2.12	1.99	1.84	1.67	1.45
25	2.89	2.81	2.75	2.68	2.60	2.50	2.38	2.23	2.07	1.88	1.63
26	3.21	3.11	3.05	2.96	2.89	2.78	2.64	2.48	2.31	2.10	1.82
27	3.52	3.42	3.35	3.27	3.17	3.05	2.91	2.74	2.54	2.31	2.00
28	3.84	3.73	3.65	3.57	3.46	3.33	3.18	2.99	2.78	2.53	2.19
29	4.16	4.04	3.96	3.86	3.74	3.61	3.45	3.25	3.02	2.75	2.38
30	4.47	4.34	4.26	4.16	4.03	3.89	3.72	3.51	3.26	2.98	2.58
31	4.79	4.66	4.56	4.46	4.32	4.18	3.99	3.77	3.51	3.21	2.78
32	5.12	4.98	4.88	4.77	4.62	4.46	4.27	4.03	3.76	3.45	2.99
33	5.45	5.30	5.19	5.07	4.92	4.75	4.54	4.30	4.01	3.68	3.19
34	5.77	5.62	5.51	5.38	5.22	5.03	4.82	4.56	4.26	3.92	3.40
35	6.09	5.94	5.82	5.69	5.52	5.32	5.09	4.82	4.52	4.15	3.61

SPIRITUS FRUMENTI. U. S. Whisky

[Sp. Frum.—WHISKEY]

Whisky is an alcoholic liquid obtained by the distillation of the fermented mash of wholly or partly malted cereal grains, and containing not less than 47 per cent and not more than 53 per cent by volume of C_2H_5OH (88.12), at 15.56° C. It must have been stored in charred wood containers for a period of not less than four years.

Preparation—Because of the immense production of grain in this country, the cheapest sources of starch (corn, wheat, and rye) are used in making alcoholic liquids. The operations by which whisky is obtained from grain are technically termed—1. *Mashing*, by which the starch is converted into sugar. 2. *Fermentation*, or the production of the alcohol. 3. *Distillation*, or the separation of the crude spirit.

The crushed grain, mixed with malt, is added to water at 15.56° C. and allowed to stand to permit the conversion of the starch into maltose and dextrose through the action of the diastase. The liquid is now termed the *wort*. This is caused to ferment by the addition of yeast, and alcohol is gradually formed, carbon dioxide escaping. The liquor is then distilled, the distillate being termed *low wines*. This is again distilled, and *raw whisky* is the product. This, upon keeping, especially in a warm room, improves in quality through the formation of esters, which are supposed to communicate an agreeable flavor to the liquid.

Owing to the fact that for many years various blends, mixtures, and dilutions were sold under the generic name whisky, the question of " What is whisky?" has frequently been discussed from the legal standpoint with a view to its commercial interpretation.

The Pharmacopœia has settled the question so far as the medicinal article is concerned by requiring the product to have been aged in charred wood for a period of at least four years. This restricted definition excludes imitation whiskies and diluted whiskies.

In the aging of whisky certain chemical and physical changes occur during which the liquid changes from a colorless alcoholic distillate, having a spirituous odor common to all fresh alcoholic distillates, to a colored liquid having a distinctive odor and certain organoleptic qualities which are associated with genuine whisky and unlike any other alcoholic liquid.

Imitation whiskies consist of diluted alcohol, colored and flavored to resemble the genuine, aged-in-the-wood article. No imitation whisky has ever been produced which cannot be detected by the application of the U. S. P. tests and their intelligent interpretation. The acidity and ester value are of particular importance in this connection as is the test for caramel coloring, which is present in imitation whisky to give it a fictitious appearance of age. The character and amount of the residue upon evaporation are also of importance. A number of the tests in the U. S. P. text are designed to detect and exclude the specially denatured alcohols which recently have found their way into the manufacture of these spurious concoctions which bootleggers usually supply under the name of whisky. Methanol, nicotine, quinine, diethylphthalate, isopropyl alcohol, heavy metals, and other special denaturants have been frequently reported by the analysts examining commercial and official whisky samples.

A more difficult type of deception to detect is that of diluted whisky, in which a certain proportion of genuine whisky is taken and is subsequently

reduced by adding diluted alcohol of whisky proof. If a very old whisky, which possesses a high acidity and high ester value, is taken to start with and the dilution or extension is not very great, this type of fraud is almost impossible to detect with certainty, as the factors would still fall within the limits of the U. S. P. standards and would probably be interpreted as indicating a less mature article, but still of U. S. P. quality. Fortunately, for the analyst, the temptation to make extra profit by dilution is so great that usually it is necessary to add caramel or an aniline dye to imitate age, and this enables the fraud to be detected, for a properly matured whisky needs no caramel or dye to improve its color.

Whisky may be purchased and sold legally only under the regulations of the Volstead Act, as administered by the Internal Revenue Department of the United States Government. The pharmacist has been selected by Congress as one of the most important distributing agents for alcoholic liquors for medicinal use, and his obligation and duty in this professional service must be rendered with a full sense of the grave responsibility involved.

The official description and tests are as follows:

Description and Physical Properties—A light to deep amber-colored liquid, having a characteristic odor and taste, and an acid reaction.

Specific gravity: from 0.935 to 0.923 at 25° C.

Tests for Identity and Purity—The residue obtained by evaporating 20 cc. of Whisky in a dish on a water bath is not completely soluble in 5 cc. of distilled water. Filter the solution and add to the filtrate a drop of diluted ferric chloride T.S. (1 in 10): a greenish-black coloration is produced (*indicating storage in wood barrels*).

A 25 cc. portion of Whisky, diluted with 50 cc. of distilled water, requires for neutralization not less than 1.5 cc. and not more than 5 cc. of tenth-normal sodium hydroxide, using 3 drops of phenolphthalein T.S. as indicator.

Mix 100 cc. of Whisky with 15 cc. of distilled water and slowly distil 100 cc., using an efficient condenser. Neutralize 50 cc. of the distillate with tenth-normal sodium hydroxide, using 5 drops of phenolphthalein T.S. as indicator, then add exactly 20 cc. more of the tenth-normal sodium hydroxide and boil for one hour under a reflux condenser. Cool and titrate the excess of alkali with tenth-normal sulphuric acid. Run a blank test, using distilled water in place of the distillate and make any necessary correction. The volume of tenth-normal sodium hydroxide consumed is not less than 1.7 cc. and not more than 7 cc. (*esters*).

To 5 cc. of the distillate add 2 cc. of sodium hydroxide T.S. and 5 drops of a freshly prepared aqueous solution of sodium nitroprusside (1 in 50), then add a slight excess of acetic acid: no violet tint is produced in one minute (*acetone*).

A mixture of 0.5 cc. of the distillate with 5 cc. of distilled water meets the requirements of the test for *methanol* under *Alcohol*.

Acidulate 10 cc. of Whisky with 5 drops of diluted hydrochloric acid and evaporate to 5 cc. Dilute with distilled water to 10 cc. and filter if necessary. The addition of iodine T.S. or mercuric potassium iodide T.S. yields no precipitate (*alkaloids*).

Dilute 10 cc. of Whisky with 2 cc. of distilled water, transfer to a test tube, and shake gently for two minutes with 15 cc. of a mixture of 100 cc. of amyl alcohol, 3 cc. of phosphoric acid, and 3 cc. of distilled water, and allow the layers to separate completely: the lower aqueous layer is colorless or very nearly so (*caramel*).

Mix 5 cc. of Whisky with 5 cc. of distilled water and shake the mixture with 10 cc. of purified petroleum benzin. Transfer the separated benzin to a dish of from 70 to 80 cc. capacity, add 1 cc. of sodium hydroxide solution (1 in 10), and evaporate to dryness on a water bath. Add to the dry residue 2 cc. of sulphuric acid, rotating the acid in the dish so that the residue will be completely moistened. Heat for two minutes on a water bath, and pour the solution into a dry test tube containing from 0.03 to 0.05 Gm. of resorcinol. Heat the mixture for three minutes at 160° to 170° C., shaking at intervals to dissolve all of the resorcinol. Then pour the solution into a mixture of 70 cc. of distilled water and 30 cc. of sodium hydroxide solution (1 in 10), adding more sodium hydroxide, if necessary, to make the mixture alkaline. The liquid shows no yellowish-green fluorescence after standing twenty-four hours (*diethylphthalate*).

Mix 2 cc. of an aqueous solution of phloroglucinol (1 in 100) with 5 cc. of sodium hydroxide T.S. and add 2 cc. of Whisky: no red color is produced (*formaldehyde*).

Mix 20 cc. of Whisky with 20 cc. of distilled water and shake the mixture with 10 cc. of ether. Allow the mixture to stand until separation takes place, separate the ether layer, and allow it to evaporate spontaneously on a watch glass: the residue has no disagreeable or irritating odor.

Evaporate 20 cc. of Whisky in a dish on a water bath and dry the residue to constant weight at 100° C.: the weight of the residue does not exceed 0.10 Gm. This residue is not sticky, it has a slightly astringent taste but is not distinctly sweet or bitter (*glycerin, sugar, etc*).

Evaporate 10 cc. of Whisky to 5 cc. and dilute with 10 cc. of distilled water, acidulate with 5 drops of hydrochloric acid, and add 10 cc. of hydrogen sulphide T.S.: no precipitate is formed before or after rendering alkaline with ammonia T.S. (*heavy metals*).

Place 2 cc. of mercuric sulphate T.S. in a test tube, add 5 drops of Whisky and heat the mixture just to boiling over a small Bunsen burner and remove it from the flame: no yellow precipitate is formed (*isopropyl alcohol*).

The addition of an excess of bromine T.S. to 5 cc. of Whisky, diluted with an equal volume of distilled water, produces no precipitate (*phenols*).

Uses—Crude or "raw" whisky is the chief source of alcohol which is largely used in the industries and arts. When purified and mellowed by age, whisky is used as a stimulant.

SPIRITUS VINI VITIS. U.S. Brandy

[Sp. Vin. Vit.—Spiritus Vini Gallici]

Brandy is an alcoholic liquid obtained by the distillation of the fermented juice of sound, ripe grapes and containing not less than 48 per cent and not more than 54 per cent by volume of C_2H_5OH, at 15.56° C.

It must have been stored in wood containers for a period of not less than four years.

Preparation—Brandy varies in quality according to the source from which it is obtained. The best brandy is obtained from French wines, and the kind called Cognac is most esteemed. Very large quantities of brandy are now made in California but the taste is peculiar and easily distinguished from that of Cognac. The Pharmacopœia recognizes all spirits when obtained from the juice of grapes, if sufficiently strong and pure to meet the tests given below.

Brandy owes its aroma to œnanthic and acetic ethers and other volatile products. Œnanthic ether is known chemically as ethyl pelargonate, $C_{11}H_{22}O_2$, but in commerce it is called *oil of cognac*. It is a fragrant, ethereal oil, of a greenish color.

Brandy resembles whisky in some respects and is totally unlike it in others. The aging is performed in wood containers, but not necessarily in charred wood. Hence brandy is much lighter in color than whisky as a rule, and is permitted to be colored with caramel and even to contain small amounts of sugar. The flavors of whisky and of brandy are distinctly different. The former, being a grain distillate, owes its predominant flavor and odor to *amylic compounds*. Brandy, being a wine distillate, owes its characteristic aroma and flavor to certain esters never found in whisky, of which *ethyl pelargonate* is an example.

The detection of spurious or of diluted brandy is much more difficult than in the case of whisky, unless foreign substances included in the list of special denaturants are found to be present.

Description and Physical Properties—A pale amber-colored liquid, having a characteristic odor and taste, and an acid reaction.

Specific gravity: from 0.933 to 0.921 at 25° C.

Tests for Identity and Purity—Evaporate 20 cc. of Brandy in a dish on a water bath, treat the residue with 5 cc. of distilled water, filter, and add to the filtrate a drop of diluted ferric chloride T.S. (1 in 10): a greenish-black coloration is produced (*indicating storage in wood barrels*).

Evaporate 20 cc. of Brandy in a dish on a water bath and dry the residue to constant weight at 100° C.: the weight of the residue does not exceed 0.30 Gm.

A 25 cc. portion of Brandy, diluted with 50 cc. of distilled water, requires for neutralization not more than 3.8 cc. of tenth-normal sodium hydroxide, using 3 drops of phenolphthalein T.S. as indicator (*free acid*).

Dilute 20 cc. of Brandy with 5 cc. of distilled water and slowly distil 20 cc., using an efficient condenser: the distillate meets the requirements of the tests for *acetone* and *methanol* under *Spiritus Frumenti*.

Brandy meets the requirements of the tests for purity under *Spiritus Frumenti*, beginning with the test for *alkaloids* but omitting the tests for *caramel* and for *glycerin, sugar, etc.*

Uses—Brandy is employed as a stimulant, and is often administered with milk, yolk of eggs, etc.

ÆTHER. U.S. **Ether**, STRONGER ETHER, PHARM. 1880, "SULPHURIC ETHER"

Ether contains from 96 per cent to 98 per cent of $(C_2H_5)_2O$, the remainder consisting of alcohol and water.

Caution—Ether to be used for anesthesia must be preserved only in small, well-closed containers, and is not to be used for this purpose, if the original container has been opened longer than twenty-four hours.

Preparation—Ether is made by acting on alcohol with sulphuric acid between the temperatures of 130° and 137.7° C., which is known as the etherifying temperature. The sulphuric acid is not consumed in the process, but is regenerated, so that the making of ether is practically continuous. This will be understood when the reactions are explained. Ether is the oxide of the monad radicle ethyl, C_2H_5. Alcohol, as has been already stated, is the hydroxide, C_2H_5OH.

The following equation illustrates the production of ether:

$$\underset{\text{alcohol}}{C_2H_5OH} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\substack{\text{ethylsulphuric}\\\text{acid}}}{C_2H_5HSO_4} + \underset{\text{water}}{H_2O}$$

then

$$\underset{\substack{\text{ethylsulphuric}\\\text{acid}}}{C_2H_5HSO_4} + \underset{\text{alcohol}}{C_2H_5OH} = \underset{\text{ether}}{(C_2H_5)_2O} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4}$$

Formerly it was believed that the sulphuric acid acted as a catalyzer and that it dehydrated the alcohol through its affinity for water; but the presence of ethylsulphuric acid, which is formed during the process, has made it necessary to abandon this simple theory.

Ether is now made from tax-free, specially denatured alcohol, and is consequently greatly reduced in price and may be used economically in the preparation of the oleoresins where it has again replaced acetone in the U. S. P.

Description and Physical Properties—A transparent, colorless, mobile liquid, having a characteristic odor, and a burning, sweetish taste. It is highly volatile and inflammable. Its vapor when mixed with air and ignited may explode violently. It is slowly oxidized by the action of air, moisture, and daylight with the formation of peroxides.

Ether is soluble in about 12 times its volume of water at 25° C. with slight contraction of volume. It is miscible with alcohol, benzene, chloroform, petroleum benzin, and fixed or volatile oils.

Tests for Identity—Specific gravity: 0.713 to 0.716 at 25° C.

Boiling point: about 35° C.

Tests for Purity—The color of light blue litmus paper moistened with water is not changed to red when the paper is immersed in Ether for ten minutes.

Allow 50 cc. of Ether to evaporate spontaneously from a shallow dish, and dry at 100° C. for one hour: the residue does not exceed 0.001 Gm.

Place 10 cc. of 80 per cent alcohol in a 50 cc. glass-stoppered flask, add 0.5 cc. of phenolphthalein T.S. and just sufficient fiftieth-normal sodium hydroxide to produce a pink color which persists after shaking for one-half minute. Then add 25 cc. of Ether, stopper the flask, mix gently, and add again fiftieth-normal sodium hydroxide until the pink color persists after shaking for one-half minute: not more than 0.4 cc. additional fiftieth-normal sodium hydroxide is required to neutralize the Ether (*acid*).

Pour 10 cc. of Ether, in portions, upon clean, odorless blotting paper, and allow it to evaporate spontaneously: no foreign odor is perceptible when the last traces of Ether evaporate from the paper.

Shake 10 cc. of Ether occasionally during two hours with 1 cc. of potassium hydroxide T.S. in a glass-stoppered container, protected from light: no color is developed in either liquid (*aldehyde*).

Shake 10 cc. of Ether occasionally during one hour with 1 cc. of a freshly made solution of cadmium and potassium iodide (1 in 10), in a glass-stoppered cylinder, previously rinsed with the Ether under examination and protected from light: no color develops in either liquid (*peroxide*).

Preserve in partially filled, well-closed, light-proof containers, in a cool place, remote from fire.

History—Valerius Cordus in 1517 described ether or a very similar product under the name *Oleum Vitriolo Dulce*. Later it was called *Spiritus Vini Aethereius*, and still later *Ether Sulphuricus*.

In 1842 Dr. Crawford Long of Athens, Georgia, first used ether as a general anesthetic. In 1844 Dr. Horace Wells, of Hartford, Conn., used it independ-

ently for the same purpose and Doctor Jackson of Boston, Mass., had used it several years earlier. The first hospital operation under ether anesthesia was performed in Boston, in 1846.

Uses—Ether is used principally as an anesthetic, and, notwithstanding the many efforts made to supplant it, continues to be the most largely used substance employed for producing insensibility to pain in surgical operations. It is occasionally given by mouth as a carminative. It is also used as a solvent. It dissolves iodine and bromine freely, and sulphur and phosphorus sparingly. Its power to dissolve corrosive sublimate makes it a useful agent in the manipulations for detecting that poison. It is also a solvent of volatile and fixed oils, many resins and balsams, tannic acid, caoutchouc, and most of the alkaloids.

Especial care should be observed in pouring ether from one vessel to another in the presence of a flame, as the vapor is heavy—two and a half times as heavy as air—and it readily ignites with explosive violence, when mixed with air.

OLEUM ÆTHEREUM N. F. Ethereal Oil

[Ol. Æther.]

A volatile liquid consisting of equal volumes of heavy oil of wine and ether.

	Metric	Alternative
Alcohol	**1000 cc.**	2 pints
Sulphuric Acid	**1000 cc.**	2 pints
Distilled Water	**25 cc.**	384 min.
Ether, a sufficient quantity.		

Add the sulphuric acid slowly to the alcohol, mix them thoroughly, and allow the mixture to stand, in a closed flask, for twenty-four hours, or until the liquid is clear; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure, so that the bulb shall be deeply immersed in the liquid, and having connected the retort with a well-cooled condenser, and also having connected a bent glass tube with the receiver for conducting the uncondensed gases into water, distil, by means of a sand bath, at a temperature between 150° and 160° C. until oily drops cease to come over, or until a black froth, which forms on the surface, begins to rise in the retort. Separate the yellow, ethereal liquid from the distillate, and expose it to the air for twenty-four hours, in a shallow dish. Then transfer it to a wet filter, and, when the aqueous portion has drained off, wash the oil which is left on the filter with the distilled water, which must be as cold as possible. When this also has drained off, transfer the oil to a graduated measure and add to it an equal volume of ether.

Preserve the product in small, glass-stoppered bottles, in a cool place.

A transparent, nearly colorless, volatile liquid of a peculiar, aromatic, ethereal odor, and a pungent, refreshing, bitter taste; neutral to dry litmus paper.

Specific gravity: about 0.905 at 25° C.

N. F. Preparation—Spiritus Etheris Compositus.

If alcohol is distilled with a large excess of sulphuric acid, there are formed toward the close of the distillation heavy oil of wine, sulphurous acid, olefiant gas, and empyreumatic products. The product of the distillation is generally in two layers, one consisting of water holding sulphurous acid in solution, and the other, of ether containing the heavy oil of wine. After separation, the latter liquid is exposed for twenty-four hours to the air, in order to dissipate the ether by evaporation, and the oil which is left is washed with water to deprive it of all traces of sulphurous acid.

In the early stage of the distillation of a mixture of sulphuric acid and alcohol, ethylsulphuric acid, $C_2H_5HSO_4$, is formed. During its progress, this is decomposed so as to yield ether. When, however, the alcohol is distilled with a large excess of sulphuric acid, the ethylsulphuric acid is decomposed so as to form a small quantity of the heavy oil of wine. This is a mixture of ethyl sulphate, $(C_2H_5)_2SO_4$, ethyl sulphite, $(C_2H_5)_2SO_3$ (the sulphurous acid having been formed by reduction of sulphuric acid), with polymeric forms of ethylene, C_2H_4.

Uses—Ethereal oil is used solely as an ingredient in compound spirit of ether. It differs from the official liquid in containing variable proportions of light and heavy oil of wine, ether, and alcohol. It is obtained as a by-product in the manufacture of ether.

During the rectification of crude ether, the distillation is continued as long as ether of the proper specific gravity comes over; after which the receiver is changed and an additional distillate is obtained, consisting of ether and alcohol impregnated with a little ethereal oil. It is this second distillate, variously modified by the addition of alcohol, ether, or water, so as to make it conform in taste, smell, opalescence, etc., to a standard preparation kept by the manufacturer, that is sold as Hoffmann's anodyne.

The expensiveness of the ethereal oil is alleged to be the cause of this substitution. The cheap commercial liquid may be known by adding it to water; it usually mixes without causing milkiness. The official compound spirit of ether produces a slight opalescence when forty drops are added to a pint of water, and the peculiar odor or ethereal oil is distinctly noticed; but castor oil is sometimes added by dishonest manufacturers to circumvent this test. This fraud may be detected by mixing equal parts of the suspected liquid and water, and collecting the oil which separates on a piece of filtering paper and exposing it to heat. A permanent greasy stain indicates a fixed oil, while an ethereal oil stain disappears on heating.

SPIRITUS ÆTHYLIS NITRITIS. U. S. Spirit of Ethyl Nitrite

[**Sp. Æth. Nitrit.**—Spiritus Ætheris Nitrosi U. S. P. IX, Spirit of Nitrous Ether, Sweet Spirit of Nitre]

Spirit of Ethyl Nitrite is an alcoholic solution of ethyl nitrite containing not less than 3.5 per cent and not more than 4.5 per cent of $C_2H_5NO_2$ (75.06).

The several manufacturing processes will be found on pages 305 to 307. In these, ethyl nitrite, an ester, is produced by substituting the acid radicle for the hydroxyl in the alcohol. This is then preserved from decomposition by the addition of sufficient alcohol.

Unofficial manufacturing processes are outlined on page 306. The distillation method is the only one applicable to large-scale preparation, but the U. S. P. IX process may be used in emergency by the practicing pharmacist, since it may be completed with the usual apparatus in the drug store laboratory.

The following equation is illustrative of the chemistry of either process:

$$\underset{\text{alcohol}}{2C_2H_5.OH} + \underset{\text{sodium nitrite}}{2NaNO_2} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{ethyl nitrite}}{2C_2H_5NO_2} + \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{water}}{2H_2O}$$

Pure ethyl nitrite is pale yellow, has the odor of apples, boils at 18° C. (note that this is below the body temperature), and has the specific gravity 0.900 at 15.56° C. The density of its vapor is 2.627. Litmus is not affected by it. It is soluble in forty-eight parts of water, and in all proportions in alcohol. It is highly inflammable and burns with a white flame without residue. Mixed with an alcoholic solution of potassium hydroxide, it becomes dark brown, showing the presence of aldehyde. When kept, the pure ethyl nitrite and also the Spirit become acid in a short time, as shown by litmus, and nitric oxide is given off, which often causes the bottle to burst. The tendency to become acid is rendered greater by the action of the air, and depends on the absorption of oxygen by the aldehyde which is converted into acetic acid. These facts show the necessity of preserving the spirit in *small, well-stoppered, dark amber-colored bottles, in a cool and dark place, remote from fires,* as required by the Pharmacopœia *and, in warm weather, of cooling the stock bottle thoroughly before opening it. The pharmacist should abandon the custom of keeping the solution in the regular glass-stoppered shop bottle, partially filled and exposed to heat and light.* This need not be a hardship, however, as the spirit may be placed in suitable small bottles, as soon as prepared, and be ready for dispensing or sale without further handling.

Spirit of ethyl nitrite is now usually prepared by mixing pure ethyl nitrite directly with the specified volume of alcohol, the ethyl nitrite being obtainable

in hermetically sealed tubes holding just sufficient ethyl nitrite for one pint of the official spirit. The tube should be well cooled, and the narrow neck plunged beneath the alcohol, before opening. It is well to wrap the tube in a towel before carrying out this operation, as the tubes have been known to explode violently, especially if the ethyl nitrite has not been recently prepared. The tubes are usually dated and the pharmacist cautioned not to use old stock.

The U. S. P. describes spirit of ethyl nitrite as follows:

Description and Physical Properties—A clear, mobile liquid of a pale yellow or faintly greenish-yellow tint. It has a fragrant, ethereal, pungent odor, free from acridity, and a sharp, burning taste. It is volatile and inflammable and rapidly decomposes on exposure to light and air.

When freshly prepared or even after being kept for some time with but little exposure to light and air, it is neutral to dry litmus paper. When long kept or after having been exposed to light and air, it acquires an acid reaction.

Specific gravity: not above 0.823 at 25° C.

Tests for Identity and Purity—Immerse a test tube half filled with the Spirit in a water bath heated to 65° C. until it has acquired that temperature: the Spirit distinctly boils upon the addition of a few small pieces of broken glass.

Effervescence does not result when a crystal of potassium bicarbonate is added to 5 cc. of the Spirit (*free acid*).

Mix 10 cc. of the Spirit with 5 cc. of potassium hydroxide T.S. previously diluted with 5 cc. of distilled water: the mixture assumes a yellow color which does not turn decidedly brown within twelve hours (*aldehyde*).

Assay—Transfer about 40 cc. of Spirit of Ethyl Nitrite, which has been previously shaken with 0.5 Gm. of powdered potassium bicarbonate, to a tared, 100 cc. measuring-flask, and weigh accurately. Add sufficient alcohol to bring the volume to exactly 100 cc. and mix thoroughly. Introduce into a nitrometer, page 1517, exactly 10 cc. of the alcoholic solution, followed by 10 cc. of potassium iodide T.S. and afterwards by 5 cc. of diluted sulphuric acid. When the volume of gas has become constant (within thirty to sixty minutes), note the volume of gas collected. Multiply this volume in cc. by 0.307, and divide the product by one-tenth of the weight of the Spirit of Ethyl Nitrite taken. At standard temperature and pressure, the quotient represents the percentage of ethyl nitrite in the liquid. The temperature correction is 1/273 of the total percentage just found for each degree of temperature, added if the temperature is below, subtracted if above, 25° C. The barometric correction is 1/760 of the total percentage just found for each mm., added if above, subtracted if below, 760 mm.

This assay is explained on page 1482.

Preserve in small, well-stoppered, dark amber-colored bottles, in a cool, dark place, remote from fire.

Alcohol content, by volume, 85 to 93 per cent.

Uses—Spirit of ethyl nitrite is a valuable diaphoretic and diuretic. The dose is thirty minims to one fluidrachm (2 to 4 cc.).

ÆTHYLIS CHLORIDUM. U. S. Ethyl Chloride

[Æthyl. Chlor.]

Monochlorethane [C_2H_5Cl = 64.51].

Preparation—Ethyl chloride may be made by the action of dry hydrochloric acid gas upon alcohol. The yield by this method is low unless zinc chloride is added to the alcohol before passing in the hydrogen chloride. The equation is as follows:

$$\underset{\text{ethyl alcohol}}{C_2H_5OH} + \underset{\substack{\text{hydrogen}\\\text{chloride}}}{HCl} = \underset{\substack{\text{ethyl}\\\text{chloride}}}{C_2H_5Cl} + \underset{\text{water}}{H_2O}$$

Ethyl chloride is more conveniently prepared by distilling a mixture of alcohol, sodium chloride, and sulphuric acid according to the following equation:

$$\underset{\text{ethyl alcohol}}{C_2H_5OH} + \underset{\substack{\text{sodium}\\\text{chloride}}}{NaCl} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\text{ethyl chloride}}{C_2H_5Cl} + \underset{\substack{\text{acid sodium}\\\text{sulphate}}}{NaHSO_4} + \underset{\text{water}}{H_2O}$$

The vapor is finally condensed with the aid of ice surrounding the receiver.

Description and Physical Properties—At low temperatures or under pressure it is a colorless, mobile, very volatile liquid. It has a characteristic, ethereal odor, and a burning taste.

When Ethyl Chloride is liberated at ordinary room temperature from its sealed container, it vaporizes at once. *As its vapor is very inflammable, do not use it near fire.* It burns with a smoky, greenish flame with the production of hydrogen chloride.

Ethyl Chloride is slightly soluble in water, and is freely soluble in alcohol and in ether.

Tests for Identity—Specific gravity: about 0.921 at 0° C.

Boiling point: between 12° and 13° C.

Tests for Purity—Add a few drops of silver nitrate T.S. to 10 cc. of alcohol, cool to the temperature of melting ice, and add to the clear liquid about 0.5 cc. of Ethyl Chloride cooled in the same manner: no turbidity is produced at once (*chloride*).

Shake 10 cc. of Ethyl Chloride with 10 cc. of distilled water, both previously cooled to the temperature of melting ice, and allow the supernatant stratum of Ethyl Chloride to evaporate spontaneously: the residual liquid is neutral to litmus paper, and on adding to it a few drops of potassium dichromate T.S., followed by 2 cc. of diluted sulphuric acid, and boiling the mixture, no odor of aldehyde is developed, and no greenish or purplish color is produced (*alcohol*).

Allow 5 cc. of Ethyl Chloride to evaporate spontaneously from a shallow dish: no foreign odor is noticeable while the last portions evaporate, and only a negligible residue remains.

Preserve in hermetically sealed containers, in a cool place, remote from fire, protected from light.

Uses—Ethyl chloride is used as a local anesthetic by "freezing"; its great volatility requires special methods for dispensing; hermetically sealed tubes are used, so made that when the end is broken off, or the metallic orifice opened, and the tube held in the hand, the heat causes expansion and expells the liquid in a fine stream which is directed against the part to be anesthetized. It is also employed as a general anesthetic by inhalation, especially for minor operations.

ÆTHYLIS CHAULMOOGRAS. U. S. Ethyl Chaulmoograte

[Æthyl. Chaulmoog.]

The ethyl esters of the fatty acids of chaulmoogra oil.

Description and Physical Properties—A clear, pale yellow liquid, having a slight, fruity odor. It is insoluble in water, but is miscible with alcohol, chloroform, and ether.

Tests for Identity and Purity—Specific gravity: about 0.904 at 25° C.

The specific rotation $[\alpha]_D$ of Ethyl Chaulmoograte, determined at 25° C. in chloroform, containing in each 10 cc. of solution 5 cc. of the Ethyl Chaulmoograte, and using a 100 mm. tube, is not less than +44.5°, page 1524.

A solution of 1 cc. Ethyl Chaulmoograte in 10 cc. of neutralized alcohol requires not more than 0.1 cc. of tenth-normal sodium hydroxide for neutralization, using 2 drops of phenolphthalein T.S. as indicator (*free acid*).

Saponification value: not less than 190 and not more than 196, page 1519.

Iodine value: not less than 90 and not more than 100, page 1519.

Preserve in well-closed containers.

Uses—The uses are described under chaulmoogra oil, page 1035. It is administered in gradually increasing doses of from 1 cc. to 5 cc. daily after meals with warm milk or hot tea. Intramuscularly, 1 cc. is the initial dose, this being increased by 1 cc. every second or third injection until a maximum of 3 cc. to 5 cc. is reached. The injections are administered once a week. The only preparation of Ethyl Chaulmoograte on the American market is sold by the Bayer Company, Inc., under the trademarked name "*Chaulmestrol*". The patent on this expires in 1927.

SULPHONMETHANUM. U. S. Sulphonmethane

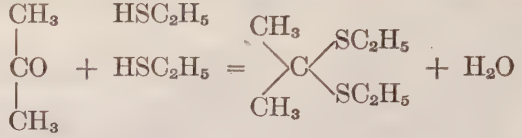
[Sulphonmeth.—Sulphonal]

Diethylsulphon-dimethylmethane $[(CH_3)_2C(SO_2C_2H_5)_2 = 228.28]$.

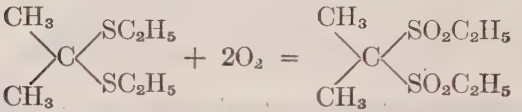
Preparation—Sulphonmethane or *Sulphonal* may be made by agitating mercaptol, obtained by the condensation of acetone with ethyl mercaptan, with a 5 per cent solution of potassium permanganate until the color of the solution remains unchanged, thus showing that the oxidation is completed.

The crystals are purified by redissolving in water or alcohol, and evaporating the solution, collecting, and drying the product.

The synthesis of this product is described by the following equations:



acetone ethyl mercaptan acetone-ethyl mercaptol water



acetone-ethyl mercaptol oxygen sulphonal

Description and Physical Properties—Colorless, odorless crystals or a white, odorless powder.

One Gm. of Sulphonmethane is soluble in 365 cc. of water, 60 cc. of alcohol, 11 cc. of chloroform, and in 64 cc. of ether, at 25° C. One Gm. is soluble in 16 cc. of boiling water and in 3 cc. of boiling alcohol. It is soluble in benzene.

Tests for Identity and Purity—Sulphonmethane melts between 124° and 126° C.

In other respects it responds to the tests for identity and purity under *Sulphonethylmethanum*.

Preserve in well-closed containers.

Uses—Sulphonmethane is not readily soluble, is slowly absorbed, and its hypnotic action is but slowly established. It is used as a hypnotic in doses of twelve to fifteen grains (0.75 to 1 Gm.). It should be administered in a hot liquid. When sulphonmethane or sulphonethylmethane are used frequently, the administration should be suspended once in two or three days to permit complete elimination.

SULPHONETHYLMETHANUM. U.S. Sulphonethylmethane

[Sulphonethylmeth.—TRIONAL]

Diethylsulphon-methylethylmethane $[(CH_3)(C_2H_5)C(SO_2C_2H_5)_2]$.

Preparation—Sulphonethylmethane or *Trional* is made by the same process as that employed in making sulphonal (see above), except that in making the mercaptol, acetone is replaced by methylethylketone, thus substituting an ethyl for a methyl group.

Description and Physical Properties—Colorless, lustrous, odorless, crystalline scales, having a bitter taste in aqueous solution.

One Gm. of Sulphonethylmethane is soluble in 200 cc. of water at 25° C. It is more soluble in boiling water; soluble in alcohol and in ether.

Tests for Identity—A saturated aqueous solution of Sulphonethylmethane is neutral to litmus paper.

It melts between 74° and 76° C.

When strongly heated, it is decomposed, with the evolution of sulphur dioxide.

Heat about 0.1 Gm. of Sulphonethylmethane with an equal weight of powdered charcoal in a dry test tube: the characteristic unpleasant odor of mercaptan is evolved.

Tests for Purity—Ash: not more than 0.05 per cent.

Boil 2 Gm. of Sulphonethylmethane with 100 cc. of distilled water until solution is complete: no odor develops. Cool the solution, add sufficient distilled water to restore the volume to 100 cc., filter, and to 20 cc. of the filtrate add 0.05 cc. of tenth-normal potassium permanganate: the pink color does not disappear at once (*readily oxidizable substances*).

To 10 cc. of the filtrate obtained in the preceding test add a few drops of silver nitrate T.S.: no turbidity is produced at once (*chloride*).

A 50 cc. portion of the same filtrate shows no more *sulphate* than corresponds to 1 cc. of fiftieth-normal sulphuric acid, page 1520.

Preserve in well-closed containers.

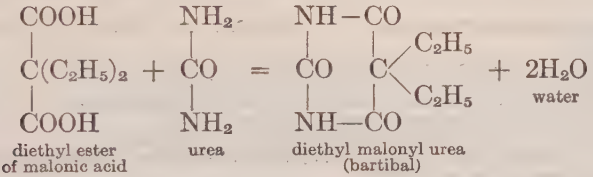
Uses—Sulphonethylmethane or Trional is used as a hypnotic in doses of twelve to fifteen grains (0.75 to 1 Gm.). It is more soluble than sulphonmethane and acts more quickly. It should be administered in a hot liquid. It is usually effective within an hour or two.

BARBITALUM. U.S. Barbital

[**Barbital.**—Diethylbarbituric Acid, Barbitone, Veronal]

Diethylmalonylurea $[CO(HN.CO)_2C(C_2H_5)_2]$.

Preparation—Barbital is made by the interaction of the diethyl ester of malonic acid and carbamide. The reaction is illustrated as follows:



Description and Physical Properties—Colorless or white, crystals, or a white crystalline powder. It is odorless, has a slightly bitter taste, and is stable in the air.

One Gm. of Barbital is soluble in 130 cc. of water, 14 cc. of alcohol, 75 cc. of chloroform, and in 35 cc. of ether, at 25° C. One Gm. is soluble in 13 cc. of boiling water. It is also soluble in acetone and in ethyl acetate.

Tests for Identity—Barbital melts between 187° and 190° C.

A saturated aqueous solution of Barbital is acid to litmus paper.

A saturated aqueous solution of Barbital yields with mercuric nitrate T.S. a white precipitate which is soluble in an excess of the reagent.

When Barbital is boiled with an excess of sodium carbonate T.S. for thirty minutes, or when fused with sodium hydroxide, it is decomposed with the evolution of ammonia.

Tests for Purity—The ash from 0.5 Gm. is negligible.

A solution of 0.2 Gm. of Barbital in 2 cc. of sulphuric acid is colorless (*readily carbonizable substances*). Another portion of 0.2 Gm. of Barbital is not colored by shaking with 2 cc. of nitric acid.

Uses—Barbital is quickly absorbed, especially when it is given in solution. In small doses it induces sleep, apparently without any other effect. In larger doses the temperature falls and animals show marked trembling and restlessness in their sleep. In small doses it is a relatively safe hypnotic, but fatalities have followed its indiscriminate use.

It is claimed that barbital is useful in simple insomnia, as well as in accompanying hysteria, neurasthenia and mental disturbances. The formation of a habit has been reported.

Dose—From 5 to 15 grains (0.3 to 1 Gm.), in hot water, tea or milk, or, if in wafers or capsules, followed by a cupful of some warm liquid.

The title *veronal* is trademarked by the Winthrop Chemical Company, Inc.

Barbital Compounds

Prolonged heating with sodium carbonate solution liberates ammonia. Deniges' reagent (mercuric sulphate) produces a white precipitate; in a solution acidulated with nitric acid, Millon's reagent produces a precipitate.

Barbital-Abbott—A brand of barbital-N. N. R.
Manufactured by The Abbott Laboratories, Chicago, under U. S. patent 782,739 (Feb. 14, 1905; expired).
Barbital-Abbott Tablets, 5 grains.

Barbital-M. C. W.—A brand of barbital-N. N. R.
Mallinckrodt Chemical Works, St. Louis, distributor. No U. S. patent or trademark.

Barbital-Merck—A brand of barbital-N. N. R.
Merck and Company, New York, distributor. No U. S. patent or trademark.

Veronal—A brand of barbital-N. N. R.
Manufactured by Winthrop Chemical Company, Inc., New York. U. S. patent 782,739 (Feb. 14, 1905; expired). U. S. trademark 40,115.
Veronal Tablets, 5 grains.
Elixir of Veronal—Each fluidrachm contains veronal 2 grains in a menstruum containing alcohol 33.5 per cent.

BARBITALUM SOLUBILE. U.S. Soluble Barbital

[**Barbital. Sol.**—Barbital Sodium, Sodium Diethylbarbiturate, Sodium Diethylmalonylurea, Barbitone Sodium, Veronal-Sodium]

Soluble Barbital, when dried to constant weight at 100° C., contains not less than 98.5 per cent of $CO(NaN.CO)(HN.CO)C(C_2H_5)_2$.

A sodium salt of Barbital, , which is more soluble in water and with a more bitter, alkaline taste. It differs structurally from barbital only in having one atom of hydrogen replaced by an atom of sodium.

Description and Physical Properties—A white powder. It is odorless, has a bitter taste, and is stable in the air.

One Gm. of Soluble Barbital is soluble in about 5 cc. of water at 25° C., and in 2.5 cc. of boiling water. It is slightly soluble in alcohol and is insoluble in ether.

Tests for Identity—The barbital obtained in the assay melts between 187° and 190° C., and responds to the other identity tests given under *Barbitalum*.

An aqueous solution of Soluble Barbital is alkaline to litmus paper.

The addition of diluted hydrochloric or sulphuric acid to an aqueous solution of the salt (1 in 20) produces a precipitate of barbital.

Tests for Purity—A solution of 0.2 Gm. of the salt in 2 cc. of sulphuric acid is colorless (*readily carbonizable substances*).

Ten cc. portions of an aqueous solution of Soluble Barbital (1 in 100) acidulated with a few drops of nitric acid yield no opalescence at once on the addition of a few drops of silver nitrate T.S. (*chloride*), and no turbidity within one minute on the addition of 1 cc. of barium chloride T.S. (*sulphate*).

An aqueous solution of the salt meets the requirements of the test for *heavy metals*, page 1519.

When dried to constant weight at 100° C., it loses not more than 1 per cent (*water*).

Shake 0.5 Gm. of Soluble Barbital with 20 cc. of dehydrated ether for ten minutes, filter, evaporate the ether, and dry at 100° C.: the weight of the residue does not exceed 0.003 Gm. (*uncombined barbital*).

Assay—Dissolve about 1 Gm. of Soluble Barbital, previously dried at 100° C. and accurately weighed, in 10 cc. of distilled water in a separator, add to the solution 15 cc. of diluted hydrochloric acid, and extract the liberated barbital by shaking successively with eight portions of 25 cc. each of ether. Evaporate the combined ether solutions at as low a temperature as possible, and dry at 100° C. The weight of the barbital so obtained is not less than 88 per cent and not more than 90 per cent of the dried Soluble Barbital. About 0.2 Gm. of the Barbital, obtained in the assay, leaves a negligible residue upon ignition.

This assay is explained on page 1476.

Uses—The same as those of barbital, but it is claimed that this drug acts more rapidly on account of its greater solubility. Because of its solubility, administration by rectal injection and also subcutaneous injection has been proposed.

The title *veronal-sodium* is trademarked by the Winthrop Chemical Company, Inc.

Dose—The same as that of barbital. It should be administered in an aqueous solution.

Barbital Sodium-Abbott—A brand of barbital sodium-N. N. R.
Manufactured by The Abbott Laboratories.
Elixir Barbital Sodium-Abbott—Each fluidounce contains barbital sodium-Abbott 20 grains in a liquid composed of water and glycerin, and sugar flavored.
Barbital Sodium-Merck—A brand of barbital sodium-N. N. R.
Merck and Company, distributor.
Veronal-Sodium—A brand of barbital sodium-N. N. R.
Manufactured by Winthrop Chemical Company, Inc., New York.
Veronal-Sodium Tablets, 5 grains.

CARBROMALUM. U.S. Carbromal

[**Carbrom.**—Bromdiethylacetylurea, Adalin]

Brom-diethylacetyl carbamide $[C(C_2H_5)_2Br.CONH.CONH_2]$.

Description and Physical Properties—A white, crystalline, odorless powder.

One Gm. of Carbromal is soluble in about 3000 cc. of water, 18 cc. of alcohol, 3 cc. of chloroform, and in 14 cc. of ether, at 25° C. It is very soluble in boiling alcohol. It dissolves in sulphuric,

nitric, and in concentrated hydrochloric acids, from which it is precipitated by dilution with water. It is dissolved by solutions of alkali hydroxides.

Tests for Identity—Carbromal melts between 116° and 117° C.

On boiling about 0.2 Gm. of Carbromal with 5 cc. of a 10 per cent aqueous sodium hydroxide solution: ammonia is evolved.

Mix 0.1 Gm. of Carbromal with 0.5 Gm. of anhydrous sodium carbonate, and ignite gently until completely decomposed. Dissolve the residue in 5 cc. of hot distilled water, cool, acidulate with acetic acid, and filter. Add to the filtrate 2 cc. of chloroform and then chlorine T.S., drop by drop: the chloroform acquires a red-brown color on shaking.

Tests for Purity—The ash from 0.5 Gm. is negligible.

A solution of 0.2 Gm. of Carbromal in 2 cc. of sulphuric acid is colorless or at most faintly brown (*readily carbonizable substances*).

Shake 1 Gm. of Carbromal with 20 cc. of distilled water during five minutes, and filter; the filtrate is neutral to litmus paper.

Five cc. portions of the filtrate obtained in the preceding test show no more *chloride* than corresponds to 0.1 cc. of fiftieth-normal hydrochloric acid, and no more *sulphate* than corresponds to 0.1 cc. of fiftieth-normal sulphuric acid, page 1520.

Uses—Carbromal is said to be an efficient and prompt sedative, reducing excitement and promoting sleep in conditions in which a powerful hypnotic is not required. In therapeutic doses it is said not to exert any unfavorable influence on the respiration or heart action. The sleep produced is said to be restful, dreamless and exceptionally free from unpleasant by-effects and sequelæ.

Carbromal is stated to be useful as a sedative and mild hypnotic in neurasthenia, hysteria, cardiac neuroses with tachycardia, chorea, mental disorders with moderate excitement, insomnia due to various internal diseases, etc.

The title *adalin* is trademarked by the Winthrop Chemical Company, Inc.

Dose—As a sedative from 5 to 10 grains (0.3 to 0.6 Gm.) given in cold water, repeated three or four times daily if necessary; as a hypnotic from 10 to 20 grains (0.6 to 1.3 Gm.), followed by a drink of hot, sweetened water or weak tea.

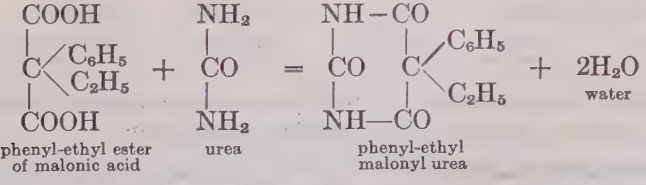
Manufactured by Bayer Company, and distributed by the Winthrop Chemical Company, Inc.

PHENOBARBITALUM. U.S. Phenobarbital

[**Phenobarb.**—PHENYLETHYLMALONYLUREA, LUMINAL]

Phenylethyl Barbituric acid $[CO(NH.CO)_2C(C_2H_5)(C_6H_5)]$.

Preparation—Luminal is closely related chemically to barbital in that it represents barbital with an ethyl group replaced by a phenyl group. The equation showing its production is given as follows:



Description and Physical Properties—White, glistening, small crystals, or a white, crystalline powder. It is odorless, and is stable in the air.

One Gm. of Phenobarbital is soluble in about 1000 cc. of water, 8 cc. of alcohol, 40 cc. of chloroform, 13 cc. of ether, and in about 700 cc. of benzene, at 25° C. It is soluble in solutions of alkali hydroxides and of alkali carbonates.

Tests for Identity—Phenobarbital melts between 172° and 174° C.

A saturated aqueous solution of Phenobarbital is acid to litmus paper.

Boil about 0.2 Gm. of Phenobarbital with 5 cc. of a 25 per cent sodium hydroxide solution: ammonia is evolved.

Shake about 0.3 Gm. of Phenobarbital for two minutes with 1 cc. of normal sodium hydroxide and 5 cc. of distilled water, filter, and divide the filtrate into 2 portions. To 1 portion add mer-

curic chloride T.S.: a white precipitate is produced. To the other portion add silver nitrate T.S., a few drops at a time: a white precipitate is produced which at first redissolves but becomes insoluble when an excess of silver nitrate has been added.

Tests for Purity—The ash from 0.5 Gm. is negligible.

A solution of 0.2 Gm. of Phenobarbital in 2 cc. of sulphuric acid is colorless or only faintly yellow (*readily carbonizable substances*).

Boil 2 Gm. of Phenobarbital with 10 cc. of alcohol under a reflux condenser during three minutes: a clear and complete solution results (*phenylbarbituric acid*).

Uses—It is claimed that the introduction of the phenyl group increases the hypnotic power of phenobarbital over that of barbital but the relative toxicity of hypnotic doses of luminal and barbital has not been determined definitely.

A period of excitement sometimes precedes sleep.

Luminal is used as a useful hypnotic in nervous insomnia and conditions of excitement of the nervous system; its chief use in this field is as a sedative and antispasmodic in the treatment of epilepsy. Its use as a sedative has also been proposed in chorea, neurasthenia, cardiac and gastric neuroses, climacteric disorders, dysmenorrhea, exophthalmic goiter, and pre- and post-operative cases, but it should be remembered that it has no curative action, in such conditions.

The title *luminal* is trademarked by the Winthrop Chemical Company, Inc.

Dose—From ½ to 5 grains (0.03 to 0.3 Gm.), increased if necessary to 12 grains (0.8 Gm.). A maximum dose of 12 grains (0.8 Gm.) should not be exceeded.

A soluble sodium salt of phenobarbital is also sold under the title *phenobarbital sodium* or *luminal-soluble*. The uses are the same as for phenobarbital with a 10 per cent increase in dose.

AMYLIS NITRIS. U.S. Amyl Nitrite

[Amyl. Nitris]

Amyl Nitrite contains not less than 80 per cent of $C_5H_{11}NO_2$ (117.12).

Preparation—Amyl Nitrite is conveniently prepared by distilling a mixture of amyl alcohol, sodium nitrite, and sulphuric acid, as indicated by the following equation:

$$\underset{\text{amyl alcohol}}{C_5H_{11}OH} + \underset{\substack{\text{sodium}\\\text{nitrite}}}{NaNO_2} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\text{amyl nitrite}}{C_5H_{11}NO_2} + \underset{\substack{\text{acid sodium}\\\text{sulphate}}}{NaHSO_4} + \underset{\text{water}}{H_2O}$$

Difficulties are experienced in rectifying amyl nitrite on account of the number of products present having similar boiling points.

Description and Physical Properties—A clear, yellowish liquid, having a peculiar, ethereal, fruity odor, and a pungent, aromatic taste. It is volatile even at low temperatures, and is inflammable.

Amyl Nitrite is almost insoluble in water, but is miscible with alcohol and with ether.

Tests for Identity—Specific gravity: 0.865 to 0.875 at 25° C.

Add 2 cc. of sulphuric acid to a mixture of 2 drops of Amyl Nitrite and 2 drops of water: amyl valerate is produced, recognizable by its odor on dilution with water.

Add a few drops of Amyl Nitrite to a mixture of 1 cc. of ferrous sulphate T.S. and 5 cc. of diluted hydrochloric acid: a greenish-brown color is produced.

Tests for Purity—Mix 1 cc. of normal sodium hydroxide and 10 cc. of distilled water with a drop of phenolphthalein T.S. in a glass-stoppered cylinder, and add 5 cc. of Amyl Nitrite. After inverting the cylinder a few times, the red tint of the aqueous layer is still perceptible (*free acid*).

To a mixture of 1.5 cc. of silver nitrate T.S. and 1.5 cc. of alcohol, add a few drops of ammonia T.S. until the precipitate first formed is redissolved. Then add 1 cc. of Amyl Nitrite, and gently heat for one minute: the mixture does not become brown or black (*aldehyde*).

Assay—Transfer about 3 cc. of Amyl Nitrite, which has been previously shaken with 0.5 Gm. of potassium bicarbonate and carefully decanted to a 100 cc. flask, tared with about 20 cc. of alcohol, and weigh accurately. Add sufficient alcohol to bring the volume to exactly 100 cc. and mix thoroughly. Introduce into a nitrometer, page 1517, exactly 10 cc. of the alcoholic solution, wash any adhering Amyl Nitrite into the nitrometer with 5 cc. of alcohol, followed by 10 cc. of potassium iodide T.S. and afterwards by 5 cc. of diluted sulphuric acid. When the volume of gas has become constant (in about thirty to sixty minutes), note the amount collected, multiply this volume in cc. by 4.8, and divide the product by the weight of the Amyl Nitrite taken. At standard temperature and pressure, the quotient represents the percentage of Amyl Nitrite in the liquid. The temperature correction is 1/273 of the total percentage just found for each degree, additive if the temperature is below 25° C. and subtractive if it is above 25° C. The barometric correction is 1/760 of the total percentage just found for each millimeter, additive if it is above 760 mm. and subtractive if it is below 760 mm.

This assay is explained on page 1481.

Preserve in hermetically-sealed glass bulbs, or in tightly-stoppered vials, in a cool place, protected from light.

Uses—Amyl nitrite is exceedingly volatile. It is a valuable remedy and is much used in asthma, angina pectoris, and similar complaints, by inhalation. It may be administered by dropping a small quantity on a handkerchief and inhaling the vapor or by crushing a glass *pearl of amyl nitrite* in the handkerchief and inhaling the liquid which volatilizes. The official dose is three minims (0.2 cc.).

ÆTHER ACETICUS. N.F. Acetic Ether

[**Æth. Acet.**—Ethyl Acetate]

A liquid containing not less than 96 per cent, by volume, of $C_4H_8O_2$ or $CH_3COO.C_2H_5$ (88.08), the remainder consisting of alcohol and a little water.

Preparation—Hager's process may be used for making this ester: 440 Gm. of official sulphuric acid are added slowly to 250 Gm. of official alcohol contained in a flask, and the mixture allowed to stand for two or three days to permit the formation of ethylsulphuric acid; then 325 Gm. of sodium acetate, previously dried by heating it at a temperature of 130° C., until its weight remains constant, are introduced into a retort connected with a well-cooled receiver; the acid and alcohol mixture is slowly added, heat carefully applied, and the distillation continued as long as vapors of ethyl acetate come over.

$$\underset{\text{sodium acetate}}{NaC_2H_3O_2} + \underset{\text{ethylsulphuric acid}}{C_2H_5HSO_4} = \underset{\text{ethyl acetate}}{C_2H_5C_2H_3O_2} + \underset{\text{acid sodium sulphate}}{NaHSO_4}$$

Ethylsulphuric acid is formed through the action of the sulphuric acid and heat upon the alcohol. This is then decomposed by contact with sodium acetate, while ethyl acetate and acid sodium sulphate are produced.

Description and Physical Properties—Acetic Ether is a transparent, colorless liquid, of a fragrant and refreshing, slightly acetous odor, and a peculiar acetous and burning taste.

Specific gravity: 0.890 to 0.896 at 25° C.

One cc. of Acetic Ether is soluble in about 10 cc. of water at 25° C., miscible with alcohol, ether, or fixed or volatile oils.

Tests for Identity—It does not immediately redden blue litmus paper.

Boiling point: from 72° to 77° C.

Acetic Ether is readily volatilized even at a low temperature. It is inflammable, burning with a yellowish flame.

Tests for Purity—No weighable residue remains on evaporating 10 cc. of acetic ether.

Allow 10 cc. of Acetic Ether to evaporate spontaneously from clean, odorless blotting paper; the final odor does not resemble that of pineapple (*butylic or amylic derivatives*).

Pour carefully 2 cc. of Acetic Ether on 10 cc. of sulphuric acid; no dark ring is developed at the point of contact of the two layers within fifteen minutes (*readily carbonizable organic impurities.*)

Mix 20 cc. of Acetic Ether with a solution of 20 Gm. of sodium hydroxide in 50 cc. of distilled water, allow the mixture to stand, agitating occasionally, or heat it gently under a reflux condenser until a homogeneous liquid results, and then distil about 25 cc. This distillate complies with the test for absence of methanol under Alcohol in the U. S. Pharmacopœia X (see page 905).

Shake 25 cc. of Acetic Ether in a graduated cylinder with 25 cc. of distilled water just previously saturated with Acetic Ether; the ethereal layer when separated measures not less than 24 cc. (*undue proportion of alcohol or water*).

Preserve it in well-stoppered bottles, in a cool place, remote from fire and protected from light.

N. F. Preparations—Elixir Gentianæ Glycerinatum; Elixir Terpini Hydratis et Creosoti; Spiritus Odoratus; Tinctura Antimonii.

Uses—Acetic ether is used only as a flavoring agent. Its odor is frequently noticed in old tinctures and extemporaneous mixtures which have once contained alcohol and acetic acid. Dose, fifteen minims (1 cc.).

CHAPTER LXV

ALDEHYDE, ITS DERIVATIVES AND PREPARATIONS

PARALDEHYDUM. U.S. Paraldehyde
[Paraldehyd.—Paracetaldehyde]

A polymer $[(CH_3.CHO)_3 = 132.13]$ of acetaldehyde.

Preparation—This official liquid is a product of the condensation of three molecules of ordinary aldehyde; it may be made by treating acetaldehyde with small quantities of sulphur dioxide, hydrochloric acid, carbonyl chloride, or zinc chloride; almost complete conversion occurs, and by freezing the liquid and rectifying, pure paraldehyde is produced.

Description and Physical Properties—A colorless, transparent liquid. It has a strong, characteristic, not unpleasant or pungent odor, but a disagreeable taste.

One cc. of Paraldehyde is soluble in about 8 cc. of water at 25° C. One cc. is soluble in 17 cc. of boiling water. It is miscible with alcohol, chloroform, ether, and with volatile oils.

Tests for Identity—Specific gravity: about 0.990 at 25° C.

It boils between 120° and 125° C.

Congealing point: not below 9° C.

When heated with a small quantity of sulphuric acid, Paraldehyde is converted into acetaldehyde, recognizable by its odor.

Tests for Purity—Heat 5 cc. of Paraldehyde on a water bath: no disagreeable odor is noticeable as the last portions evaporate (*impurities derived from fusel oil*) and not more than 0.003 Gm. of residue remains.

One cc. of Paraldehyde forms with 10 cc. of distilled water at 25° C. a clear solution, free from oily drops (*amyl alcohol*). A 5 cc. portion of this solution, acidulated with a drop of hydrochloric acid, yields no turbidity on the addition of 3 drops of barium chloride T.S. (*sulphate*). Another 5 cc. portion, acidulated with 1 drop of nitric acid, yields no opalescence at once on the addition of 3 drops of silver nitrate T.S. (*chloride*).

A mixture of 6 cc. of Paraldehyde and 8 cc. of alcohol with 1 drop of phenolphthalein T.S. acquires a pink color upon the addition of 0.5 cc. of normal sodium hydroxide (*free acid*).

Shake 5 cc. of Paraldehyde with 5 cc. of potassium hydroxide T.S. and allow the mixture to stand at 20° C.: the aqueous layer is not colored yellow or brown within thirty minutes (*acetaldehyde*).

Preserve in well-closed containers, in a cool place, protected from light.

Uses—Paraldehyde is a hypnotic. Owing to its unpleasant taste, it is usually prescribed in combination with alcoholic liquors, elixirs, etc. Dose, thirty minims to one fluidrachm (2 to 4 cc.).

LIQUOR FORMALDEHYDI. U.S. Solution of Formaldehyde
[Liq. Formaldehyd.]

An aqueous solution containing not less than 37 per cent of H.CHO(30.02) with variable amounts of ethyl or methyl alcohol, or both, to prevent polymerization.

Preparation—This liquid, commonly known as *formaldehyde* or *formalin*, is made by mixing the vapor of boiling methyl alcohol, while under pressure, with air in proper quantity, and allowing the mixed vapors to pass over heated copper tubes, and then condensing the vapors by passing them into a copper tank provided with the means for cooling the temperature to 0° C.

The reaction is expressed by the following equation:

$$\underset{\text{methyl alcohol}}{2HCH_2OH} + \underset{\text{oxygen}}{O_2} = \underset{\text{formaldehyde}}{2HCHO} + \underset{\text{water}}{2H_2O}$$

Sufficient water is added to the product to make it contain 37 per cent by weight of absolute formaldehyde.

Description and Physical Properties—A clear, colorless or nearly colorless liquid, having a pungent odor. Its vapor irritates the mucous membrane of the throat and nose.

On long standing, especially in the cold, Solution of Formaldehyde sometimes becomes cloudy, due to the separation of paraformaldehyde.

It is miscible with water and alcohol.

Tests for Identity—Dilute 2 cc. of Solution of Formaldehyde with 10 cc. of distilled water in a test tube, and add 1 cc. of silver ammonium nitrate T.S.: metallic silver is produced either in the form of a finely divided gray precipitate, or as a bright metallic mirror on the sides of the test tube.

Add 2 drops of Solution of Formaldehyde to 5 cc. of sulphuric acid in which about 0.02 Gm. of salicylic acid has been dissolved, and warm the liquid very gently: a permanent, deep red color appears.

Test for Purity—Not more than 1 cc. of normal sodium hydroxide is required to neutralize 20 cc. of Solution of Formaldehyde, using 2 drops of phenolphthalein T.S. as indicator (*free acid*).

Assay—Transfer 3 cc. of Solution of Formaldehyde to a tared flask containing 10 cc. of distilled water, tightly stopper, and weigh accurately. Add 50 cc. of normal sodium hydroxide, and follow this immediately but slowly through a small funnel with 50 cc. of hydrogen dioxide T.S. which has previously been rendered neutral to litmus T.S. with sodium hydroxide T.S. Heat the mixture cautiously on a water bath for five minutes, shaking it occasionally. Allow the mixture to cool, rinse the funnel and sides of the flask with distilled water, and, after allowing it to stand thirty minutes, titrate with normal sulphuric acid, using litmus T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.03002 Gm. of H.CHO.

This assay is explained on page 1454.

Preserve in a moderately warm place, protected from light.

Uses—Solution of formaldehyde or "Formalin" is extensively used as a disinfectant and deodorant. Its employment for preserving milk, meat, and other articles of food likely to spoil through fermentation, is prohibited by both National and State laws. It is, however, used for disinfecting apartments which have been subjected to infection by spraying it on sheets hung in the room or the vapor may be conducted into the room from a generator, of which there are numerous forms on the market (see Disinfectants, page 1866).

PARAFORMALDEHYDUM. U.S. Paraformaldehyde

[**Paraform.**—Paraform, Trioxymethylene]

Paraformaldehyde contains not less than 95 per cent of $(HCHO)_3$ (90.06).

Preparation—It is prepared by evaporating an aqueous solution of formaldehyde until it polymerizes in white masses.

Description and Physical Properties—White, friable masses, or a white powder, having a slight odor of formaldehyde.

Paraformaldehyde is very slowly soluble in cold water, more readily soluble in hot water, with the formation of formaldehyde; insoluble in alcohol and in ether; soluble in solutions of fixed alkali hydroxides.

Paraformaldehyde, when heated, is partly converted into formaldehyde and partly sublimed unchanged.

Tests for Identity—Add 10 drops of sulphuric acid to a mixture of about 0.01 Gm. each of Paraformaldehyde and morphine sulphate: a violet color is produced.

Gently warm about 0.02 Gm. of Paraformaldehyde with 5 cc. of sulphuric acid in which about 0.1 Gm. of salicylic acid has been dissolved: a deep red color develops.

Tests for Purity—Shake 0.5 Gm. of Paraformaldehyde, finely powdered, with 10 cc. of distilled water: the water remains neutral to litmus paper.

Ash: not more than 0.1 per cent.

Assay—Mix about 1 Gm. of Paraformaldehyde, finely powdered and accurately weighed, with 50 cc. of normal sodium hydroxide in a 250 cc. flask, and add immediately, but slowly, through a small funnel, 50 cc. of solution of hydrogen dioxide which has been previously rendered neutral to litmus T.S. with sodium hydroxide T.S. When the reaction has ceased and the foam subsided, rinse the funnel and the sides of the flask with distilled water, allow the liquid to stand for half an hour, and then determine the excess of alkali with normal sulphuric acid, using litmus T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.03002 Gm. of $(HCHO)_3$.

This assay is explained on page 1454.

Preserve in well-closed containers, in a cool place, protected from light.

Uses—Paraldehyde has been used in throat lozenges. It is also employed for the generation of formaldehyde, by heating in an open vessel, over a direct flame.

METHENAMINA. U.S. Methenamine

[**Methenam.**—HEXAMETHYLENAMINA, U.S.P. IX, HEXAMETHYLENETETRAMINE]

Methenamine contains not less than 99 per cent of $(CH_2)_6N_4$ (140.16).

Preparation—Made by passing a current of dry ammonia gas over warm trioxymethylene (paraformaldehyde) and purifying the product.

It is also prepared by evaporating to dryness, under reduced pressure, a mixture of stronger ammonia water and solution of formaldehyde and recrystallizing the residue from dehydrated alcohol. The reaction is illustrated by the following equation:

$$\underset{\text{formaldehyde}}{6HCHO} + \underset{\text{ammonia}}{4NH_3} = \underset{\substack{\text{hexamethylene}\\\text{tetramine}}}{(CH_2)_6N_4} + \underset{\text{water}}{6H_2O}$$

Description and Physical Properties—Colorless, lustrous crystals, or a white, crystalline powder. It is odorless.

One Gm. of Methenamine is soluble in 1.5 cc. of water, 12.5 cc. of alcohol, and in about 10 cc. of chloroform, at 25° C.

At about 263° C. it sublimes without melting, partly decomposing and evolving a disagreeable odor. When brought into contact with fire, it readily ignites, burning with a smokeless flame.

Tests for Identity—An aqueous solution of Methenamine is alkaline to litmus paper.

Heat an aqueous solution of Methenamine (1 in 10) with diluted sulphuric acid: it decomposes with the liberation of formaldehyde, recognized by its odor or by its darkening paper moistened with silver ammonium nitrate T.S. On the subsequent addition of an excess of solution of sodium hydroxide, ammonia is liberated.

Tests for Purity— Ash: not more than 0.05 per cent.

Add 1 cc. of alkaline mercuric potassium iodide T.S. to 10 cc. of an aqueous solution of Methenamine (1 in 20): no darker color is produced than results from the addition of the same amount of the reagent to 10 cc. of distilled water (*ammonium salts*).

An aqueous solution of Methenamine (1 in 50) does not become colored or turbid when mixed with an equal volume of hydrogen sulphide T.S. (*heavy metals*).

The addition of 5 drops of barium chloride T.S. to 10 cc. of an aqueous solution of Methenamine (1 in 50), acidulated with 5 drops of hydrochloric acid, produces no turbidity within one minute (*sulphate*).

One Gm. of Methenamine shows no more *chloride* than corresponds to 0.2 cc. of fiftieth-normal hydrochloric acid, page 1520.

Assay—Place about 1 Gm. of Methenamine, accurately weighed, in a beaker, add 40 cc. of normal sulphuric acid, and evaporate on a water bath (or boil gently, adding a little distilled water from time to time, if necessary) until the odor of formaldehyde is no longer perceptible. Cool, add 20 cc. of distilled water, and titrate the excess of acid with normal sodium hydroxide, using methyl orange T.S. as indicator. Each cc. of normal sulphuric acid corresponds to 0.03504 Gm. of $(CH_2)_6N_4$.

This assay is explained on page 1458.

Preserve in well-closed containers.

Uses—Hexamethylenamine is marked under many trade names among which are *urotropine*, *cystogen*, *hexamine*, *formin*, *aminoform*, *cystamine*, and *uritone*. It is employed chiefly as a urinary antiseptic. It is occasionally prescribed in "colds". It is given in doses of from four to fifteen grains (0.25 to 1 Gm.).

A tablet of hexamethylenamine may be conveniently used as a source of heat at the bedside or under other conditions where ordinary means of heating are not available. It may be ignited by a burning match and burns with a practically smokeless flame. While a tablet burns for only a few moments it is long enough to heat a small amount of water for a hypodermic injection or a test.

Unofficial Compound of Hexamethylenamine

Amphotropin—Hexamethylene-tetramine Camphorate—$[(CH_2)_6N_4]_2.C_8H_{14}(COOH)_2$—A molecular combination of camphoric acid and hexamethylene-tetramine.

A light, white, crystalline powder, soluble in water, alcohol, and chloroform, but almost insoluble in ether and benzene. The aqueous solution is acid.

Actions and Uses—Amphotropin combines the actions of camphoric acid and hexamethylenamine, but is effective in smaller doses. It acts as a urinary antiseptic, induces diuresis, and increases the elimination of uric acid in pathologic conditions.

Dose—Eight grains (6.5 Gm.), three times daily.

Manufactured by H. A. Metz Laboratories.

Unofficial Organic Compounds

Acetal (Diethylacetal, Diethylaldehyde, Ethylenediethyl Ether), $CH_3—CH(OC_2H_5)_2$
: Obtained from reaction between acetaldehyde and alcohol in the presence of dehydrating agents. Soluble in 20 parts of water, and in all proportions of alcohol and ether. Used as a hypnotic in doses of two fluidrachms (8 cc.)

Acetbromanilid, Antisepsin, $C_6H_4Br.NH(C_2H_3O)$
: Prepared by adding 160 parts bromine to a solution of 135 parts of acetanilid in glacial acetic acid, and crystallizing the precipitate from hot alcohol. Colorless needles, tasteless, owing to their sparing solubility. Antipyretic and analgesic. Dose, three to ten grains (0.2 to 0.65 Gm.)

Acetylphenylhydrazin, $C_6H_5NH = NHCH_3CO$ (Pyrodin, Hydracetin)
: Antipyretic. Powerful remedy. Dose, one-half to one grain (0.03 to 0.065 Gm.) per day

Agathin, $C_6H_4(OH)CH = N.N(CH_3)C_6H_5$ (Salicyl-alpha-methyl-phenylhydrazine)
: A yellowish, crystalline salt; insoluble in water, soluble in alcohol. Antiseptic and anti-neuralgic. Dose, eight to ten grains (0.5 to 0.6 Gm.)

Aldehyde (Acetaldehyde), C_2H_4O
: By gently warming a mixture of alcohol, manganese dioxide, sulphuric acid, and water, and collecting the vapor which is formed by means of a condenser. If exposed, it will gradually be converted into acetic acid. It is a colorless, thin, and very inflammable liquid, having an ethereal odor, and the sp. gr. 0.805

Alphol (Alphanaphthol Salicylate) $C_6H_4.OH.COOC_{10}H_7$
: A reddish-white powder, soluble in alcohol and ether. It is used in doses of from eight to fifteen grains (0.5 to 1 Gm.) in rheumatism and as an intestinal antiseptic

Alphozone, Succinic Dioxide
: Prepared by the interaction of a strong solution of hydrogen peroxide and succinic anhydride. A fluffy white, crystalline powder, odorless. Used as a germicide and antiseptic in solutions of from 1 to 3000 to 1 to 1000

Alumnol N.N.R. (Aluminum Beta-naphtholdisulphonate), $(C_{10}H_5(OH)(SO_3)_2)_3Al_2$
: A white powder, soluble in water and glycerin, slowly soluble in alcohol. It is used as an antiseptic and astringent; mixed with from 5 to 10 parts of starch in the form of a dusting powder and, in from 1 to 5 per cent solution, as a wash

Amygdophenin (Phenetidin Amygdalate) $C_6H_4.OC_2H_5NH.CO.CH.OH.C_6H_5$
: Prepared by heating *p*-phenetidin with mandelic acid until all of the water is expelled, washing the product with diluted sodium hydroxide solution and crystallizing from ether-alcohol mixture. White, crystalline powder or glistening scales. Used in rheumatic fever. Dose, ten to fifteen grains (0.65 to 0.97 Gm.) every 4 or 5 hours

Amyl Acetate, $C_5H_{11}.C_2H_3O_2$
: By distilling amyl alcohol with an acetate and sulphuric acid. It is, when pure, a colorless liquid having a very fragrant pear-like odor. Insoluble in water. Sp. gr. 0.876. Used as a solvent for resins, pyroxylins, lacquers, and varnishes

Amyl Alcohol, $C_5H_{11}OH$
: See reagents, Chapter XCII

Amyl Butyrate, $C_5H_{11}.C_4H_7O_2$
: Sp. gr. 0.852. Fragrant odor

Amyl Chloride, $C_5H_{11}.Cl$
: By the action of strong hydrochloric acid upon amylic alcohol. Sp. gr. 0.874

Amyl Iodide, $C_5H_{11}.I$
: By acting upon amylic alcohol with iodine and phosphorus. It is a colorless, transparent liquid, of a faint odor and a pungent taste. Sp. gr. 1.509

Amyl Valerate, $C_5H_{11}.C_5H_9O_2$
: Sp. gr. 0.864. Odor of apples. Used as a sedative and as a solvent for cholesterin. Dose, two to three grains (0.1 to 0.2 Gm.)

Amylene (Valerene, Pentene, Pental), $(CH_3)_2C.CH.CH_3$
: A colorless liquid, having a peculiar, disagreeable odor; density, 0.655 at 10° C. (50° F.). Anesthetic. Too dangerous for use

Amylene-chloral Solution (50 per cent)
: Used much like that of chloral, but less powerful. A hypnotic. Dose, eight to forty-five minims (0.5 to 3 cc.)

Anthrasol, Purified or Colorless Coal Tar
: A thin, mobile, light-yellow, oily fluid, freed from pyridin and chinoline by acid treatment and from pitch by distillation; insoluble in water but miscible with oils and fats. Used as an antiseptic parasiticide in form of 5 to 30 per cent ointment

Antithermin (Phenylhydrazin-levulinic Acid), $C(CH_3).C_6H_5N_2H.C_3H_5O_2$
: In colorless crystals, insoluble in cold water. Used as an antipyretic, but with caution because of depressant action. Dose, 3 grains (0.2 Gm.)

Antitussin Di-fluor-di-phenyl $(C_6H_4F.)_2$
: Used in whooping cough, by inunction in the form of a 5 per cent ointment

Apolysin (Monophenetidin Citrate) $C_6H_4{<}^{OC_2H_5}_{NH.CO.C_3H_4(OH)(COOH)_2}$
: A yellowish-white, crystalline powder, sparingly soluble in water and glycerin. It resembles the phenacetin chemically and medicinally, being used as an antipyretic and analgesic in doses of from 8 to 30 grains (0.5 to 2 Gm.)

Argentamine, (Ethylene-Diamine Silver Nitrate)
: An aqueous solution of ethylene-diamine and 10 per cent silver nitrate. Said to be non-irritating. An antiseptic and astringent like other silver salts. It is also used as a dusting powder and in ointments and suppositories. Used in 1 to 5 per cent solution

Asaprol (Beta-naphthol-alpha-mono-sulphonate of Calcium, Abrastol), $(C_{10}H_6.OH.SO_3)_2Ca+3H_2O$
: A colorless, pale-reddish powder without odor, soluble in about 2 parts of water and 3 parts of alcohol. Used as an antipyretic and analgesic in acute muscular rheumatism in doses of 5 to 15 grains (0.3 to 1 Gm.)

Benzacetin, Acet-amido-ethyl-salicylic Acid
: Colorless crystals; soluble in alcohol and aqueous alkaline solutions. An analgesic. Dose, 8 to 15 grains (0.5 to 1 Gm.)

Benzamine Lactate (Br. 1914) $C_{15}H_{21}NO_2.C_3H_6O_3$
: A white, crystalline powder used the same as alpha- and beta-eucaine, being more soluble than either of these salts

Benzanilid (Phenylbenzamide, Benzoylanilid) $C_6H_5NHCO_6H_5$
: Obtained by the action of benzoyl chloride on aniline in the presence of sodium hydroxide. A pinkish powder, soluble in alcohol, insoluble in water. Used as an antipyretic for children in doses of one-half to five grains (0.03 to 0.32 Gm.)

Unofficial Organic Compounds—*Continued*

Benzonaphthol, N. N. R. (Benzoyl-naphthol, Benzoate of Naphthol, Betanaphthol Benzoate) $C_6H_5CO_2-C_{10}H_7$	Colorless needles, or a white, tasteless, crystalline powder, having a faintly aromatic odor. Almost insoluble in water, very soluble in alcohol and in ether, also soluble in chloroform and in fixed oils. Antiseptic. Dose, 4 to 8 grains (0.25 to 0.5 Gm.), repeated frequently
Benzosalin (Benzoyl-salicylic-acid-methyl Ester) $C_6H_4O(CH_3).CO.O.(C_6H_5CO)$, 1 : 2	White, acicular crystals; insoluble in water, readily soluble in alcohol. Incompatible with acids. Said to decompose in the intestines into benzoic and salicylic acids. Used in rheumatism, neuritis and neuralgia. Dose, 8 to 60 grains (0.5 to 4.0 Gm.)
Benzosol (Guaiacol Benzoate, Benzoyl-guaiacol). $C_6H_4O\langle^{O.CH_3}_{O—C_6H_5.CO}$	White, crystalline powder, odorless and tasteless, soluble in alcohol, but insoluble in water. It contains about 54 per cent of guaiacol and is used as an internal antiseptic in phthisis, in doses of from 4 to 10 grains (0.25 to 0.65 Gm.)
Benzyl Benzoate, N. N. R. Benzylis Benzoas $C_6H_5COO.CH_2C_6H_5$	The benzyl alcohol ester of benzoic acid. It contains not less than 95 per cent benzyl benzoate A colorless oily liquid above about 20° C. It is odorless, or has a faint aromatic odor, and a sharp burning taste. It is insoluble in water or glycerin but miscible in all proportions with alcohol, chloroform, and ether. Benzyl benzoate boils at from 320° to 325° C. with partial decomposition. When ignited it burns with a very smoky flame. Sp. gr. 1.09 to 1.13 at 15°C., 1.083 to 1.122 at 25° C. For further tests see the N. N. R. 1925 *Uses*—In dysmenorrhea and intestinal colic. Dose, from 5 to 8 minims (0.3 to 0.5 cc.)
Benzyl Fumarate-Abbott, N. N. R. Benzylis Fumaras, Dibenzyl Fumarate $C_6H_5CH_2.OOC.OH : CH.COO.CH_2C_6H_5$	It contains not less than 99 per cent of benzyl fumarate A white, crystalline solid; odorless; almost tasteless. It is almost insoluble in water; soluble in alcohol, ether and chloroform; also soluble in the fixed and volatile oils. It melts at 58.5 to 59.5°C. The solution of benzyl fumarate in chloroform (1 : 25) should be clear and colorless For further tests see the N. N. R. 1925 *Uses*—See *Benzyl Benzoate*. Dose, in from 5 to 20 grains (0.3 to 1.3 Gm.) Manufactured by The Abbott Laboratories.
Benzyl Succinate, N. N. R Benzylis Succinas, Dibenzyl Succinate $C_6H_5CH_2.OOC.CH_2.CH_2.COO.CH_2.C_6H_5$	The dibenzyl ester of succinic acid. It contains not less than 99 per cent of benzyl succinate. A white, or faintly yellowish-white, crystalline powder; odorless; almost tasteless; permanent in the air. Almost insoluble in water, soluble in alcohol, ether and chloroform; also soluble in the fixed and volatile oils For additional tests see the N. N. R. 1925. *Uses*—See *Benzyl Benzoate*. Dose, 5 to 15 grains (0.3 to 1 Gm.) Prepared by Hynson, Westcott and Dunning.
Betanaphthol Salicylate, N. N. R. (Betol Naphthalol, Naphthosalol, Salinaphthol), $C_6H_4(OH)COO.C_{10}H_7$	White, odorless, tasteless powder, insoluble in water, but soluble in alcohol and ether. It is used as an internal antiseptic and anti-rheumatic in doses of from 4 to 10 grains (0.25 to 0.65 Gm.)
Bismal, (Bismuth Methylene-digallate) $4(C_{15}H_{12}O_{12}).3\ Bi(OH)_3$	Prepared by digesting methylene digallic acid with bismuth hydroxide. Used as an astringent in chronic diarrhea in doses of 2 to 5 grains (0.13 to 0.32 Gm.)
Borophenol	Disinfectant. A combination of borax and phenol
Bromal, C_2HBr_3O	Hypnotic. Dose, 3 grains (0.2 Gm.)
Bromalin (Hexamethylene-tetramine Bromethylate) $(CH_2)_6N_4.C_2H_5Br$	Prepared by the interaction between equal parts of ethyl bromide and hexamethylene-tetramine. Used in epilepsy to replace alkaline bromides. Dose, 30 to 60 grains (2 to 4 Gm.)
Bromamide, $C_6H_2Br_3NH_2.HBr$	Prepared by reducing nitro-tribrom-benzene with tin and sulphuric acid. Antipyretic, analgesic, and antirheumatic. Dose, 10 to 15 grains (0.65 to 1 Gm.)
Bromopyrine (Monobromantipyrine), $C_{11}H_{11}BrN_2O$	In white, crystalline needles. Soluble in alcohol and chloroform. Slightly soluble in hot water
Butyl Chloral, $C_4H_5Cl_3O$,	Pass chlorine into aldehyde; this compound is formed in addition to
Butyl Chloral Hydrate, N. N. R. (Croton Chloralhydrate), $C_4H_5Cl_3O.H_2O$	chloral. Butyl chloral is a dense, oily liquid, of peculiar odor. It dissolves when treated with an excess of warm water, and on cooling deposits *butyl chloral hydrate*. Used as a hypnotic in 10 grain (0.65 Gm.) doses
Cacodylic Acid, $(CH_3)_2\ AsO.OH$ (Dimethylarsenic Acid)	Prepared by distilling arsenous acid and potassium acetate together and oxidizing the resulting product with mercuric oxide. Used in the form of the sodium salt in skin diseases
Chinoline, C_9H_7N Quinoline	A colorless, mobile liquid, having a pungent, somewhat bitter-almond odor, and a bitter taste. Sp. gr. 1.081
Chinosol, N.N.R., $(C_9H_7ON)_2\ H_2SO_4$ Oxyquinolin Sulphate	A powerful antiseptic. Dose, internally, 5 grains (0.3 Gm.); nasal spray, 1 to 3000; eye wash, 1 to 4000; gargle, 1 to 250. Manufactured by the Chinosol Company
Chloralformamide, N. N. R. (Chloralamide), $C_3H_4Cl_3NO_2$	It is an addition product of chloral, CCl_3COH, and formamide, $CH(OH)NH$. It is used as a hypnotic in doses of 15 grains (1 Gm.)
Chloralimide, $CCl_3CH–NH$	Prepared by heating chloralamide to the temperature of boiling water, when it decomposes into chloralimide and water. Antipyretic and analgesic. Dose, 3 to 7 grains (0.2 to 0.45 Gm.)
Chloral Menthol (Mentholated Chloral)	An oily, colorless liquid, with a mint-like odor. Sp. gr. 1.984. Counterirritant and local anesthetic
Chlormethylmenthyl Ester, (Forman), $C_{10}H_{19}O.CH_2Cl$	Prepared by the action of formaldehyde on menthol in the presence of hydrochloric acid gas. Used for catarrhal affections of the respiratory passages
Chloralose, $C_8H_{11}Cl_3O_6$	Hypnotic. Dose, 12 grains (0.77 Gm.)

Unofficial Organic Compounds—*Continued*

Chloral Phenol	Prepared by triturating equal parts of phenol and chloral hydrate together. Used as a hypnotic, locally as a counterirritant and anesthetic
Citrophen $C_3H_4(OH)(CONH.C_6H_4OC_2H_5)_3 + 3H_2O$	Prepared by heating a mixture of *p*-phenetidin and citric acid in the presence of a dehydrating agent, washing the product with a very dilute solution of sodium hydroxide and crystallizing from water. A white crystalline powder having an acidulous aromatic taste and acid reaction. Uses identical with acetphenetidin. Dose, 5 to 10 grains (0.32 to 0.65 Gm.)
Creolin	Said to be an emulsion of cresol obtained by means of rosin soap
Cresol Iodide (Losophan), $C_6HI_3(CH_3)OH$	A yellow powder, containing 80 per cent of iodine. Soluble in alcohol, insoluble in water. Used as an external application in skin diseases, in the form of a solution or of an ointment
Dipropylbarbituric Acid, Proponol, $C_{10}H_{16}O_3N_2$	Preparation analogous to that of Veronal. Uses similar to those of Veronal. Dose, 3 to 8 grains (0.2 to 0.5 Gm.)
Eosin, $C_{20}H_8Br_4O_5$	A bronze-colored, crystalline powder, obtained from the action of phthalic acid upon phenols. Eosin is largely used as a dye, and for making a brilliant *red ink*, by dissolving 5 grains in a fluidounce of water in which 10 grains of acacia have been dissolved (see also page 853)
Epicarin, Betanaphtholhydroxytoluic Acid	A parasiticide occurring on the market in pure and impure form, the latter being used in veterinary practice. The pure product is used in skin affections in 10 per cent solution or in 10 to 20 per cent ointment
Erythrol Tetranitrate, N.N.R., $C_4H_6(NO_3)_4$ Tetranitrol	The tetranitrate of erythrite (butane-tetrol), $C_4H_6(OH)_4$. Colorless, crystalline scales, insoluble in cold water, readily soluble in alcohol. It explodes on percussion. Uses, much like nitroglycerin. Action, slower and more lasting. Dose, ½ to 1 gram (0.03 to 0.06 Gm.) Distributed by Merck and Co.
Ethyl Benzoate, $C_2H_5.C_7H_5O$	By heating to 100° C. (212° F.) in a sealed glass tube a mixture of alcohol and benzoic acid. It is a colorless, oily liquid with a pleasant aromatic odor and a pungent taste. Sp. gr. 1.051
Ethyl Bromide, N. N. R., C_2H_5Br	The hydrobromic acid ester of ethyl alcohol, containing approximately 1 per cent of ethyl alcohol Ethyl bromide should be kept in glass stoppered containers and protected from the light, and a bottle when opened should be used at once, as it deteriorates rapidly. (To be preserved carefully in a small, opaque bottle containing not more than 50 cc.) It should not be confounded with ethylene bromide, which is said to be very poisonous. The specific gravity of ethylene bromide is 2.179, while that of ethyl bromide is about 1.45 Ethyl bromide is a colorless, strongly refractive, easily volatile liquid, having a pleasant ethereal odor. It is insoluble in water, but readily soluble in alcohol and in ether. It boils at from 38° to 40° C. Its specific gravity at 15° C. is from 1.453 to 1.457 *Uses*—Ethyl bromide is a rapid anesthetic, acting much like chloroform. The anesthesia is quickly and pleasantly induced and the recovery is rapid, but subsequently the patient may have general mild depression. Pain is abolished before consciousness. The respiration is paralyzed at about the same time as the reflexes, so that the zone of safety is very narrow. It has been recommended for short operations in obstetrics, gynecology and minor surgery, but is not to be used for long operations. It must be regarded as a very dangerous agent in inexperienced hands. Dose, from 45 minims to 3 fluidrachms (3 cc. to 12 cc.) is sufficient to induce anesthesia. It should be administered rapidly with little or no air. The administration requires from twenty to forty seconds; the anesthesia lasts about two minutes. The dose for children should not exceed 1 cc. for each year of age
Ethyl Butyrate, $C_2H_5.C_4H_7O_2$	By heating together a mixture of strong sulphuric acid, butyric acid, and strong alcohol. A transparent, colorless, very thin liquid. It has an odor resembling that of pineapple. Sp. gr. 0.902
Ethyl Carbamate (Urethane) (U. S. P. IX) $C_3H_7O_2N$ or $CO(OC_2H_5)NH_2$	The ethyl ester of carbamic acid. Preserve it in well-closed containers. It is made by acting upon *urea nitrate* with alcohol in excess, in closed vessels at a temperature of 120° to 130° C. Colorless, columnar crystals or scales. Odorless and having a cooling, saline taste. Its aqueous solution (1 in 20) is neutral to litmus. One Gm. of Ethyl Carbamate dissolves in 0.45 cc. of water, 0.8 cc. of alcohol, 2.5 cc. of glycerin, 9.9 cc. of chlorofo m, 1.5 cc. of ether, and in 32 cc. of olive oil, at 25° C. It is used as a hypnotic in doses of 15 grains (1 Gm.)
Ethyl Cyanide (Hydrocyanic Ether, Propionitrile), C_3H_5N, or $C_2H_5.CN$	A colorless liquid. Sp. gr. 0.78. Very poisonous, but less so than hydrocyanic acid, with which it agrees in therapeutic action and dose
Ethyl Disulphide, C_2H_5S	By acting upon potassium disulphide in concentrated solution with potassium sulphethylate. A colorless, oily liquid, having a very strong odor and a sharp, sweetish taste
Ethyl Formate, (Formic Ether) $C_2H_5CHO_2$	Prepared by distilling sodium formate, alcohol and strong sulphuric acid together. Causes muscular relaxation and anesthesia when inhaled
Ethyl Iodide, C_2H_5I	By acting upon alcohol with iodine and phosphorus. A colorless, volatile liquid, but gradually turning brown in the light. Slightly soluble in water. Sp. gr. 1.946. Anesthetic, antispasmodic, and stimulant. Dose, fifteen drops three or four times a day, inhaled from a handkerchief

Unofficial Organic Compounds—*Continued*

Ethyl Pelargonate (Grape Oil), $C_2H_5.C_9H_{17}O_2$	By adding sulphuric acid and water to wine lees, and distilling in a current of steam. A colorless, mobile liquid, of a strong vinous odor. Almost insoluble in water, but soluble in alcohol. Sp. gr. 0.860
Ethylproprionyl, (Diethylketone) $C_5H_{10}O$	Prepared by the dry distillation of calcium proprionate; it can also be prepared by distilling sugar with an excess of lime. Hypnotic. Dose, 8 to 45 minims (0.5 to 3 cc.) largely diluted
Ethyl Salicylate, $C_6H_4.OH.CO.O.(C_2H_5)$	Analogous to methyl salicylate, has the same action but less irritating and toxic. Dose, 5 to 10 minims (0.3 to 0.6 cc.)
Ethyl Sulphydrate (Mercaptan), $C_2H_5.HS$	By distilling crystallized calcium sulphethylate with a solution of barium sulphydrate, collecting the product in a well-cooled receiver, then decanting the aqueous portion and purifying the mercaptan by distilling with mercury and dehydrating by calcium chloride. A colorless, very mobile liquid, having an alliaceous odor
Ethylsulphuric Acid (Sulphovinic Acid), $C_2H_5.HSO_4$	By reacting upon sulphuric acid with alcohol. It is produced during the preparation of ether
Ethyl Valerate, $C_2H_5.C_5H_9O_2$	A colorless liquid having a fruity odor, and also one like that of valerian. Sp. gr. 0.866. It is also called ethyl valerianate
Ethylene for Anesthesia, N. N. R. Aethylenum pro Narcosi	It contains not less than 98 per cent by volume of ethylene (CH_2: CH_2)
	Ethylene for anesthesia is a colorless gas possessing a slightly sweet odor and taste which is offensive to some. It is somewhat lighter than air. Pure ethylene is solid at below −169.4° C. and boils at −103.9° C. The gas is inflammable and a mixture of it and oxygen explodes when brought in contact with a flame or an electric spark
	Uses—A considerable number of trials give promise that ethylene is of value for the production of surgical anesthesia and that it has advantages over nitrous oxide. These advantages are stated to be equally rapid but more pleasant induction, satisfactory relaxation without cyanosis or sweating and rapid recovery
	Dose—Ethylene for anesthesia is supplied in compressed state in metal cylinders. For use the gas is passed into an inhalation apparatus and is then inhaled with or without admixture of oxygen. The concentration employed for surgical anesthesia is generally 90 per cent ethylene and 10 per cent oxygen, though after a prolonged period of anesthesia, a deep anesthetic state may be maintained on 80 per cent ethylene. To avoid accidental explosion, ethylene for anesthesia must not be brought in contact with a naked flame or an electric spark
	Manufactured by the U. S. Industrial Chemical Company, New York (Ohio Chemical and Manufacturing Company, Cleveland, distributor)
Ethylene Bromide, $C_2H_4.Br_2$	Contains 90.9 per cent of bromine. Dose, six drops three times a day. Used in epilepsy
Ethylene Diamine, $C_2H_4(NH_2)_2$	Prepared by heating ethylene bromide with an excess of alcoholic ammonia, filtering, evaporating to dryness and distilling the residue with potassium hydroxide. Used as a solvent for the false membrane in diphtheria in 2 per cent solution
Ethylidene Chloride, (Aran's Ether, Wigger's Ether, Ethydene Chloride), CH_3CHCl_2	A colorless liquid, somewhat resembling chloroform. Sp. gr. 1.175 at 17° C. (62.6° F.); boiling at 60° C. (140° F.). Anesthetic
Eucodin, (Methyl-codeine Bromide) $C_{18}H_{21}O_3N(CH_3)Br$	Used as a sedative as a substitute for codeine, especially in cough. Dose, one grain (0.065 Gm.)
Eudoxin (Tetra-iodo-phenolphthalein Bismuth)	A bismuth salt of nosophen containing about 52.9 per cent of iodine and 14.5 per cent of bismuth. Odorless, tasteless, insoluble powder, used as an intestinal antiseptic in doses of three to eight grains (0.2 to 0.5 Gm.)
Eugoform (Acetylized Methylene Diguaiacol)	Prepared from guaiacol by the action of formaldehyde and acetylization. Used as an antiseptic in form of a dusting powder and ointment
Eumydrin (Methylatropine)	Prepared by the treatment of methyl atropine with nitric acid. Used as a mydriatic, internally as an antihidrotic in doses of one-sixtieth to one-twenty-fourth grain (0.001 to 0.0025 Gm.)
Euphorin, N. N. R. (Phenyl Urethane), $CO\begin{matrix}/OC_2H_5\\ \backslash NH(C_6H_5)\end{matrix}$	Colorless, crystalline powder, soluble in alcohol and ether, slightly soluble in water. Prepared by the interaction of aniline and ethyl chloroformate purified by recrystallization from diluted alcohol. Antipyretic, antiseptic, antirheumatic, and analgesic. Dose, 8 grains (0.5 Gm.), equivalent to 15 grains (1 Gm.) of antipyrine
Euphthalmine (Phenylglycoll-N-methyl-β-vinyl-diacetonalkamine)	Prepared by methylating vinyldialkamine and treating the resulting compound with a very dilute solution of mandelic acid. Used as an active mydriatic in from 2 to 10 per cent solutions
Euphthalmine (Hydrochloride) (Phenylglycolyn-methyl-vinyl-diacetonalkamine Hydrochloride)	A derivative of beta-eucaine, said to resemble atropine in its effect upon the system, producing prompt mydriasis without anesthetic action or pain. Use two to three drops of a 5 to 10 per cent solution
Eupyrine, Vanillin-ethylcarbonate-para-phenetidin	Light-yellow needle-shaped crystals, tasteless and having a faint odor of vanillin. Used as a non-toxic antipyretic in doses of from 15 to 30 grains (1.0 to 2.0 Gm.) once or twice daily
Euresol, Resorcin Monoacetate $C_6H_4(OH)OCOCH_3$	The action is similar to that of resorcinol but milder and more lasting. Used in from 5 to 20 per cent ointments
Europhen (Di-isobutyl-ortho-cresol-iodide), $C_6H_3(CH_3)(C_4H_9)O\diagdown\diagup HI$ $C_6H_3(CH_3)(C_4H_9)O\diagup$	A yellow, amorphous powder having an aromatic odor; soluble in alcohol, ether, and fixed oils, but insoluble in water. Used as an antiseptic dusting powder or in 5 to 10 per cent ointments. (Similar to thymol iodide)

Unofficial Organic Compounds—*Continued*

Exalgine (Methylacetanilid) $C_6H_5N(CH_3)CH_3CO$, or $C_9H_{11}NO$	Antipyretic, analgesic, and antispasmodic. Dose, 3 to 6 grains (0.2 to 0.38 Gm.), not more than twelve grains being given in twenty-four hours
Fluorescein, $C_{20}H_{12}O_5 + H_2O$	Yellowish-red or dark red powder. Soluble in alcohol with yellow-red color and green fluorescence. Used to detect foreign bodies in the eye (see also page 853)
Formanilid (Phenylformamide) $C_6H_5NH.HCO$	Prepared by heating analine with ethyl formate. Colorless prisms, soluble in water, glycerin, and fixed oils; readily soluble in alcohol. Antipyretic and analgesic in doses of from 2 to 5 grains (0.13 to 0.32 Gm.). Locally applied to mucous membrane it produces anesthesia
Formylphenetidin $C_6H_4(OC_2H_5)NH.COH$	Colorless, odorless, tasteless crystalline scales. An antiseptic and analgesic. Dose, 5 grains (0.32 Gm.)
Fuchsin (Rosaniline), $C_{20}H_{19}N_3$	A non-volatile, colorless, bitter substance, produced whenever a mixture of aniline and toluidine is heated to about 180° C. (356° F.) with an oxidizing agent of moderate power, as, for example, arsenic trioxide. The solutions of some of its acid salts are used largely for dyeing silk and wool a magnificent crimson (see also page 853)
Gallacetophenone, $C_6H_2\begin{cases}(OH)_3\\CH_3CO\end{cases}$	Proposed as a substitute for pyrogallol as a local application
Gallanilid, Gallanol, $C_6H_5NH.CO.C_6H_2(OH)_3 + 2H_2O$	Prepared by heating gallic acid with an excess of analine at 150° C. (302° F.) the mixture treated several times with diluted hydrochloric acid and crystallizing from boiling water. Colorless, crystals, readily soluble in alcohol, ether and boiling water, sparingly soluble in cold water. Used in skin affections as a substitute for chrysarobin in 10 to 20 per cent solution or ointment
Gallobromol, Dibromgallic Acid $C_6Br_2(OH)_3COOH$	A substitution compound of gallic acid. Used in place of potassium bromide as a sedative in cases of epilepsy in doses of 10 to 30 grains (0.65 to 2.0 Gm.)
Geosote (Guaiacol Valerate)	The guaiacol ester of valeric acid; yellow, oily liquid of smoky odor and burning taste. Used as an antitubercular and intestinal disinfectant in three- to ten-minim (0.2 to 0.6 cc.) doses
Guaethol (Ajacol, Thanatol, Pyrocatechin-mono-ethyl Ether), $C_6H_4\begin{cases}OC_2H_5\\OH\end{cases}$	An oleaginous fluid, congealing to a crystalline mass at low temperatures, soluble in alcohol and ether. Similar to guaiacol in medicinal properties. Dose, 2 to 4 grains (0.13 to 0.25 Gm.)
Guaiacetin (Sodium Pyrocatechin Monoacetate) $C_6H_4.(OH).OCH_2COONa$	A white powder used in the treatment of tuberculosis and chronic bronchitis. Dose, 8 grains (0.5 Gm.)
Guaiacol Cinnamate (Styracol) $C_6H_4(OCH_3)C_9H_7O_2$	Colorless, needle-shaped crystals used in catarrhal affections of the digestive tract and in the treatment of phthisis. Dose, 15 grains (1 Gm.)
Guaiacol Salicylate, Guaiacol Salol $C_6H_4(OCH_3)C_7H_5O_3$	This compound is analogous to salol. Used as an intestinal antiseptic. Dose, 15 grains (1 Gm.)
Guaialin (Methylene Diguaiacol-benzoic Ester)	An antipyretic and alterative tonic in tubercular affections
Guaiasanol (Diethylglycocoll-guaiacol Hydrochloride)	Small, colorless, prismatic crystals. Used as an antiseptic and anesthetic in the treatment of intestinal and pulmonary tuberculosis. Dose, 15 to 45 grains (1 to 3 Gm.)
Halazone (Para-toluolsulphon-dichloramino-benzoic Acid, Dakin-Dunham Tablets)	This tablet is used for the sterilization of water for drinking purposes. One-fourth of a milligramme (0.00025 Gm.) of Halazone will sterilize one quart of water in from fifteen to sixty minutes
Hedonal (Methyl-propyl-carbinol Urethane)	Used as a hypnotic in treatment of insomnia due to mental overwork. Dose, 15 to 30 grains (1 to 2 Gm.)
Helmitol (Hexamethylene-tetramine-anhydro-methylene Citrate)	Colorless crystals, soluble in 15 parts of water, slowly soluble in alcohol. Used as a urinary antiseptic in doses of 15 grains (1 Gm.)
Hetocresol, Metacresol Cinnamate $C_6H_5CH{=}CH.COOC_3H_4CH_3$	A white, crystalline powder recommended for use in tuberculosis of the bladder in form of ½ per cent suspension
Hetralin (Resorcin Hexamethylene-tetramine, $C_6H_6O_2(CH_2)_6N_4$	White, needle-shaped crystals. Used in the treatment of gonorrhea, cystitis, etc. Dose, 15 to 30 grains (1 to 2 Gm.)
Holocaine Hydrochloride (Ethenyl-paradiethoxy-diphenyl-amidine Hydrochloride) $C_6H_4OC_2H_5NH.C(CH_3) : N.C_6H_4.OC_2H_5.HCl$	A colorless, odorless, neutral crystalline powder, used as a substitute for cocaine in ophthalmic practice. Five minims of a 1 per cent solution when introduced into the eye produces anesthesia in from 1 to 10 minutes
Hydro-quinone, (Hydrochinone) $C_6H_4(OH)_2 1:4$	Prepared by oxidizing aniline with chromium trioxide mixture. An antiseptic and antipyretic. Dose, 5 to 10 grains (0.3 to 0.6 Gm.). Largely used as a developer in photography
Hypnone (Acetophenone), C_8H_8O or $C_6H_5.CO.CH_3$	A colorless liquid, having an almond-like odor, insoluble in water or glycerin, soluble in alcohol and ether. A hypnotic; dose 10 to 20 minims (0.6 to 1.2 cc.)
Ichthalbin (Ichthyol Albuminate)	A grayish-brown, odorless powder, insoluble in ordinary solvents, but soluble in alkaline solutions, as the intestinal secretions. Used as an intestinal antiseptic, and antiphlogistic in doses of 10 to 30 grains (0.65 to 2 Gm.); also as an antiseptic dusting powder for wounds, etc.
Ichthargan, Silver Ichthyol	A compound containing about 30 per cent of metallic silver. It is used as a bactericide, astringent and antiphlogistic in gonorrhea

Unofficial Organic Compounds—*Continued*

Ichthoform (Ichthyol-formaldehyde)	A blackish-brown, insoluble powder, with little odor or taste. Used as an antiseptic, in surgical practice, for dusting on wounds, etc., and as an intestinal antiseptic. Dose, 15 to 30 grains (1 to 2 Gm.)
Iodo-gallicin (Bismuth oxyiodo-methyl-gallol)	Prepared by the action of bismuth oxyiodide on methylgallate. Used as a substitute for iodoform
Iodol, $C_4I_4.NH$ (U. S. P. VIII) (Tetraiodopyrrol)	In rhombic flakes. Melting at 114° C., and then volatilizing. Slightly soluble in cold water, readily soluble in alcohol Prepared by dissolving pyrrol and iodine in alcohol, allowing it to stand 24 hours and precipitating with water. It is used as an antiseptic dressing to wounds
Iodophenacetin (Iodophenine)	Prepared by adding some moderately diluted hydrochloric acid and a solution of potassium iodide and iodine in water to a solution of phenacetin in glacial acetic acid, when, upon cooling, steel-blue crystals are deposited. Contains about 50 per cent of iodine. Used externally
Iodopyrine, $C_{11}H_{11}IN_2O$	Prepared by mixing alcoholic solutions of iodine and antipyrine together and allowing to stand for several days, crystals separating out. It combines the physiological action of iodine and an antipyretic. Used in bronchial asthma and tertiary syphilis. Dose, 10 to 20 grains (0.65 to 1.3 Gm.)
Kryofin (Methylglycollicphenetidin)	Colorless crystals, soluble in alcohol, ether and chloroform
Lactophenin (Lactylparaphenetidin) $C_6H_4.OC_2H_5.N.H.CO.CH(OH).CH_3$	Prepared the same as acetphenetidin except that a lactic acid radical replaces the acetic acid radicle. Uses similar to acetphenetidin and in the same dose
Liantrol	An extract of coal tar used in the treatment of eczema in 10 per cent olive oil solution
Loretin (Meta-iodo-ortho-oxychinolin-ana-sulphonic Acid), $C_9H_4IOH—SO_3H—N$	A yellow, odorless powder; almost insoluble in water; and insoluble in ether and oils. Used as a dusting powder to replace iodoform and in 5 to 10 per cent ointments
Melubrin, N. N. R.	A white, odorless, almost tasteless powder, readily soluble in water. A powerful antipyretic in fever and an analgesic. Dose, 15 to 30 grains (1 to 2 Gm.) Manufactured by H. A. Metz Laboratories, Inc.
Menthiodol	Prepared by carefully heating 4 parts of menthol in a capsule, adding 1 part of finely powdered iodol, and triturating into a homogeneous mass. Used as a local application in neuralgia
Mesotan, $C_9H_{10}O_4$	Prepared by the action of chlormethyl ether on salicylates. A clear, yellowish, faintly aromatic liquid. Used, when diluted with olive oil, in treatment of rheumatism
Methacetin (Para-methoxyacetanilid) $C_6H_4(OCH_3).NHC_2H_3O$	Prepared like phenacetin except that methyl iodide or chloride is substituted for the respective ethyl compound. Lustrous, scaly, crystals; colorless, odorless. Antipyretic and analgesic in much smaller doses than phenacetin
Methylacetanilid, Exalgine $C_6H_5N(CH_3)CH_3CO$	Prepared by gradually adding acetyl chloride to monomethylanaline and crystallizing from boiling water. Colorless needles or prisms, inodorous and tasteless; freely soluble in alcohol, chloroform and boiling water. Employed as an analgesic. Dose, 3 to 10 grains (0.20 to 0.65 Gm.)
Methyl Acetate, $CH_3.C_2H_3O_2$	Prepared by processes similar to those employed for obtaining ethyl acetate, *quod vide*. It is present to some extent in crude wood naphtha. Sp. gr. 0.919. Readily soluble in water.
Methyl Alcohol	(See page 809)
Methyl Chloride, CH_3Cl	By distilling together a mixture of methyl alcohol, sodium chloride, and sulphuric acid. It is a gas at ordinary temperatures, but may be condensed by pressure to a colorless, very mobile liquid. It has an ethereal odor and a sweet taste. A local anesthetic
Methyl Iodide, CH_3I	By distilling 1 part phosphorus, 8 parts iodine, and 12 parts methyl alcohol, allowing the distillate to pass into a bottle containing water, then rectifying the product in a water bath over calcium chloride and lead oxide. A colorless liquid. Sp. gr. 2.23. Vesicant. It is best applied on lint
Methyl Amino-oxybenzoate (Orthoform-New) $C_6H_3.NH_2.OH.CO.O.(CH_3)$	Used as a local anesthetic, resembling cocaine in its action. Dose, 8 to 15 grains (0.5 to 1.0 Gm.)
Methylal (Methylene-dimethyl Ether) $CH_2(OCH_3)_2$	Prepared by distilling a mixture of methyl alcohol, sulphuric acid and manganese dioxide. A colorless liquid, easily soluble in water, in alcohol, in fatty and in ethereal oils. Used as a hypnotic. Dose, 75 to 100 grains (5.0 to 6.5 Gm.)
Methylene Dichloride (Dichloromethane, Bichloride of Methylene) CH_2Cl_2	A colorless liquid (sp. gr. 1.344), having an odor analogous to that of chloroform. Anesthetic. Given internally in the dose of 10 to 30 minims (0.6 to 2 cc.)
Methylenedicotoin, Fortoin $CH_2(C_{14}H_{11}O_4)_2$	A condensation product of cotoin and formaldehyde obtained by means of a dehydrating agent. Used as an antiseptic astringent in doses of 4 grains (0.25 Gm.) three times daily
Methyl-ethyl Ether, $CH_3C_2H_5O$	Prepared by the action of ethyl iodide upon sodium methylate. These substances are caused to react in a retort and passed through a solution of sodium hydroxide and cooled. Its use as an anesthetic is limited
Methylic Ether (Oxide of Methyl) $(CH_3)_2O$	Anesthetic
Migrainin Antipyrine-caffeine Citrate	Prepared by fusing on a water bath a mixture of 85 parts of antipyrine, 9 parts of caffeine and 6 parts of citric acid. A colorless, hygroscopic powder used in the treatment of headache in doses of from 5 to 15 grains (0.3 to 1 Gm.)
Monochlorphenol (Chlorphenol), $C_6H_4Cl.OH$	Germicide and antiseptic. Used by inhalation and as a local application

Unofficial Organic Compounds—*Continued*

Naftalan
An ointment-like body prepared by distilling a peculiar naphtha from the Caucasus district of Asia Minor, mixed with an anhydrous soap. It is used with good results in cases of burns and in various skin diseases

Naphthalene (U. S. P. VIII), $C_{10}H_8$
A distillation product from coal tar, purified by distillation. Colorless, shining, transparent laminæ. Used as an insecticide

Neuronal, Bromodiethylacetamide $C_6H_{13}BrNO$
A white, crystalline powder used as an effective hypnotic. Dose, 8 to 15 grains (0.5 to 1.0 Gm.)

Nirvanin $(OH)C_6H_3(COOCH_3)NH.CO.CH_2.N:(C_2H_5)_2.HCl$
Colorless, prismatic crystals, having about one-tenth the toxicity of cocaine while said to be equally effective

Nitrobenzene, Nitrobenzol, Oil of Mirbane $C_6H_5NO_2+H_2O$
A poisonous compound used in the perfuming of soap and in the manufacture of aniline

Nosophen (Iodophen, Tetra-iodophenolphthalein), $(C_6H_2I_2.OH)_2.C\begin{matrix}C_6H_4CO\\O\end{matrix}$
A yellow, odorless, tasteless powder, insoluble in water and alcohol. It contains about 60 per cent of iodine, and is used as an antiseptic dusting powder and as an intestinal antiseptic, in doses of 5 to 8 grains (0.32 to 0.5 Gm.)

Novaspirin, Methylenecitryl-salicylic acid, $C_{21}H_{16}O_{11}$
White, used in from 1 to 10 per cent solution in ophthalmology. Internally in doses of 5 to 8 grains (0.32 to 0.5 Gm.), odorless powder of slight acidulous taste. Used as a substitute for other salicylates, in doses of 24 to 30 grains (1.5 to 2 Gm.)

Oleum Succini Oil of Amber
Amber is a fossil resin of an extinct coniferous wood, found principally upon the Baltic coast. By destructive distillation an acid liquor containing succinic acid is produced, together with crude oil of amber; the latter is redistilled, and rectified oil of amber is the product. It is a pale, yellow liquid, having an empyreumatic odor and a warm, acrid taste. Sp. gr. 0.920. It is soluble in alcohol, and when mixed with fuming nitric acid acquires a red color, and is subsequently converted into a brown resinous mass known as *artificial musk*

Orcin, Dihydroxytoluene, $C_6H_3(CH_3)(OH_2)$
Antiseptic, antipyretic. Poisonous

Orexin, Phenyldihydrochinazolin Hydrochlorate, $C_6H_4\begin{matrix}CH_2N.C_6H_5\\N=CHCl\end{matrix}+2H_2O$
Stomachic. Dose, 4 to 7 grains (0.25 to 0.45 Gm.) two to three times a day

Orphol (Basic Betanaphthol Bismuth, Bismuth Naphtholate) $(C_{10}H_7O)_3Bi+3H_2O$
Fawn colored, almost odorless, and tasteless powder. It splits, in the intestines, into betanaphthol and bismuth. Used as an intestinal astringent and antiseptic in about 5- to 8-grain (0.32 to 0.5 Gm.) doses

Orthin, Orthohydrazin-paraoxybenzoate, $C_6H_3.OH.COOH.NH.NH_2$
A feeble antipyretic

Orthoform (Methyl-para-amido-meta-oxybenzoate), $C_6H_3(OH)(NH_2)COOCH_3$
Methyl ester of meta-amido-para-oxybenzoic acid. A white, odorless, tasteless powder, slightly soluble in water, soluble in alcohol or ether. It is used as an antiseptic and local anesthetic in wounds, ulcers, burns, etc., and as an intestinal antiseptic in doses of 8 to 15 grains (0.5 to 1 Gm.)

Orthoform-New (meta-amino-para-oxybenzoate of Methyl) $C_6H_3.NH_2.OH.CO.O.(CH_3)$
A local anesthetic resembling cocaine in action but not toxic. Used as a dusting powder, for insufflation, or as an ointment or oil solution

Oxychinaseptol (Diaphtherin), $C_6H_4(SO_2)\begin{matrix}O-NH.C_9H_6(OH)\\O-NH.C_9H_6(OH)\end{matrix}$
A powerful antiseptic

Pentane (Amylhydride), $CH_3.CH_2.CH_2.CH_2.CH_3$
A colorless, volatile liquid (sp. gr. 0.626), very inflammable.

Phenocoll Hydrochloride, (Amido-acetparaphenetidin Hydrochloride, Phenamin) $C_6H_4.OC_2H_5(NHCOCH_2NH_2).HCl$
Prepared by the action of chloracetylchloride on phenetidin and treating the product with ammonia; the basic substance is then neutralized with hydrochloric acid and the salt obtained in white, crystalline powder. Used as an antineuralgic and antipyretic. Dose, 5 to 15 grains (0.32 to 1.0 Gm.); in large doses is valuable in rheumatic fever

Phenolsulphonphthalein, $C_6H_4.SO_2.C.(C_6H_4OH_2).O$
Used as an indicator and a diagnostic reagent

Phenolsulphonic Acid, (Sulphocarbolic Acid, Sulphophenic Acid), $C_6H_6SO_4$
This substance is produced by the direct action of concentrated sulphuric acid upon phenol. It is soluble in water and in alcohol. The acid is a decided antiseptic, and its solutions coagulate albumin

Phenosal (Phenetidin Acetosalicylate)
Colorless crystals having an acidulous taste. Used as an antipyretic and antineuralgic in articular rheumatism and sciatica. Dose, 5 to 15 grains (0.32 to 1.0 Gm.)

Phenosalyl
A mixture composed of 9 parts of phenol, 1 part salicylic acid, 2 parts lactic acid, $\frac{1}{6}$ part menthol. Used as an antiseptic in conjunctivitis and in eczema

Phenylhydrazine, $C_6H_5.NH.NH_2$
Poisonous. Used as a test for sugar in urine (see Reagents, Chapter XCII)

Phloroglucol, Phloroglucin, $C_6H_3(OH)_3$
Use as an indicator (see Reagents, Chapter XCII)

Phthalic Acid, $C_8H_6O_4$
Produced by heating salicylic acid with a mixture of sulphuric acid and potassium ferrocyanide, and, when the reaction is ended, treating the resulting mass with ether, which extracts the phthalic acid. It occurs in nacreous laminæ or shining monoclinic prisms. Soluble in alcohol, ether, and benzene

Unofficial Organic Compounds—*Continued*

Piperazine (Diethylenediamine), $N_2\begin{cases}H_2\\(C_2H_4)_2\end{cases}$	Antirheumatic and solvent of uric acid. Dose, 15 grains (1 Gm.) during the day
Pneumin, Methylene Creosote	A yellow, odorless, tasteless powder obtained as a condensation product by the action of formaldehyde or creosote. Used in tuberculosis and in pulmonary catarrh. Dose, 8 grains (0.5 Gm.) four to five times daily
Potassium Sulphethylate, $KC_2H=SO_4$	By acting upon mercaptan with potassium. It is a dull white, granular mass, very soluble in water
Pyramidon, (Di-methyl-amido-phenyl-dimethyl-pyrazolon, Dimethylamido-antipyrine)	A yellowish-white, tasteless powder, similar to antipyrine in action, but milder, more gradual and lasting in its influence. Prepared by reducing an acetic acid solution of nitrosoantipyrine in alcohol to amido-antipyrine and treating with methyl chloride or iodide. An antipyretic and analgesic in treatment of rheumatism. Dose, 5 to 8 grains (0.32 to 0.5 Gm.)
Pyrantin, Phenosuccin, $C_6H_4(OC_2H_5)N{:}(COCH_2\text{-}CH_2\text{-}CO)$	Prepared by melting together *p*-amidophenol and succinic acid and crystallizing the product from alcohol or acetic acid solution. Colorless, prismatic needles. Its uses are similar to acetphenetidin; valuable in acute rheumatism. Dose, 15 to 45 grains (1 to 3 Gm.) per day
Pyridine, C_5H_5N	Remedy for asthma. Five to twenty drops in two ounces of water may be used in an atomizer, or five drops may be inhaled directly. Dose, six drops, gradually increased to twenty-five, daily
Pyrosal, Antipyrine Salicylacetate $C_9H_8O_5C_{11}H_{12}N_2O$	Occurs in colorless leaflets or needles. Used as an analgesic, antipyretic and antirheumatic. Dose, 5 to 10 grains (0.32 to 0.65 Gm.) several times daily
Rosolic Acid (Corallin)	Obtained by acting on commercial phenol with oxalic and sulphuric acids (see Reagents, Chapter XCII). Used as an indicator
Salacetol, Salantol, $C_6H_4(OH)CO_2CH_2COCH_3$	Fine white or slightly reddish crystalline needles, having a bitter taste. A germicide used in the treatment of dysentery and summer diarrhea. It is less poisonous than salol. Dose, adult, 20 to 40 grains (1.3 to 2.6 Gm.) and for children from 5 to 8 grains daily (0.32 to 0.5 Gm.)
Salicylamide, $C_6H_4\begin{cases}OH\\CONH_2\end{cases}$	Analgesic and antipyretic. Dose, 3 grains (0.2 Gm.)
Saliformin (Formin Salicylate Hexamethylenetetramine Salicylate, Urotropine Salicylate), $(CH_2)_6N_4.C_6H_4(OH)COOH$	A white powder, having a sour taste; soluble in alcohol and water. Used as a urinary antiseptic and as a solvent for uric acid deposits. Dose, 15 to 30 grains (1 to 2 Gm.)
Salitannol, $C_{14}H_{10}O_7$	A condensation product of salicylic and gallic acids, formed by the action of phosphorous oxychloride; white amorphous powder. It is employed as a safe surgical antiseptic because of its non-poisonous properties
Salipyrine, Antipyrine Salicylate, N. N. R. $C_{11}H_{12}ON_2.C_7H_6O_3$	Antipyretic, antirheumatic, antineuralgic. Dose, 7 to 15 grains (0.45 to 1 Gm.), in capsule or tablet
Salol Camphor, Camphol	A local anesthetic; a mixture of 3 parts of phenyl salicylate and 2 parts of camphor
Salophen, Acetylparamidophenyl-salicylate, $C_6H_4\begin{cases}OH\\COOC_6H_4.NH(C_2H_3O)\end{cases}$	Antirheumatic and intestinal antiseptic. Dose, 45 to 75 grains *during the day* (3 to 5 Gm.)
Saloquinine, Salochin	Prepared by heating a mixture of phenyl salicylate and anhydrous quinine in a vacuum. White, tasteless, odorless, crystalline, powder. Used in typhoid fever and neuralgia. Dose, 8 to 30 grains (0.5 to 2.0 Gm.) daily
Scarlet Red, Biebrich (Toluyl-azo-betanaphthol), $CH_3C_6H_4N:NC_6H_3(CH_3)N:N.C_{10}H_5.OH$	A dark brownish-red powder, practically insoluble in water, but soluble in oils, chloroform and phenol. Used in 4 to 8 per cent ointment in the treatment of burns, wounds, chronic ulcers, etc. (see also page 850)
Silver Sulphethylate, $AgC_2H_5SO_4$	By adding silver nitrate to an aqueous solution of mercaptan and collecting the white precipitate
Sodium Arsanilate, Atoxyl, $C_6H_4(NH_2)(AsO.OH.ON)+4H_2O$	Prepared by condensing aniline and arsenic acid, eliminating water, isolating the arsanilic acid and neutralizing with sodium carbonate. Used in treatment of syphilis, more toxic than salvarsan. Dose, 3 to 8 grains (0.2 to 0.5 Gm.)
Sodium Ethylate, C_2H_5NaO	By treating absolute alcohol with sodium. It crystallizes in broad laminæ. Used in 10 per cent solution in the treatment of skin diseases
Somnal, $C_7H_{12}Cl_3O_3N$	A compound of chloral, alcohol, and urethane forming a clear, colorless liquid of a burning taste. Used as a hypnotic. Dose, from ½ to 1 drachm (2 to 4 Gm.)
Sozal (Aluminum Paraphenol-sulphonate), $(C_6H_4(OH)SO_3)_3Al$	Antiseptic. Used in a 1 per cent solution as a wash
Soziodol (Diiodparaphenol-sulphonic Acid), $C_6H_2I_2(SO_3H)OH$	Bactericide. Used as a dusting powder and as a wash in 3 per cent solution
Sozolic Acid (Orthophenolsulphonic Acid), $C_6H_4(HSO_3)OH$	Antiseptic. A 33⅓ per cent solution is called *aseptol*
Styptol, Cotarnine Phthalate $(C_{12}H_{13}O_3N)_2C_6H_4(COOH)_2$	Used internally as a special uterine vessel constrictor. Locally as a dusting powder. Dose, ¾ of a grain (0.048 Gm.)
Subcutin, $C_2H_5COO.C_6H_4.NH_2.SO_3H.C_6H_4OH$	A white, crystalline powder used as a local anesthetic, non-toxic and distinctly germicidal

Unofficial Organic Compounds—*Continued*

Sublamine, Mercuryethylenediamine sulphate, $HgSO_4.2C_2H_4(NH_2)_2 + 2H_2O$	A non-irritating, penetrating, readily soluble disinfectant. Used in hand disinfection in solutions of 1 to 1000 to 1 to 2000
Succinic Acid, $C_4H_6O_4$	Used with advantage in delirium tremens
Succinyl, Disalicylic Acid Diaspirin, $C_{18}H_{14}O_8$	White, crystalline powder, almost tasteless and without odor. Forms salts with inorganic and organic bases. Uses similar to those of salicylic acid. Dose, 15 grains (1 Gm.) three to four times daily.
Sulphaminol (Thioxydiphenylamine), $C_{12}H_9S_2NO$	Used as a substitute for iodoform. The dose is 4 grains (0.25 Gm.). Externally, it may be used in powder or in oily mixtures
Sulphanilic Acid, 1 : 4 Para-amino-benzene-sulphonic Acid	Produced by the action of strong sulphuric acid on colorless analine. Used in the dye industry and also in diazo test solution (see Reagents, Chapter XCII)
Tannoform (Methyleneditannin), $CH_2(C_{14}H_9O_9)_2$	Prepared by mixing solutions of formaldehyde and tannic acid, precipitating with concentrated hydrochloric acid, washing and drying. Used as an astringent dusting powder in cases of excessive sweating
Tetronal, $(C_2H_5)_2.C.(SO_2C_2H_5)_2$	Sedative hypnotic. Dose, 15 to 30 grains (1 to 2 Gm.)
Thermodin, Phenacetin Urethrane, $C_6H_4(OC_2H_5).N(COOC_2H_5)(CH_3CO)$	A compound of acetphenetidin and ethyl carbamate. Used as an analgesic, antipyretic and antiseptic, in typhoid fever, pneumonia, etc. Dose, 5 to 10 grains (0.32 to 0.65 Gm.)
Thiocol (Potassium Guaiacol Sulphonate)	A fine, white powder, soluble in water, and containing about 60 per cent of guaiacol. Antitubercular and anticatarrhal. Dose, 5 to 20 grains (0.32 to 1.3 Gm.)
Thymacetin $C_6H_2.CH_3.C_3H_7(OC_2H_5).NH(C_2H_3O)$	Prepared from thymol in a manner similar to that of phenacetin from phenol. White, crystalline powder. Used as an analgesic in doses of from 3 to 15 grains (0.2 to 1 Gm.)
Tribromphenol, $C_6H_2Br_3.OH$ Bromol	Antiseptic
Trichlorphenol, $C_6H_2Cl_3OH$ Omal	Used in erysipelas, in the form of a glycerite containing 5 to 10 per cent, applied to the parts twice daily
Triphenin, (Propionyl-phenetidin) $C_6H_4.C_2H_5O.NH.(CH_3.CH_2.CO)$	Prepared by heating *p*-phenetidin with propionic acid. Colorless, odorless and slightly bitter crystals. Soluble in about 2000 parts of water. An antipyretic and analgesic. Similar in action to phenacetin. Dose, 8 to 15 grains (0.5 to 1 Gm.)
Tropæolin	Dye-color used as an indicator in volumetric analysis
Tumenol	Used as a local application in eczema, in a 10 per cent solution
Tussol (Antipyrine Phenylglycolate, Antipyrine Mandelate), $C_{11}H_{12}ON_2.C_6H_5CH(OH)COOH$	This salt is said to be superior to antipyrine in the treatment of whooping cough. Dose, ¾ to 6 grains (0.045 to 0.4 Gm.), according to age
Urasol, Afsol (Acetyl-methylene-disalicylic Acid), $CH_2(C_6H_3.OC_2H_3O.COOH)_2$	Used in the treatment of muscular rheumatism and gout. Dose, 5 to 8 grains (0.32 to 0.5 Gm.)
Valeridin, Valerydin, Sedatin (Iso-valeryl-*p*-phenetidin) $C_6H_4.NHCOC_4H_9.OC_2H_5$	Prepared by heating *p*-phenetidin with valeric acid. White glistening needles almost insoluble in water but soluble in alcohol. Used in migraine, neuralgia and hysteria in dose of 8 to 15 grains (0.5 to 1 Gm.)
Valyl (Valeryldiethylamide) $C_4H_9CON(C_2H_5)_2$	Prepared by the interaction of valeric acid and diethylamine. Used as a sedative and antispasmodic in hysteria. Dose, 2 grains (0.13 Gm.) in capsules
Xeroform (Tribromphenol Bismuth, Tribromocarbolate of Bismuth), $(C_6H_2Br_3O)_2BiOH + Bi_2O_3$	A yellowish-green, insoluble powder, containing about 50 per cent of tribromphenol and about 50 per cent of Bi_2O_3. Used as an intestinal antiseptic in doses of 8 to 15 grains (0.5 to 1 Gm.). Also used as a dusting powder on fresh and infected wounds
Xylol (Xylene), C_8H_{10}	By treating the oily liquid separating from diluted crude wood spirit and from the light oil of wood tar or coal tar, first with sulphuric acid, and afterwards subjecting these liquids to fractional distillation, collecting only that portion which distils between 136° and 140° C. (276.8° and 284° F.). A thin, colorless liquid, resembling benzene. It has a burning taste. Soluble in alcohol. Dose, 20 to 30 minims (1.2 to 2 cc.)

CHAPTER LXVI

PRODUCTS OF THE ACTION OF FERMENTS UPON ACID SACCHARINE FRUITS

THE acid saccharine fruits form an important class in medicine and pharmacy. Their characteristic constituent is usually a vegetable acid (in some fruits several acids are found); sugar and albuminous principles are present in small amount, and, on account of the presence of sugar, vinous fermentation may be induced in these juices, resulting in the production of the alcoholic beverages known as wines, which upon distillation yield brandies. The fruits of this class which contribute the most useful products to pharmacy are grapes, lemons, limes, oranges, apples, tamarinds, raspberries, pineapples, strawberries, currants, blackberries, etc. Most of the juices of these fruits readily undergo fermentation. The clear alcoholic liquid left after decomposition has received various names, according to the fruit from which it is derived, *viz.*, wine from grapes, cider from apples, perry from pears, etc.

The products of the grape will be considered first.

Wines—There are no medicated wines now official, the Brussels Conference of 1902 having advised against their continued recognition because of the lack of uniformity in commercial wines which were used in their preparation. The Pharmacopœia dismissed all wines from the Ninth Revision, but the N.F. continued a number of the formulas for a decade. These have now been discarded. Plain wines were not admitted to the U. S. P. X and their purchase and sale are exclusively under the regulations of the Volstead Act as administered by the Internal Revenue Department (see page 1261).

Unofficial Fermentation Products

VINUM ALBUM.—White Wine

An alcoholic liquid made by fermenting the juice of fresh grapes, the fruit of *Vitis vinifera* Linné (Fam. *Vitaceæ*), freed from seeds, stems, and skins, and subjected to the usual cellar-treatment for fining and aging.

When White Wine is prescribed without further specification, it is recommended that a dry White Wine of domestic production be employed.

White Wine should be preserved in well-closed casks, filled as full as possible, or in well-stoppered bottles, in a cool place.

VINUM RUBRUM.—Red Wine

An alcoholic liquid made by fermenting the juice of fresh red-colored grapes, the fruit of *Vitis vinifera* Linné (Fam. *Vitaceæ*) in presence of their skins, and subjected to the usual cellar-treatment for fining and aging.

When Red Wine is prescribed without further specification it is recommended that a dry Red Wine of domestic production be employed.

Red Wine should be preserved in well-closed casks, filled as full as possible, or in well-stoppered bottles, in a cool place.

VINUM XERICUM. N. F. IV. Sherry Wine

An alcoholic liquid made by fermenting the juice of fresh ripe grapes, the fruit of cultivated species of *Vitis* Linné (Fam. *Vitaceæ*), freed from seeds, stems and skins, and fortifying with pure grape brandy. It contains not less than 16 per cent nor more than 24 per cent of C_2H_5OH, by volume. Preserve it in well-closed casks or in well-stoppered bottles, in a cool place.

Official Description—A pale yellowish-brown or amber-colored liquid.

Odor and Taste—It has a pleasant, aromatic odor, free from yeastiness, and a fruity, characteristic taste, without excessive sweetness or acidity.

Specific gravity: from 0.985 to 1.000 at 25° C.

Tests for Identity and Impurities—Evaporate 100 cc. of Sherry Wine in a tared dish, on a water bath, and dry the residue to constant weight at 100° C. (212° F.): it weighs not less than 3 Gm. nor more than 7 Gm. Ignite this residue at a low temperature and burn it gradually to whiteness, moisten the ash with a small portion of ammonium carbonate T.S. and again carefully ignite; the ash weighs not less than 0.175 Gm. nor more than 0.5 Gm.

Free Acid—Dilute 50 cc. of Sherry Wine with 200 cc. of distilled water; it requires for neutralization not less than 20 cc. nor more than 40 cc. of tenth-normal potassium hydroxide V.S., using phenolphthalein T.S. as indicator.

Sulphate—Acidulate 50 cc. of Sherry Wine with hydrochloric acid, heat, and add an excess of barium chloride T.S. Collect the precipitate on a filter of known ash content, wash it thoroughly, dry and ignite: the residue weighs not more than 0.034 Gm.

Tannic Acid—To 10 cc. of Sherry Wine add an equal volume of distilled water and five drops of ferric chloride T.S.: not more than a faint greenish-brown color appears.

Saccharin—Add 10 cc. of diluted sulphuric acid to 75 cc. of Sherry Wine and shake out the mixture in a separator twice, using each time 20 cc. of a mixture of equal volumes of purified petroleum benzin and ether. Transfer the separated benzin-ether solution to an evaporating dish, allow the solvent to evaporate spontaneously and dissolve the residue in 3 cc. of distilled water; the solution does not have a sweet taste.

Salicylic Acid—nor does this solution from the saccharin test yield a violet color upon the addition of a few drops of a dilute solution of ferric chloride (1 in 200).

SPIRITUS VINI VITIS. U.S. Brandy

Brandy is official in the U.S.P.X, but its legal purchase and sale are exclusively under the regulations of the Volstead Act as administered by the Internal Revenue Department of the United States (see page 1261). The official description will be found on page 916.

ACIDUM TARTARICUM. U.S. Tartaric Acid

[Acid. Tart.]

Tartaric Acid contains not less than 99.5 per cent of $C_2H_2(OH)_2(COOH)_2$ (150.07).

Preparation—This important acid may be prepared by saturating the excess of acid in acid potassium tartrate or cream of tartar with calcium carbonate, and decomposing the resulting insoluble calcium tartrate by sulphuric acid, which precipitates in combination with the lime as calcium sulphate, and liberates the tartaric acid. The process, when thus conducted, furnishes only one-half of the tartaric acid. The other half may be procured by decomposing the neutral potassium tartrate remaining in the solution after the precipitation of the calcium tartrate by calcium chloride in excess. By double decomposition potassium chloride will be formed in solution, and a second portion of calcium tartrate will precipitate, which may be decomposed by sulphuric acid, together with the first portion.

$$\underset{\text{acid potassium tartrate}}{2KHC_4H_4O_6} + \underset{\text{calcium carbonate}}{CaCO_3} = \underset{\text{potassium tartrate}}{K_2C_4H_4O_6} + \underset{\text{calcium tartrate}}{CaC_4H_4O_6} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

then

$$\underset{\text{potassium tartrate}}{K_2C_4H_4O_6} + \underset{\text{calcium chloride}}{CaCl_2} = \underset{\text{calcium tartrate}}{CaC_4H_4O_6} + \underset{\text{potassium chloride}}{2KCl}$$

and

$$\underset{\text{calcium tartrate}}{2CaC_4H_4O_6} + \underset{\text{sulphuric acid}}{2H_2SO_4} = \underset{\text{calcium sulphate}}{2CaSO_4} + \underset{\text{tartaric acid}}{2H_2C_4H_4O_6}$$

Calcium sulphate is sometimes substituted for calcium chloride in the second stage of the decomposition. Tartaric acid is a dibasic acid; one or two of its hydrogen atoms are capable of being replaced by metals. With monad metals, acid, neutral, and double tartrates may be formed, thus:

$H_2C_4H_4O_6$	$HKC_4H_4O_6$	$K_2C_4H_4O_6$	$KNaC_4H_4O_6$
tartaric acid	acid potassium tartrate	neutral potassium tartrate	potassio-sodium tartrate

Tartaric acid contains no water of crystallization. The tartrates are important salts. Three are official, two of them being double salts, *viz.*, antimony and potassium tartrate, potassium and sodium tartrate; the other salt is potassium bitartrate.

Tests for Tartrates

Tartrates—With neutral solutions of tartrates, silver nitrate T.S. produces a white precipitate. Upon dissolving this precipitate in just sufficient ammonia T.S. and warming, metallic silver is deposited on the sides of the test tube,

forming a mirror. When a drop of ferrous sulphate T.S., then a few drops of hydrogen dioxide T.S., and finally an excess of sodium hydroxide T.S. are added to a solution of tartaric acid or of a tartrate, acidified with acetic acid, a purple or violet color is produced.

Description and Physical Properties—Colorless, translucent crystals, or a white, granular or fine powder. It is odorless, has an acid taste, and is stable in the air.

One Gm. of Tartaric Acid is soluble in 0.75 cc. of water and in 3 cc. of alcohol, at 25° C. One Gm. is soluble in 0.5 cc. of boiling water. The Acid is almost insoluble in chloroform and only slightly soluble in ether.

Tests for Identity—When slowly ignited, Tartaric Acid gradually decomposes, emitting an odor resembling that of burning sugar (*difference from citric acid*).

An aqueous solution of Tartaric Acid is acid to litmus paper and responds to the reactions for tartrates, page 942.

Tests for Purity—Ash: not more than 0.05 per cent.

Nearly neutralize 10 cc. of an aqueous solution of the Acid (1 in 10) with ammonia T.S. and add 10 cc. of calcium sulphate T.S.: no turbidity is produced (*oxalate*).

The addition of 1 cc. of barium chloride T.S. to 10 cc. of an aqueous solution of the Acid (1 in 100) to which 3 drops of hydrochloric acid have previously been added, causes no turbidity (*sulphate*).

A 10 cc. portion of an aqueous solution of the Acid (1 in 50) mixed with 0.5 cc. of hydrochloric acid meets the requirements of the test for *heavy metals*, page 1519.

Dissolve 10 Gm. of Tartaric Acid in 20 cc. of distilled water, add 2 cc. of sulphurous acid T.S., and boil the mixture until the odor of sulphur dioxide is barely perceptible. Cool the solution, mix it with 1 cc. of sodium cyanide T.S., and follow this immediately with stronger ammonia water until the precipitate formed is redissolved and the solution has a slight odor of ammonia. Cool, transfer the solution to a 50 cc. graduated cylinder, dilute with sufficient distilled water to measure 50 cc. and add 3 drops of sodium sulphide T.S. After mixing well, the color produced in the solution, if any, when viewed downward against a white surface, is not darker than the color of a control solution prepared as follows: Dissolve 2 Gm. of reagent ammonium chloride (page 1529) in 20 cc. of distilled water, add 4 cc. of a solution containing 0.08 Gm. of lead nitrate in 1000 cc. of distilled water, and 1 cc. of diluted hydrochloric acid. Treat this solution with the same quantity of sulphurous acid, sodium cyanide T.S. and stronger ammonia water, as directed above; Transfer the mixture to another 50 cc. cylinder, dilute it with sufficient distilled water to make 50 cc., and add 3 drops of sodium sulphide T.S. Before adding the sodium sulphide T.S., the liquid must possess a distinct odor of ammonia. The two cylinders used must be matched, be of practically colorless glass, and have the same internal diameter (*lead*).

Assay—Proceed as directed under the assay for acids, page 1514, using about 3 Gm. of Tartaric Acid and phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.07504 Gm. of $C_2H_2(OH)_2(COOH)_2$.

This assay is explained on page 1453.

U. S. P. Preparations—Acidum Hydriodicum Dilutum; Potassii Citras Effervescens; Pulvis Effervescens Compositus; Sodii Phosphas Effervescens.

N. F. Preparations—Elixir Pepsini, Bismuthi et Strychninæ; Extractum Hydrastis; Glyceritum Bismuthi; Sal Carolinum Factitium Effervescens; Sal Kissingense Factitium Effervescens; Sal Lithii Citras Effervescens; Sal Magnesii Sulphatis Effervescens; Sal Potassii Bromidi Effervescens Compositus; Sal Vichyanum Factitium Effervescens.

History—This organic acid was discovered about 1776 by Scheele, the famous Swedish apothecary, while investigating cream of tartar which had been known for many centuries.

The list of preparations into which tartaric acid enters officially is given above. It is chiefly used as the acid ingredient of preparations in which it is neutralized by a bicarbonate, as in effervescent salts, and the free acid will not be found in the finished product.

ACIDUM CITRICUM. U. S. Citric Acid

[Acid. Cit.]

Citric Acid contains not less than 99.5 per cent of $C_3H_4(OH)(COOH)_3$ (210.11) H_2O.

Preparation—Although this acid is found in many plants, it is obtained upon a commercial scale from the juice of limes and lemons. It is prepared from *lime juice* (see page 947) by a very simple process, but one requiring some careful manipulation. The boiling juice is first completely saturated with calcium carbonate (chalk or whiting) in fine powder, and the calcium citrate

formed is allowed to subside. This is then washed repeatedly with water, and is decomposed by diluted sulphuric acid. An insoluble calcium sulphate is precipitated, and the disengaged citric acid remains in solution. This is carefully concentrated in leaden boilers until a pellicle begins to form, when it is transferred to other vessels to cool and crystallize.

$$\underset{\text{citric acid}}{2H_3C_6H_5O_7} + \underset{\substack{\text{calcium}\\\text{carbonate}}}{3CaCO_3} = \underset{\text{calcium citrate}}{Ca_3 2C_6H_5O_7} + \underset{\text{water}}{3H_2O} + \underset{\substack{\text{carbon}\\\text{dioxide}}}{3CO_2}$$

$$\underset{\text{calcium citrate}}{Ca_3 2C_6H_5O_7} + \underset{\text{sulphuric acid}}{3H_2SO_4} = \underset{\text{citric acid}}{2H_3C_6H_5O_7} + \underset{\text{calcium sulphate}}{3CaSO_4}$$

Citric acid contains one molecule of water of crystallization; it differs in this respect from tartaric acid, which contains none. The presence of this molecule of water of crystallization makes it valuable in the preparation of granular effervescent salts. It is a tribasic acid; in other words, three atoms of hydrogen are replaceable by metals, three classes of citrates being formed according as one, two, or three hydrogen atoms are replaced.

The citrates are a valuable class of medicinal salts, nine being official—five are simple salts: ferric, bismuth, lithium, potassium and sodium citrates, one granular effervescent: effervescent potassium citrate; three are double salts: bismuth and ammonium citrate, iron and ammonium citrate, iron and quinine citrate. A number of these are not true chemical compounds based upon molecular proportions, but are pharmaceutical preparations based upon the respective dosages of the constituents. Citric acid is used in two solutions —solution of magnesium citrate, and solution of potassium citrate. The numerous other official preparations into which it enters will be found below.

Tests for Citrates

Citrates—Neutral solutions of citrates are not affected in the cold by the addition of an excess of calcium chloride T.S., but, upon heating the mixture, a white precipitate is produced. When to a hot solution of a citrate, to which has been added one-tenth of its volume of mercuric sulphate T.S., potassium permanganate is added, a white precipitate is produced.

Description and Physical Properties—Colorless, translucent crystals, or a white powder. It is odorless, has an acid taste, and is efflorescent in warm air.

One Gm. of Citric Acid is soluble in 0.5 cc. of water, 1.8 cc. of alcohol, and in about 30 cc. of ether, at 25° C. One Gm. is soluble in 0.5 cc. of boiling water.

Tests for Identity—An aqueous solution of Citric Acid is acid to litmus paper and responds to the reactions for citrates, page 944.

When slowly ignited, Citric Acid is gradually decomposed without emitting an odor resembling that of burning sugar (*difference from tartaric acid*).

Tests for Purity—Ash: not more than 0.05 per cent.

Neutralize 10 cc. of an aqueous solution of the Acid (1 in 10) with ammonia T.S., add 5 drops of diluted hydrochloric acid, cool, and add 2 cc. of calcium chloride T.S.: no turbidity is produced, (*oxalic acid*).

The addition of 1 cc. of barium chloride T.S. to 10 cc. of an aqueous solution of the Acid (1 in 100), to which 3 drops of hydrochloric acid have previously been added, causes no turbidity (*sulphate*).

Mix 1 Gm. of powdered Citric Acid with 10 cc. of sulphuric acid in a test tube previously rinsed with sulphuric acid, and maintain the temperature of the mixture at 90° C. for one hour: no color darker than yellow develops (*tartaric acid*).

Ten cc. of an aqueous solution of the Acid (1 in 50) mixed with 0.5 cc. of hydrochloric acid meets the requirements of the test for *heavy metals*, page 1519.

Dissolve 10 Gm. of Citric Acid in 20 cc. of distilled water, add 2 cc. of sulphurous acid T.S., and boil the mixture until the odor of sulphur dioxide is barely perceptible. Cool the solution, mix it with 1 cc. of sodium cyanide T.S., and follow this immediately with stronger ammonia water until the solution possesses a slight odor of ammonia. Cool, transfer the solution to a 50 cc. graduated cylinder, dilute with sufficient distilled water to measure 50 cc., and add 3 drops of sodium

sulphide T.S. After mixing well, the color produced in the solution, if any, when viewed downward against a white surface is not darker than the color of a control solution prepared as follows: dissolve 2 Gm. of reagent ammonium chloride in 20 cc. of distilled water, add 4 cc. of a solution containing 0.08 Gm. of lead nitrate in 1000 cc. of distilled water, and 1 cc. of diluted hydrochloric acid. Treat this solution with the same quantity of sulphurous acid, sodium cyanide T.S. and stronger ammonia water, as directed above; transfer the mixture to another 50 cc. cylinder, dilute it with sufficient distilled water to make 50 cc., and add 3 drops of sodium sulphide T.S. Before adding the sodium sulphide T.S. the liquid must possess a distinct odor of ammonia. The two cylinders used must be matched, be of practically colorless glass, and have the same internal diameter (*lead*).

Assay—Proceed as directed under the assay for acids, page 1514, using about 3 Gm. of Citric Acid and phenolphthalein T.S. as indicator. Each cc. of normal sodium hydroxide corresponds to 0.07004 Gm. of $C_3H_4(OH)(COOH)_3.H_2O$.

This assay is explained on page 1453.

U. S. P. Preparations—Liquor Magnesii Citratis; Liquor Potassii Citratis; Potassii Citras Effervescens; Sodii Phosphas Effervescens; Syrupus Acidi Citrici; Syrupus Aurantii.

N. F. Preparations—Elixir Ferri Pyrophosphatis, Quininæ et Strychninæ; Liquor Ferri Citratis; Liquor Ferri Salicylatis; Liquor Phosphatum Compositus; Liquor Sodii Citratis; Liquor Sodii Phosphatis Compositus; Sal Carolinum Factitium Effervescens; Sal Kissingense Factitium Effervescens; Sal Lithii Citratis Effervescens; Sal Potassii Bromidi Effervescens Compositus; Sal Vichyanum Factitium Effervescens.

Uses—Citric acid in solution is often used as a substitute for lemon juice. It is sometimes called "*salt of lemon*" which has led to confusion with some of the oxalates which are also called by that name. When any inquiry is made for salt of lemon, its proposed use should be carefully investigated and in dispensing it the true name also should be placed upon the label.

Citric acid is also known by the synonym "*sour salt*", and is sold in small cartons bearing that label for use by Jewish cooks in preparing certain sour dishes. The dose is from five to thirty grains (0.3 to 2 Gm.). It is rarely given in its free state, but is largely used in combination and in many solutions and syrups, and in making effervescent salts. Its aqueous solution, even when concentrated, is not very stable, as it develops fungoid growths.

Acid Saccharine Fruits Containing Pectinous Bodies

The pulpy constituents of fruits and fleshy roots undergo naturally certain changes when subjected to the influences of a ferment known as *pectase*. These changes can be closely imitated artificially when the pulp is treated with acids or alkalies in aqueous solution, by the aid of heat. According to Fremy, pectase exists in fruits in either a soluble or an insoluble condition. Green, unripe fruits contain *pectose*, a substance which is supposed to be isomeric with cellulose and which gives to such fruits their hardness. Pectose is insoluble in water, alcohol, or ether.

In the process of ripening fruits, the pectase slowly acts on the pectose, the hardness disappears, *pectin* is formed, and the fruit is soft and ripe. When it is overripe, *parapectin* and *metapectic acid* are produced. The moderate action of heat and water upon fruits is thus explained. The citric, tartaric, or malic acid in the fruit acts on the pectose, softening it, and converting it into pectin, and the pectin is then acted upon by the ferment pectase, which causes it to gelatinize, on cooling, through the production of pectosic acid. This is the cause of the formation of fruit jellies. The rapid application of strong heat to the pulp of fruits results in the coagulation and destruction of the ferment pectase, and the production of jelly is thus prevented.

Alkalies form soluble compounds with pectosic acid and pectin, and hence, when gelatinous precipitates are found in fluidextracts and tinctures, due to the formation of either of these substances, they may be dissolved by the application of an alkaline solution. The use of solution of potassium hydroxide in fluidextract of senega is an illustration of this.

Fruit Juices—These are largely used for flavoring syrups, and for use in dispensing soda water. They are made by expressing the juice from fresh fruits and bottling as directed in the chapter on syrups (see page 262). They are often clarified by separating the albuminous and pectinous substances by a slight degree of fermentation.

There is but one fruit belonging to this class, the raspberry, official in the N. F. This is used in preparing a syrup of raspberry which is offered as a type process for other fruit syrups (see page 282).

RHUS GLABRA. U.S. Rhus Glabra

[Rhus Glab.—Sumac Berries]

Rhus Glabra is the dried ripe fruit of *Rhus glabra* Linné (Fam. *Anacardiaceæ*). Rhus Glabra contains not more than 5 per cent of stems or other foreign organic matter.

This fruit owes its acidity to malic acid, which exists in it as calcium and potassium malate. This acid is found in unripe apples and in a great number of fruits, roots, leaves, stems, etc. Rhus glabra also contains tannin, gallic acid, and red coloring matter.

Malic acid may be obtained from rhus glabra by exhausting the berries with water, evaporating, filtering, and crystallizing the acid calcium malate, which is then dissolved in boiling water, and treated with lead acetate, when lead malate is precipitated; this is then suspended in water, hydrogen sulphide is passed through it, lead sulphide is precipitated, and the solution of malic acid is evaporated to permit crystallization. Malic acid is found in colorless, shining needles having a sour taste and an acid reaction. It is soluble in alcohol and is deliquescent in the air. It is dibasic.

For the microscopic description see the U. S. P. X.

Description and Physical Properties—Flattened ovoid, nearly globular or somewhat reniform, from 3.5 to 5.5 mm. in length, nearly as broad, but usually somewhat less in thickness; a raised scar at the apex and the five-parted calyx occasionally with a short pedicle at the base; externally dark red, velvety with short hairs; endocarp smooth, shiny, crimson to yellowish-red; 1-locular, 1-seeded; seed brown, very hard; inodorous; taste acidulous and astringent.

U. S. P. Preparation—Fluidextractum Rhois Glabræ.

Uses—Rhus Glabra is a useful astringent, chiefly employed as a gargle and sometimes given for diarrhea. The dose is fifteen grains to one drachm (1 to 4 Gm.).

RUBI IDÆÆ FRUCTUS. N.F. Raspberry

[Rub. Id. Fruct.—Red Raspberries]

Raspberry is the fresh, ripe fruit of varieties of *Rubus Idæus* Linné or of *Rubus strigosus* Michaux (Fam. *Rosaceæ*).

Description and Physical Properties—An aggregate fruit, globular or hemispherical with a concave depression at the base where separated from the receptacle, composed of twenty or more small, rounded-polygonal, succulent drupelets; pericarps externally red, non-globular hairs numerous up to 0.640 mm. in length; mesocarps fleshy, juice red; parenchyma with rosettes of calcium oxalate up to 0.035 mm. in diameter; endocarps small stones with wrinkled surfaces. Odor characteristic, aromatic, taste pleasant, sweet, acidulous.

For pharmaceutical purposes, Black Raspberries, the fresh ripe fruit of varieties of *Rubus occidentalis* Linné (Fam. *Rosaceæ*) may be substituted either in part or wholly for Red Raspberries.

N. F. Preparations—Syrupus Rubi Idæi; Elixir Gentianæ Glycerinatum.

Uses—The fruit is used only for the preparation of an agreeably flavored syrup.

SUCCUS POMORUM. N.F. Fresh Apple Juice

[Suc. Pomor.—Cider]

The freshly expressed juice of sound ripe, sour apples, the fruit of cultivated varieties of *Pyrus Malus* Linné (Fam. *Rosaceæ*).

N. F. Preparation—Extractum Ferri Pomatum.

Uses—Apple juice contains *malic acid* and is used in the preparation of crude iron malate (see page 466). It must be promptly used or else preserved by sterilization as it readily undergoes alcoholic fermentation.

TAMARINDUS. N.F. Tamarind

Tamarind is the partially dried ripe fruit of *Tamarindus indica* Linné (Fam. *Leguminosæ*), deprived of the brittle outer portion of the pericarp and preserved in sugar or syrup.

Tamarind contains not more than 2 per cent of organic matter.

Description and Physical Properties—A pulpy mass of light reddish-brown color, changing with age to a dark brown, containing some branching fibers and numerous reddish-brown, smooth, oblong or quadrangular, compressed seeds, each enclosed in a tough membrane; the pulp with parenchyma cells containing a few starch grains up to 0.020 mm. in diameter, calcium oxalate in rosettes up to 0.100 mm. in diameter, and crystal fibers with prisms of calcium oxalate up to 0.050 mm. in length. Odor distinct; taste sweet and agreeably acid.

Preparation—Confectio Sennæ.

Uses—It is purgative, and is often used to make laxative confections. The dose is 4 drachms (16 Gm.).

Unofficial Fruits

Apple	The fruit of *Pyrus Malus*. The constituents are 7 to 10 per cent sugar, ½ to 1 per cent free acid, and 5 per cent each albuminous and pectinous substances. The fermented juice of the apple is termed *cider* or *vinegar*
Apricot	The fruit of *Prunus Armeniaca*. The average constituents are 1 to 2 per cent sugar, ½ to 1 per cent free acid, ½ to 1 per cent albuminous substances, and 5 to 10 per cent pectinous substances
Banana	The fruit of *Musa sapientum* and other species. The average composition is water 75.3, protein 1.3, fat 0.6, sugar 15, starch 5
Blackberry (Rubi Fructus, N. F. IV)	The fresh, ripe fruit of varieties of *Rubus nigrobaccus* Bailey or *Rubus villosus* Aiton (Fam. *Rosaceæ*). An aggregate fruit, ovate to oblong, rounded or slightly pointed, composed of numerous, shining black drupelets attached to an esculent receptacle; pericarp externally smooth or with only a few hairs (*R. villosus*), mesocarps fleshy, juice purple-red, endocarps hard, black surfaces deeply wrinkled It is used as a flavoring agent, chiefly in remedies for diarrhea such as *Blackberry Cordial*
Cherry	The fruit of a species of *Prunus*. The average constituents are 8 to 13 per cent sugar, 1 per cent free acid, and ½ to 3 per cent each albuminous and pectinous substances
Cranberry	The bright red, acid berry produced by an ericaceous plant of the genus *Oxycoccus*. It is much used for making sauce, jelly tarts, etc.
Currant	The fruit of *Ribes rubrum*. The average constituents are 4 to 7 per cent sugar, 1 to 2 per cent free acid, ¼ to ½ per cent albuminous substances, and ⅛ per cent pectinous substances
Figs	The oblong or nearly globose fruit of the fig tree (*Ficus carica*). The fruit is pulpy when ripe, and is eaten raw, or preserved, or dried with sugar, in which form it is generally known
Gooseberry	The fruit of *Ribes Grossularia*. The average constituents are 6 to 8 per cent sugar, 1 to 1½ per cent free acid (chiefly citric), ½ per cent albuminous substances, and ½ to 2 per cent pectinous substances
Huckleberry	The edible black or dark blue berry of any species of *Gaylussacia*, the common market variety being *G. resinosa*. This name is frequently applied to the *Blueberry* which is a species of *Vaccinium* and contains numerous minute seeds, while the huckleberry contains ten nutlets
Lemon Juice (Limonis Succus)	The freshly expressed juice of the ripe fruit of *Citrus Limonum* Risso (Fam. *Rutaceæ*), a slightly turbid, yellowish liquid. Used as an antiscorbutic and also in the preparation of true *neutral mixture* and for the making of lemon syrup
Lime Juice (Succus Citri, N. F. IV)	The expressed juice of the ripe fruit of *Citrus medica acida* (Roxburgh) Bonavia (Fam. *Rutaceæ*), containing in each 100 cc. not less than 5 Gm. nor more than 10 Gm. of total acids, calculated as crystallized citric acid A clear or slightly turbid, pale yellow or yellowish-green liquid, having the characteristic odor and taste of limes. It is used as a pleasant flavor and vehicle. For test for purity see the N. F. IV
Orange	The large globose fruit of the rutaceous tree *Citrus Aurantium*. The orange botanically is a berry, consisting of ten or more separable pulpy carpels, each containing several seeds. These are covered by a yellowish, leathery rind containing many oil glands. The juice contains citric acid and some sugar
Peach	The fruit of *Amygdalus Persica*. The average constituents are 1½ per cent sugar, ½ per cent free acid, ½ per cent albuminous substances, and 6 per cent pectinous substances
Pear	The fruit of *Pyrus communis*. The average constituents are 7 per cent sugar, 1 per cent free acid, ¼ per cent albuminous substances, and 3 per cent pectinous substances
Pineapple	The fruit of *Ananas sativa*. The juice contains 2 per cent sugar, 1 per cent free acid, and 3 per cent albuminous and pectinous substances
Plum	The fruit tree belonging to the genus *Prunus*. The average constituents are about 1 to 2 per cent sugar, ½ to 1 per cent free acid, ½ per cent albuminous substances, and 2 to 11 per cent pectinous substances
Pomegranate	The somewhat angular fruit resembling an orange in size and color, of a tropical, Asiatic Punicaceous tree, *Punica Granatum*. It has a hard rind and many seeds in a crimson pulp of agreeable acid flavor which may be eaten uncooked or made into a beverage
Strawberry	The fruit of different species of *Fragaria*. The average constituents are 3 to 7 per cent sugar, 1 per cent free acid, ½ per cent albuminous substances, and 2 per cent pectinous substances

CHAPTER LXVII

VOLATILE OILS

Volatile oils, or *essential oils*, are found in various plant organs and tissues. In some countries they are called *Ætherolea*. In France and Spain they are called *Essences*, a name which conflicts with our ordinary use of that word which designates an alcoholic solution of a volatile oil. They usually constitute the sapid and odorous principles of the plants in which they exist, and they either preëxist in the tissues, or are produced by the reaction of certain constituents when the tissues are brought into contact with water. Volatile oils are sometimes formed through destructive distillation, as the oils of tar and of amber, these being occasionally referred to as *pyrolea*.

The volatile oils are sometimes hydrocarbons, although with these are frequently associated alcohol- or ketone-like bodies called *camphors*, and products of oxidation known under the general name of resins, and, undoubtedly, formed from the hydrocarbons. Phenols, aldehydes, esters, ethers, and sulphides are also represented. The hydrocarbons are generally known as *terpenes*, from oil of turpentine, which is taken as a type.

In some volatile oils, as thyme, a separation into a solid and a liquid portion occurs on standing in the cold. The solid portion is frequently known by the name *stearoptene*, and the liquid portion is called *eleoptene*. Some of the stearoptenes are of commercial importance (examples: thymol, camphor, menthol). The eleoptenes are often used as adulterants of volatile oils (examples: oil of camphor and dementholized oil of peppermint).

Wallach, to whom much of our knowledge of volatile oils is due, divides the hydrocarbons into classes, as follows:

1—*True terpenes*, of the formula $C_{10}H_{16}$, of which there are two main groups: (*a*), the *terpane* group, uniting with two molecules of haloid acid or four atoms of bromine; this group includes limonene, dipentene, sylvestrene, terpinolene, terpinene, thujene, and phellandrene, their boiling point being between 175° and 185° C. (347° and 365° F.); (*b*), the *camphene* group, uniting with one molecule of haloid acid or two atoms of bromine; this group includes pinene, bornylene, camphene, and fenchene, and they boil between 151° and 161° C. (303.8° and 321.8° F.).

2—*Hemiterpenes*, of the formula C_5H_8, such as isoprene.

3—*Polyterpenes*, such as cedrene, cubebene, etc., of the formula $C_{15}H_{24}$ (sesquiterpenes); colophene, of the formula $C_{20}H_{32}$; and caoutchouc, of the formula $(C_{10}H_{16})x$.

Hydrocarbons other than those of the terpene class or derivable from them occur very sparingly in the natural oils. Thus there is of the paraffin series of saturated hydrocarbons, *heptane*, C_7H_{16}, occurring in the oil from the *Pinus sabiniana*, or California *digger pine*, and solid hydrocarbons of the same series in oil of rose, and probably in oils of wintergreen and sweet birch. Of the benzene series there is a single representative in *cymene*, $C_{10}H_{14}$, found in the oils of the Thymus and Monarda species.

In addition to these naturally occurring hydrocarbons, there is a class of artificially prepared hydrocarbons known as *hydroterpenes*, such as dihydrodipentene from dipentene, menthene and carvomenthene from menthol and carvone.

The terpenes in general are practically insoluble in water, but soluble in alcohol, ether, chloroform, benzene, petroleum benzin, and the fixed and volatile oils.

Many of the essential oils, however, owe their essential character and their value to other constituents than hydrocarbons. A brief consideration of the most important of these will be found in the Chapter on Perfumes, Part VI, page 1211.

Color of Volatile Oils—Most oils are colorless when pure and fresh, or can be made colorless by redistillation. Upon exposure to the air they acquire various colors, becoming green, as in oil of wormwood; yellow, as in oil of peppermint; red, as in oil of origanum; brown, as in oil of cinnamon. The blue color of oil of chamomile is an inherent property of the oil even when freshly distilled and is said to be due to a constituent which has been named *azulene* or *cærulein*.

Odor—The odors of volatile oils are extremely variable. It is their most characteristic feature. The odor of an oil is sensibly modified by exposure to the air. Oil of turpentine may be rectified by redistillation in an atmosphere of carbon dioxide, or *in vacuo*, so that it will be almost odorless, or have an agreeable, fragrant odor. A very slight exposure to the air is sufficient, however, to restore the well-known unpleasant odor. Other terpene containing oils are quickly oxidized and the delicacy and fineness of their flavor and odor seriously impaired. This is especially true of the oils of orange and lemon peel.

Taste—The tastes of volatile oils are almost as variable as their odors. Some are sweet, others have a mild, pungent, hot, acrid, caustic, or burning taste.

Density—The specific gravity of official volatile oils also varies (from 0.842 to 1.172). They are mostly lighter than water.

Optical Activity—This important physical factor is used in determining the purity of many oils. It is explained at length under the U. S. P. Test (see page 1524).

Refractive Index—This factor is of increasing importance, as it serves as a delicate test, chiefly for the purity of oils and fats. It is explained under the U. S. P. Test (see page 1525).

Boiling Point—This factor is also variable. The oils volatilize to some extent at ordinary temperatures and diffuse their peculiar odors. One of the principal distinctions from fixed oils is the fact that they completely vaporize on heating. When sufficiently heated, they take fire, and burn with a bright flame.

Solubilities—Water is a poor solvent for volatile oils, although it acquires a decided odor and flavor when brought in contact with the oil in a finely divided state, as has been shown under medicated waters. Alcohol, ether, chloroform, glacial acetic acid, petroleum benzin, benzene, and many other organic solvents will dissolve volatile oils. Alcohol is a better solvent for the oxygenated oils than for the terpenes. Volatile oils freely dissolve fixed oils, fats, resins, camphors, sulphur and phosphorus.

Exposure to Light and Air injures the quality and destroys the fragrance of volatile oils. Ozone is frequently developed, and, after extended exposure, the oils thicken and become resinified, or deposit crystalline compounds. The whitening of corks, inserted for a long time in bottles containing certain volatile oils is due to the bleaching action of the ozone which is gradually produced during their decomposition. This is true only of oils containing notable amounts of terpenes. Volatile oils should be kept in well-filled tightly stoppered, amber-colored bottles, in a cool place. A suggestion has been made to

replace the air with nitrogen in original packages to prevent oxidation. Storage in tin cans causes pronounced deterioration in odor and the development of color.

Volatile oils do not deteriorate so readily when mixed with alcohol, and it is the practice of some pharmacists to preserve them in this manner. Fixed oils, when present to the extent of five or ten per cent, have a remarkable preserving power, even upon such easily decomposed oils as those of the citrus family. In using oils so preserved allowance must be made for the dilution.

Action of Acids, Alkalies, etc.—Nitric acid, if strong, decomposes volatile oils with great rapidity. Iodine reacts with some oils with explosive violence. Alkalies affect volatile oils containing esters or phenolic compounds, as the oils from clove, gaultheria, cinnamon, etc.

Adulterations—The volatile oils are costly enough to tempt the cupidity of some manufacturers of these products. A fixed oil is sometimes used to adulterate the volatile oil. This adulteration may be detected by dropping the suspected oil on a piece of filter paper. The stain of a pure volatile oil is not permanent. By slightly heating the volatile oil it should vaporize; if fixed oil is present, the stain remains after the odor has disappeared. Alcohol may be detected by shaking the mixed oil in a graduated tube with glycerin or water. The volume of the oil will be diminished, and that of the water or glycerin correspondingly increased, in proportion to the amount of alcohol present. This test is not susceptible of fine determination, because of a slight solubility of volatile oils in water and in mixtures of alcohol and water. Metallic sodium, calcium chloride, aniline red, have all been used to show the presence of alcohol and traces of water in volatile oils. The adulteration of volatile oils by the addition of cheaper grades of the same oil, or by using a cheaper oil having a similar odor, is largely practiced. The only reliable test here is the use of the senses of smell and taste, applied to dilutions of the oil in various media. By practice, the sense of smell can be highly developed by the pharmacist, perfumer, or analyst. The specific rotary power, the index of refraction, the amount of iodine absorbed, and the saponification number, or the amount of potassium hydroxide absorbed by the ester to form a potassium salt, have all been used with more or less success in detecting adulterations. The detection of adulterations in volatile oils is difficult, and as a rule those who practice this nefarious art are very skilful. The U. S. P. has included a number of assays to indicate the required percentage of the valuable constituents.

Preparation of Volatile Oils

Volatile oils are generally obtained from plants by the following methods: 1. Distillation with steam. 2. Distillation *per se*. 3. Expression. 4. Solution.

1. **Distillation with Steam**—This is the method most frequently employed. The general formula is as follows: Place the substance from which the oil is to be extracted into a still (see Distillation, page 141), and add enough water to cover it; then distil by a regulated heat into a large condenser. Separate the distilled oil from the water which comes over with it.

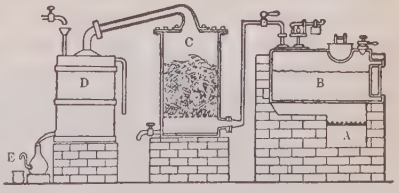
The substances from which the volatile oils are extracted may be employed in either the recent or the dried state. Certain flowers, however, such as orange flowers and roses, must be used fresh, or preserved with salt or by means of glycerin, as they afford little or no oil after desiccation. Dried substances, such as sandalwood, cloves, cinnamon bark, etc., before being submitted to distillation, require to be macerated in water till they are thor-

oughly penetrated by this fluid; and, to facilitate the action of the water, it is necessary, when of a hard or tough consistence, that they should be properly comminuted.

The water which is added to the substance to be distilled answers the double purpose of preventing the decomposition of the vegetable matter by regulating the temperature, and of facilitating the volatilization of the oil, which, though in most instances it readily rises with the vapor of boiling water, requires, when distilled alone, a considerably higher temperature, and is at the same time liable to be partly decomposed. Some oils, however, will not ascend readily with steam at 100° C. (212° F.), and in the distillation of these it is customary to use water saturated with common salt, which does not boil under 108.4° C. (227.1° F.) (see page 113). Other oils, again, may be volatilized with water at a temperature below the boiling point and may be distilled with the aid of a partial vacuum. To prevent injury from heat, it has been recommended to suspend the substance containing the oil in a basket, or to place it upon a perforated shelf, in the upper part of the still, so that it may be penetrated by the steam without being in direct contact with the water. Steam can be very conveniently applied for this purpose by causing it to pass through a coil of tube, of an inch or three-quarters of an inch bore, placed in the bottom of a common still (see page 141). In some instances it is desirable to conduct the steam immediately into the still near the bottom, by which the contents are kept in a state of brisk ebullition (see Fig. 436). The distillation of volatile oils is now conducted on a large scale with enormous stills. (For description and illustrations see Gildemeister and Hoffman on Volatile Oils, translated from the German by Prof. Edward Kremers.)

The quantity of water added is of importance. Too large an amount causes loss by holding the oil in solution when the mixed vapors are condensed. On the contrary, if the quantity is too small, there will be danger of the substance in the still adhering to the sides of the vessel and thus becoming burnt. The cage shown on page 141 will be found useful in this connection. Where the yield of oil is very small, the process of *cohobation* is applicable; this consists in repeatedly returning the aqueous portion of the distillate to the still, the water in this way becoming supersaturated, and the yield of oil increased. Fig. 436 illustrates one method of distilling volatile oils from plants. *A* shows the fire box, *B* the steam boiler, *C* the tank containing the plant on the slat or perforated bottom, and *D* the condenser.

FIG. 436



Distillation of volatile oils

2. **Distillation** *per se*—By this is meant the distillation of certain bodies without the use of water (*per se*, "by itself"). This is done in the cases of certain oleoresins, copaiba, etc., water not being required in the process, and always being difficult to separate from the distillate.

3. **Expression** (see page 225)—This method is very limited in its application and generally produces the most fragrant products, because there are very few volatile oils, the aroma of which is not injuriously affected by the action of heat. The volatile oils of the Citrus family (orange, lemon, bergamot, and lime), are generally made by expressing the rind of the fresh fruit. These are usually known as "hand pressed". Three methods are practiced: (*a*) The sponge process; (*b*) the ecuelle method; and (*c*) the machine process.

In the sponge process the rind is removed from the fruit, and, after dipping in water, is pressed by hand, the oil collecting in a shallow bowl from which it is transferred to a larger container for separation.

In the ecuelle method the fruit is rolled about in hollow bowls, the walls of which are covered with spikes. The oil cells are punctured and the oil which exudes is collected in the hollow handle.

In the machine process either the sponge or the ecuelle processes are adapted to machines which perform the operation on a larger scale.

4. **Extraction**—Some volatile oils are so readily decomposed that they are dissociated by distillation, or exist in such minute traces as to make their commercial production impracticable. In such cases the odorous principle may be extracted by some form of solution or absorption. This may be effected by maceration, digestion, percolation with an appropriate immiscible solvent, enfleurage, or extraction with a volatile solvent.

Maceration—In obtaining volatile oils by maceration, the odorous portions of the plant (generally fragrant flowers) are allowed to remain in contact with a bland, inodorous, fixed oil or fat; the oil or fat absorbs the odor, and after a certain length of time the oil is strained and is subsequently used in the manufacture of perfumes in a manner similar to pomades. The flowers extracted by this method are chiefly cassie, rose, violet, orange flowers, narcissus, and lily.

Digestion—This process is similar to maceration, except that a moderate heat is employed, by the use of a salt bath, to aid in the extraction.

Enfleurage was at one time largely used for extracting the odors of very delicate flowers. It is a cold process, and consists in spreading a thin layer of purified inodorous fat upon both sides of sheets of glass, held in frames, known as a *chassis*. These resemble an ordinary window sash, with one pane of glass in each. The flowers are spread lightly upon the surface of the fat, and a number of chassis thus prepared, are arranged in tiers so that the flowers are between layers of fat. The whole is left undisturbed for a time varying from twelve hours to four days. The resulting fatty product impregnated with the floral odor is called a "pomade". When strong pomades are desired, the flowers are replaced daily by fresh lots, as long as the absorption continues, the old flowers being removed by the use of a vacuum. The pomades are known commercially as Nos. 6, 12, 18, 24 and 36, the numbers indicating the relative strength. The absorbed volatile products are then obtained from the pomade by washing in pure alcohol in an appropriate mixing device. The alcohol dissolves out the floral odors and leaves only a trace of the fat behind, and this trace may be separated by subjecting it to a cold atmosphere in a refrigerator, when the congealed fat can be filtered out. The enfleurage process is used for jasmine, tuberose, cassie, rose, violet, jonquil, lily, orange flowers, and a few others.

The pomades are mostly imported from Grasse, France, but their use today is very limited, having been largely replaced by *concretes* and *absolutes* (see page 1210).

Percolation with Volatile Solvents—The chief solvent employed is a highly purified petroleum benzin of a specific gravity of 0.650. The solvent is allowed to flow through the flowers which are arranged on trays in the apparatus. The extraction requires about eight hours. The volatile solvent is then removed by vacuum distillation and the resulting product is known as a *concrete*.

These concretes contain the plant or flower waxes and are removed by dissolving the odorous portion in strong alcohol and separating the insoluble waxes by filtration. Small quantities of alcohol-soluble waxes are removed by

chilling to 20° C. below zero when the resulting products are known as *absolutes*. These products, although very costly, are largely used in perfumery, their great odor value making their employment economically possible.

Synthetic Perfumery—Many of the constituents of volatile oils, already enumerated, and other alcohols, aldehydes, ketones, esters, etc., are now manufactured synthetically for use in perfumery. This has become an extensive business and requires a comprehensive knowledge of organic synthesis and methods for the purification of the resulting compounds. (See the Chapter LXXVI on Perfumery.)

For the purpose of study, the volatile oils are grouped according to botanical families, as follows:

Official Products from the Rutaceæ

The Family Rutaceæ furnishes valuable products to medicine and pharmacy.

AURANTII AMARI CORTEX. U.S. Bitter Orange Peel, Bitter Orange; Curaçao Orange Peel, Bigarade Orange

[Aurant. Amar. Cort.]

Bitter Orange Peel is the dried rind of the unripe fruit of *Citrus Aurantium* Linné (Fam. *Rutaceæ*).

Description and Physical Properties—Thin, irregular bands (ribbons) or quarters, outer surface yellowish- or reddish- or greenish-brown with numerous, minute pits and fine reticulate ridges; inner surface whitish with many slight conical projections and fine anastomosing lines formed by the vascular bundles; fracture hard, short; odor fragrant and aromatic; taste aromatic and bitter. For further description and tests see the U. S. P. X.

U. S. P. Preparations—Tinctura Aurantii Amari; Tinctura Cinchonæ Composita; Tinctura Gentianæ Composita.

N. F. Preparations—Infusum Gentianæ Compositum; Tinctura Amara.

The inner thick part of the peel from the bitter orange contains a volatile oil and *hesperidin*, having the formula $C_{22}H_{26}O_{12}$. This is a glucoside, which yields, on treatment with sulphuric acid, *hesperetin*, $C_{16}H_{14}O_6$, and rhamnose, $C_6H_{12}O_5$. It also contains a small quantity of volatile oil. It is used to communicate flavor, and as a bitter tonic. The dose is ten to forty grains (0.6 to 2.6 Gm.).

AURANTII DULCIS CORTEX. U.S. Sweet Orange Peel

[Aurant. Dulc. Cort.]

Sweet Orange Peel is the fresh, outer rind of the ripe fruit of *Citrus Aurantium* var. *sinensis* Linné (Fam. *Rutaceæ*).

In separating the rind the white portion must be discarded as far as possible since it contains no oil but does contain hesperidin which would impart a bitter taste to the preparations in which the orange peel is intended for a flavor.

Description and Physical Properties—The outer, orange-yellow layer recently separated by grating or paring and consisting of epidermal cells, parenchyma, and oil reservoirs with globules of volatile oil; odor highly fragrant; taste pungently aromatic.

U. S. P. Preparations—Tinctura Aurantii Dulcis; Syrupus Aurantii (from Tincture).

N. F. Preparations—Elixir Gentianæ Glycerinatum; Elixir Pepsini et Rennini Compositum; Elixir Taraxaci Compositum; Elixir Terpini Hydratis.

Uses—Sweet orange peel owes its virtues to the volatile oil found in the epidermis. It also communicates a yellowish color to the preparations made with it, and is used exclusively as a flavoring substance. The 50 per cent tincture, made from the freshly grated rind, has a finer flavor than the oil and is less likely to become terebinthinate.

OLEUM AURANTII. U. S. Oil of Orange

[Ol. Aurant.—Orange Oil, Oil of Sweet Orange]

The volatile oil obtained by expression from the fresh peel of the ripe fruit of *Citrus Aurantium* var. *sinensis* Linné (Fam. *Rutaceæ*). Oil of Orange which has a terebinthinate odor must not be dispensed.

This oil consists of *d-limonene* to the extent of at least 90 per cent; of the remainder, about 5 per cent are the odorous constituents, among which are *decylic aldehyde*, one of the most important, *linalol*, *l-terpineol*, *d-terpineol*, *nonyl alcohol*, *methyl anthranilate*, and traces of *caprylic acid esters*. It may be preserved by shaking it with one-eighth of its volume of distilled water, allowing it to separate, then removing the essential oil, filtering rapidly if necessary, and mixing the filtered oil with 95 per cent alcohol in the proportion of one volume of the oil to seven volumes of alcohol.

It may also be preserved by adding 10 per cent of its volume of olive oil. Kept under the usual conditions it is very prone to decompose, and rapidly acquires a terebinthinate odor.

Description and Physical Properties—A yellow liquid, having the characteristic odor and taste of the outer part of sweet orange peel.

Tests for Identity and Purity—The Oil does not form a clear solution with 2 volumes of 90 per cent alcohol, by volume (*washed citrus oils*). It is soluble in all proportions in dehydrated alcohol and in carbon disulphide, and in an equal volume of glacial acetic acid.

Specific gravity: 0.842 to 0.846 at 25° C.

Optical rotation: not less than +94° and not more than +99° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4723 to 1.4737 at 20° C., page 1525.

A solution of recently expressed Oil of Orange in dehydrated alcohol is neutral to moistened litmus paper.

The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

A 25 Gm. portion of Oil of Orange evaporated to dryness at a temperature not exceeding 100° C. yields not less than 2 per cent of residue (*washed citrus oils*).

Place 50 cc. of Oil of Orange in a 250 cc. three-bulb Ladenburg flask of approximately the following dimensions: The lower or main bulb, 6 cm. in diameter, with the smaller condensing bulbs 3.5 cm., 3.0 cm. and 2.5 cm., respectively, in diameter; the distance from the bottom of the flask to the side arm, 20 cm. Distil the Oil at the rate of 1 drop per second until the distillate measures 5 cc.: the angle of rotation of the distillate is equal to that of the original Oil, or does not differ more than 2 degrees from it, and the refractive index of the distillate is not less than 0.0008 and not more than 0.0015 lower than that of the original Oil at 20° C.

Preserve in small, completely filled, well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Elixir Aromaticum (from Compound Spirit); Spiritus Aurantii Compositus.

N. F. Preparations—Elixir Cardamomi Compositum (from Compound Spirit); Elixir Ferri Pyrophosphatis, Quininæ et Strychninæ; Elixir Vanillini Compositum (from Compound Spirit); Elixir Pepsini Compositus; Liquor Ferri Peptonati; Liquor Ferri Peptonati et Mangani; Spiritus Cardamomi Compositus; Spiritus Myrciæ Compositus; Spiritus Vanillini Compositus; Syrupus Quinidinæ; Tabellæ Sulphuris et Potassii Bitartratis; Trochisci Eucalypti Gummi.

Uses—It is used as a flavoring agent in elixirs and other preparations.

Average dose—1½ minims (0.1 cc.).

For the *Oils of Bitter Orange* and *Orange Flowers*, which are official in the N. F., see page 956.

LIMONIS CORTEX. U.S. Lemon Peel

[Limon. Cort.—Fresh Lemon Peel]

Lemon Peel is the outer yellow rind of the fresh ripe fruit of *Citrus medica* var. *Limonum* (Risso) Hooker filius (Fam. *Rutaceæ*).

Lemon peel is principally used to communicate flavor and color to spirit and syrup of lemon. It contains a volatile oil and *hesperidin*.

Description and Physical Properties—The outer lemon-yellow or dark-yellow layer, recently separated by grating or paring; consisting of the epidermis and numerous parenchyma cells containing yellow chromoplastids and large oil reservoirs with globules of the volatile oil; odor fragrant, distinctive; taste aromatic.

U.S.P. Preparation—Tinctura Limonis.

OLEUM LIMONIS. U.S. Oil of Lemon

[Ol. Limon.—Lemon Oil]

The volatile oil obtained by expression from the fresh peel of the fruit of *Citrus medica* var. *Limonum* (Risso) Hooker filius (Fam. *Rutaceæ*). Oil of Lemon yields not less than 4 per cent of the aldehydes of Oil of Lemon, calculated as citral [$C_{10}H_{16}O$]. Oil of Lemon which has a terebinthinate odor must not be dispensed.

This important volatile oil contains a number of constituents, among the most important of which is *citral*, about 4 to 5½ per cent. *Pinene* is present in small amount, also *camphene*, *phellandrene*, and *γ-terpinene*. About 90 per cent of the oil, however, consists of *d-limonene*. Traces of many other substances are also present such as *octyl* and *nonyl* aldehydes, *citronellal*, etc., and about 2 per cent of a solid substance known as *citraptene* or *lemon-camphor*. When fresh, the oil has the fragrant odor of lemons. It may be preserved from the effects of oxidation by the addition of 5 per cent of alcohol and separation from the sediment. Five per cent of olive or cottonseed oil will also preserve it indefinitely. This oil is prepared by expression. The method of its production has been described on page 951.

Description and Physical Properties—A pale yellow or greenish-yellow liquid, having the characteristic odor and taste of the outer part of fresh lemon peel.

Tests for Identity and Purity—The Oil is soluble in 3 volumes of alcohol, and in all proportions in dehydrated alcohol, carbon disulphide, and in glacial acetic acid.

Specific gravity: 0.851 to 0.855 at 25° C.

Optical rotation: varies from +57° to +64° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4744 to 1.4755 at 20° C., page 1525.

A solution of the recently expressed Oil in alcohol (1 in 3) is neutral or only slightly acid to moistened litmus paper.

Oil of Lemon when distilled as described under *Oleum Aurantii*, page 954, gives the following results: The angle of rotation of the first 5 cc. is not more than 5 degrees less than that of the original Oil. The refractive index of this same portion is not less than 0.0020 and not more than 0.0027 lower than that of the original Oil.

Assay—Place about 15 cc. of Oil of Lemon in a tared, 250 cc. Erlenmeyer flask, and weigh accurately. Add 10 cc. of an alcoholic solution of phenylhydrazine (1 in 10) (not darker in color than pale yellow), and allow it to stand for thirty minutes at room temperature. Then add 3 drops of methyl-orange T.S., and neutralize the liquid by the addition of half-normal hydrochloric acid. If difficulty is experienced in determining the end point of the reaction, continue the titration until the liquid is distinctly acid, transfer it to a separatory funnel, and after the layers have separated draw off the alcoholic portion. Wash the oil remaining in the funnel with distilled water, adding the washings to the alcoholic solution, and titrate the latter with half-normal sodium hydroxide. Carry out a blank test identical with the foregoing, omitting the Oil of Lemon, and note the amount of half-normal hydrochloric acid consumed. Subtract the number of cc. of half normal sodium hydroxide from the number of cc. of half-normal hydrochloric acid consumed in the test containing the Oil of Lemon, and this result from the number of cc. of half-normal hydrochloric acid consumed in the test without the Oil of Lemon. Each cc. of this difference corresponds to 0.07609 Gm. of aldehydes calculated as citral.

Preserve in completely filled, well-stoppered, amber-colored bottles, in a cool place, protected from light.

This assay is explained on page 1460.

U. S. P. Preparations—Elixir Aromaticum (from Compound Spirit of Orange); Liquor Magnesii Citratis; Spiritus Ammoniæ Aromaticus; Spiritus Aurantii Compositus.

N. F. Preparations—Acetum Aromaticum; Linimentum Terebinthinæ Aceticum; Mistura Oleo-Balsamica; Spiritus Odoratus; Syrupus Eriodictyi Aromaticus; Syrupus Sennæ Aromaticus.

Uses—Oil of lemon is used as a flavor in the official preparations named above.

Average dose—1½ minims (0.1 cc.).

OLEUM AURANTII AMARI. N. F. Oil of Bitter Orange
[Ol. Aurant. Amar.]

A volatile oil obtained by expression from the fresh peel of the bitter orange, *Citrus Aurantium* Linné (Fam. *Rutaceæ*). Preserve it in small, well-stoppered, amber-colored bottles, in a cool place, protected from light. Oil of Bitter Orange having a terebinthinate odor is not to be dispensed.

Official Description—A pale yellow liquid.

Odor, Taste, and Reaction—Characteristic, aromatic odor of the Seville orange, and an aromatic, somewhat bitter taste. The alcoholic solution is neutral to litmus paper.

Solubility—Soluble in four volumes of alcohol. Also soluble in all proportions in dehydrated alcohol and in an equal volume of glacial acetic acid.

Specific gravity: 0.842 to 0.848 at 25° C. (77° F.).

Tests for Identity and Purity—It is dextrorotatory, the angle of rotation varying from +88° to +98° in a 100 mm. tube, at 25° C. (77° F.).

Introduce 50 cc. of Oil of Bitter Orange into a 200 cc., three-bulb, fractionating flask. Distil the Oil at the rate of 2 cc. per minute until a distillate measuring 5 cc. has been collected. The angle of rotation of this distillate is equal to, or only slightly lower, than that of the original Oil.

N. F. Preparation—Elixir Aurantii Amari.

Uses—It is used as an adjuvant and flavor. The dose is three minims (0.2 cc.).

OLEUM AURANTII FLORUM. N. F. Oil of Orange Flowers
[Ol. Aurant. Flor.—Oil of Neroli]

A volatile oil distilled from the fresh flowers of the bitter orange, *Citrus Aurantium* Linné (*Citrus vulgaris* Risso, *Citrus Bigaradia* Risso) (Fam. *Rutaceæ*). Preserve it in small, amber-colored, well-stoppered bottles, in a cool place, protected from light.

Official Description—A pale yellow, slightly fluorescent, neutral liquid.

Odor, Taste, and Reaction—A distinctive fragrant odor similar to that of orange blossoms and an aromatic, at first sweet, then somewhat bitter taste. The alcoholic solution is neutral to litmus paper.

Solubility—Soluble in an equal volume of alcohol, the solution having a violet fluorescence. Also soluble in two volumes of 80 per cent alcohol, the solution becoming cloudy on the further addition of alcohol of the same percentage.

Specific gravity: 0.868 to 0.880 at 25° C. (77° F.).

Tests for Identity and Purity—It is dextrorotatory, the angle of rotation varying from +1° 30′ to + 5°, in a 100 mm. tube, at 25° C. (77° F.).

When agitated with a concentrated solution of sodium bisulphite, it assumes a permanent purple-red color.

N. F. Preparation—Spiritus Odoratus.

Uses—It is used as a perfume, being the dominant odor in Cologne water. Several less valuable varieties of the oil are commercially known. These are designated as *Bigarade* (from the flowers of the bitter orange, the ordinary neroli oil), *Portugal* (from the flowers of sweet orange), and *Petit-grain* (from the leaves and young shoots of the bitter orange). The finest variety is known as *Petale*.

OLEUM BERGAMOTTÆ. N. F. Oil of Bergamot
[Ol. Bergam.]

A volatile oil obtained by expression from the rind of the fresh fruit of *Citrus Aurantium* Linné var. *Bergamia* (Risso et Poiteau) Wight et Arnott (Fam. *Rutaceæ*), and containing not less than 36 per cent of ester, calculated as linalyl acetate. Preserve it in small, amber-colored, well-stoppered bottles, in a cool place, protected from light.

Official Description—A green or greenish-yellow liquid, neutral or only faintly acid.

Odor and Taste—A characteristic fragrant odor and an aromatic bitter taste.

Solubility—Two volumes of the Oil, when mixed with one volume of alcohol, give a clear solution and this does not become turbid on the further addition of alcohol. It is soluble in two volumes of

80 per cent alcohol with not more than a slight cloudiness, and no separation of oil globules. Also soluble in all proportions in glacial acetic acid.

Specific gravity: 0.875 to 0.880 at 25° C. (77° F.).

Tests for Identity and Purity—It is dextrorotatory, the angle of rotation varying from +8° to +24°, in a 100 mm. tube, at 25° C. (77° F.).

Fixed Oils—Evaporate in a tared dish on a water bath about 2 Gm. of the Oil, accurately weighed, until the odor has completely disappeared; a soft green residue remains, corresponding to not more than 6 per cent of the Oil.

Chlorinated Compounds—To 2 Gm. of Oil of Bergamot add 10 cc. of alcoholic potassium hydroxide V.S., free from chloride, evaporate to dryness and incinerate. Extract the ash with distilled water and acidify with diluted nitric acid: no cloudiness is produced on the addition of silver nitrate T.S.

Assay—To 2 Gm. of the Oil add 20 cc. of half-normal alcoholic potassium hydroxide and heat the mixture in a flask on a water bath, under a reflux condenser, for a half hour. Cool the mixture, add 100 cc. of distilled water and titrate with half-normal sulphuric acid, using phenolphthalein T.S. as indicator. Not more than 12.6 cc. of half-normal sulphuric acid is required, corresponding to not less than 36 per cent of ester, calculated as linalyl acetate, in the Oil. Each cc. of half-normal potassium hydroxide corresponds to 0.09808 Gm. of ester, calculated as linalyl acetate.

For a description of this assay, see page 1461.

N. F. Preparation—Spiritus Odoratus.

Uses—A constituent of Cologne water, and also much used in other perfumes, chiefly in oils and pomades for the hair.

Official Products from the Labiatæ

The family of the mints is a strongly marked group, the members of it being remarkable for their botanical analogy and for the similarity of their chemical constituents.

MENTHA PIPERITA. U. S. Peppermint

[**Menth. Pip.**—Peppermint Herb or Leaves]

Peppermint consists of the dried leaves and tops of *Mentha piperita* Linné (Fam. *Labiatæ*).

Peppermint contains not more than 2 per cent of stems over 3 mm. in diameter, or other foreign organic matter.

Description and Physical Properties—Leaves more or less crumpled and frequently detached from the stem; ovate-oblong to oblong-lanceolate, petiole from 4 to 15 mm. in length, slightly pubescent, blade from 1 to 9 cm. in length, acute and sharply serrate, light green to purplish-brown; upper surface nearly glabrous, lower surface glandular-hairy, especially on the veins; stem quadrangular, from 1 to 3 mm. in diameter, glabrous except for a few scattered deflexed hairs; flower-whorls usually in a compact, oblong or oval spike, from 1 to 1.5 cm. in breadth, rounded at the summit, and in fruit attaining a length of from 3 to 7 cm.; bracts, oblong-lanceolate, from 4 to 7 mm. in length; calyx tubular, equally 5-toothed, pubescent and glandular-punctate, often dark purple in color; corolla tubular-campanulate, 4-cleft, about 3 mm. in length and often light purple; stamens 4, short and equal; nutlets ellipsoidal, about 0.5 mm. in diameter, blackish-brown; odor aromatic, characteristic; taste aromatic, pungent, followed by a cooling sensation in the mouth. For further description, see the U. S. P. X.

U. S. P. Preparation—Spiritus Menthæ Piperitæ.

Uses—Its properties are due to the presence of about 2 per cent of a volatile oil which contains *menthol*. It is largely cultivated, and is a grateful aromatic stimulant. It is used in making spirit of peppermint. The dose is one drachm (4 Gm.).

OLEUM MENTHÆ PIPERITÆ. U. S. Oil of Peppermint

[**Ol. Menth. Pip.**—Peppermint Oil]

The volatile oil distilled from the fresh, over-ground parts of the flowering plant of *Mentha piperita* Linné (Fam. *Labiatæ*), rectified by steam distillation.

Oil of Peppermint yields not less than 5 per cent of esters, calculated as menthyl acetate [$C_{10}H_{19}.C_2H_3O_2$], and not less than 50 per cent of total menthol [$C_{10}H_{19}.OH$], free and as esters.

This is one of the most important of the group of volatile oils. It has been found to contain the following constituents: acetaldehyde, isovaleraldehyde, dimethyl sulphide, amyl acetate, isovaleric aldehyde, pinene, phellandrene, cineol, limonene, *menthone*, $C_{10}H_{18}O$, menthol, the acetate and isovalerate of menthyl, *a-lactone*, $C_{10}H_{16}O_2$, and cadinene. Menthol, its oxidation product menthone, and the acetic and isovaleric esters of menthyl have been identified as present in English and French peppermint oils, which probably also contain most of the other constituents mentioned above. Menthol and its esters are regarded as the main constituents of oil of peppermint. The dimethyl sulphide and some of the other constituents are objectionable from the flavoring standpoint, and are largely removed by the steam distillation which is required for rectification. The polariscope has been shown to be an uncertain guide in determining the quality of oil of peppermint. It is distilled in large quantities in Michigan, Ohio, Indiana, and New York from cultivated plants. *Menthol* is official, and the proportion which should be present forms the basis of the official assay (see below). The eleoptene or dementholized oil is often found in the market as a substitute in whole or in part for the genuine oil.

Description and Physical Properties—A colorless liquid, having a strong, penetrating odor of peppermint, and a pungent taste, followed by a sensation of cold when air is drawn into the mouth.

Tests for Identity and Purity—The Oil is soluble in 4 volumes of 70 per cent alcohol by volume, showing not more than a slight opalescence and no separation of oil globules (*dementholized or impure peppermint oil*).

Specific gravity: 0.896 to 0.908 at 25° C.

Optical rotation: varies between −23° and −33° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4600 to 1.4710 at 20° C., page 1525.

A solution of the recently rectified Oil in 70 per cent alcohol (1 in 4) is neutral to moistened litmus paper.

Distil 1 cc. from 25 cc. of Oil of Peppermint, and carefully superimpose the distillate on 5 cc. of mercuric chloride T.S. in a test tube: a white film does not form at the zone of contact within one minute (*dimethyl sulphide found in nonrectified peppermint oils*).

Assay for Esters—Place 10 cc. of Oil of Peppermint in a tared, 125 cc. Erlenmeyer flask, and weigh accurately. Add 25 cc. of half-normal alcoholic potassium hydroxide, connect the flask with a reflux condenser, and boil the mixture on a water bath for one hour. Allow the mixture to cool, disconnect the flask from the condenser, and titrate the excess of alkali with half-normal sulphuric acid, using 10 drops of phenolphthalein T.S. as indicator. Subtract the number of cc. of half normal sulphuric acid required for neutralization from the 25 cc. of half-normal alcoholic potassium hydroxide taken, multiply the difference by 9.912, and divide this product by the weight of Oil of Peppermint taken: the result shows the per cent of esters calculated as menthyl acetate.

For an explanation of this assay, see page 1461.

Assay for Total Menthol—Place 10 cc. of Oil of Peppermint in an acetylization flask of 100 cc. capacity, add 10 cc. of acetic anhydride, and 1 Gm. of powdered anhydrous sodium acetate. Boil the mixture gently for one hour, cool, disconnect the flask from the condenser, transfer the mixture to a small separatory funnel, rinsing the acetylization flask with three successive 5 cc. portions of warm distilled water, and add the rinsings to the separatory funnel. When the liquids have completely separated, remove the aqueous layer, and wash the remaining oil with successive portions of sodium carbonate T.S., diluted with an equal volume of distilled water, until the mixture is alkaline to 2 drops of phenolphthalein T.S. Dry the resulting Oil with fused calcium chloride, and filter. Transfer 5 cc. of the dry acetylized oil to a tared, 100 cc. Erlenmeyer flask, note the exact weight, add 50 cc. of half-normal alcoholic potassium hydroxide, connect the flask with a reflux condenser, and boil the mixture on a water bath for one hour. Allow the mixture to cool, disconnect the flask from the condenser, and titrate the excess of alkali with half-normal sulphuric acid, using 10 drops of phenolphthalein T.S. as indicator. Calculate the per cent of menthol by the following formula:

$$\text{Per cent of total menthol} = \frac{A \times 7.811}{B - (A \times 0.021)} \times [1 - (E \times 0.0021)]$$

A is the result obtained by subtracting the number of cc. of half-normal sulphuric acid required in the above titration from the number of cc. of half-normal alcoholic potassium hydroxide originally taken, *B* is the weight of acetylized oil taken, and *E* is the per cent of esters calculated as menthyl acetate.

For an explanation of this assay see page 1461.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Aqua Menthæ Piperitæ; Spiritus Menthæ Piperitæ.

N. F. Preparations—Acetum Aromaticum; Cataplasma Kaolini; Elixir Catharticum Compositum (from Spirit); Elixir Euphorbiæ Compositum; Gargarisma Guaiaci Composita; Lavatio Ori; Linimentum Opii Compositum; Mistura Carminativa; Mistura Chloroformi et Morphinæ Composita; Mistura Opii et Rhei Composita (from Spirit);

Mistura Rhei Alkalina (from Spirit); Mistura Rhei Composita (from Spirit); Oleum Hyoscyami Compositum; Pilulæ Catharticæ Vegetabiles; Pilulæ Rhei Compositæ; Syrupus Ficorum Compositus (from Spirit); Tabellæ Menthæ Piperitæ.

Uses—Oil of peppermint is a local anesthetic, antiseptic, and carminative. It is much used in sick stomach and also as a flavor in the dose of one and one-half minims (0.1 cc.) and as an ingredient in the official preparations listed above.

MENTHOL. U.S. Menthol

[Peppermint Camphor, Peppermint Crystals, Headache Crystals]

An alcohol [$C_{10}H_{19}OH$] obtained from oil of peppermint or other mint oils. The oil of peppermint owes its odor to *menthol* which is a stearoptene obtained from it through fractional distillation, cooling, and crystallization. It is sometimes called *peppermint camphor.*

Description and Physical Properties—Colorless, acicular crystals, having a strong, peppermint-like odor.

Menthol is slightly soluble in water; very soluble in alcohol, chloroform, ether, and in petroleum benzin. It is freely soluble in glacial acetic acid, liquid petrolatum, and in fixed or volatile oils.

When menthol is triturated with about an equal weight of camphor, chloral hydrate, phenol, or thymol, the mixture liquefies.

Tests for Identity and Purity—Menthol melts between 42° and 44° C.

Its alcoholic solution is lævorotatory.

Heat 2 Gm. of Menthol in an open dish on a water bath: it gradually volatilizes without leaving more than 0.05 per cent of residue (*wax, paraffin, or inorganic substances*).

Dissolve about 0.1 Gm. of Menthol in 1 cc. of glacial acetic acid, and add 3 drops of sulphuric acid and 1 drop of nitric acid: no green color is produced (*thymol*).

Preserve in well-closed containers, in a cool place.

N.F. Preparations—Dentifricium; Dentilinimentum Aconiti Compositum; Dentilinimentum Aconiti et Iodi Compositum; Inunctum Mentholis; Inunctum Mentholis Compositum; Linimentum Sinapis Compositum; Liquor Antisepticus; Liquor Pepsini Antisepticus; Menthol Camphoratum; Nebula Aromatica; Nebula Mentholis; Nebula Mentholis Composita; Petroxolinum Mentholis; Pulvis Antisepticus.

Uses—Menthol is largely used, compressed into cones, as a local remedy in neuralgia and headache and as a constituent in solutions for nasal and throat sprays, etc. It is also much used in throat lozenges and as a local application to relieve itching.

Average dose—1 grain (0.06 Gm.).

MENTHOL CAMPHORATUM. N.F. Camphorated Menthol

[**Menthol Camph.**—Camphor and Menthol]

	Metric	Alternative
Camphor	**47.5 Gm.**	1 oz. av. 394 gr.
Menthol	**47.5 Gm.**	1 oz. av. 394 gr.
Alcohol	**5.0 Gm.**	87 gr.
To make	**100 Gm.**	4 oz. av.

Reduce the camphor to a powder by triturating it with about one-tenth of its weight of menthol, add the rest of the menthol and continue trituration until the mixture is completely liquefied; then add the alcohol.

Camphorated Menthol may also be prepared by placing the camphor and menthol in a suitable bottle, tightly stoppered, and partially immersing it in hot water until, after occasional agitation, the mixture is completely liquefied. Finally add the alcohol.

In this preparation an *eutectic* mixture is produced having a melting point lower than that of its constituents. This phenomenon of two solids uniting to produce a liquid, without any chemical reaction taking place is not uncommon among organic substances, especially the stearoptenes.

Uses—It is used externally as a local anesthetic and counterirritant.

MENTHA VIRIDIS. U.S. Spearmint

[Menth. Vir.—Spearmint Leaves, Spearmint Herb—Mint]

Spearmint consists of the dried leaves and tops of *Mentha spicata* Linné (*Mentha viridis*, Linné) (Fam. *Labiatæ*).

Spearmint contains not more than 2 per cent of stems over 3 mm. in diameter, or other foreign organic matter.

Description—Leaves about 5 cm. long, subsessile, lance-ovate, acute, serrate, glandular, nearly smooth; branches quadrangular, mostly light green; flowers in terminal, interrupted, narrow, acute spikes, with a tubular, sharply five-toothed calyx, a light purplish, four-lobed corolla, and four rather long stamens; odor aromatic; taste pungent.

For further description see the U. S. P. X.

U. S. P. Preparation—Spiritus Menthæ Viridis.

The spearmint is the mint of culinary use in preparing mint sauce, and also the well-known mint julep. The volatile oil is the only constituent of importance in this plant; the yield is from ½ to 1 per cent. The dose of the drug is one drachm (4 Gm.).

OLEUM MENTHÆ VIRIDIS. U.S. Oil of Spearmint

[Ol. Menth. Vir.—Spearmint Oil]

The volatile oil distilled from the fresh, over-ground parts of the flowering plant of *Mentha spicata* Linné (*Mentha viridis* Linné) (Fam. *Labiatæ*).

Oil of Spearmint yields not less than 43 per cent by volume, of carvone [$C_{10}H_{14}O$].

The German and American oils of spearmint also contain a terpene, *l-limonene*, $C_{10}H_{16}$, and *l-carvone*, $C_{10}H_{14}O$, the latter in the amount of from 35 to 66 per cent. It also contains phellandrene, dihydrocarveol acetate, and the esters of acetic, butyric, and caproic acids. The Russian oil has been found to contain from 5 to 10 per cent of carvone only, but 50 to 60 per cent of linaloöl, together with some cineol and *l-limonene*.

Description and Physical Properties—A colorless, yellow or greenish-yellow liquid, having the characteristic odor and taste of spearmint.

Tests for Identity and Purity—The Oil is soluble in 1 volume of 80 per cent alcohol by volume, forming a clear solution, which becomes cloudy on dilution with more of the alcohol.

Specific gravity: 0.917 to 0.934 at 25° C.

Optical rotation: varies from −38° to −56° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4820 to 1.4900 at 20° C., page 1525.

A solution of the recently distilled Oil in an equal volume of 80 per cent alcohol is neutral or only slightly acid to moistened litmus paper.

Assay—Proceed as directed under *Oleum Cari*, page 965, using 10 cc. of Oil of Spearmint. The oily layer measures not more than 5.7 cc., indicating the presence of not less than 43 per cent by volume, of carvone.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Aqua Menthæ Viridis; Spiritus Menthæ Viridis.

Uses—It is used sometimes as a carminative in doses of one and one-half minims (0.1 cc.), and extensively as a flavor, especially in chewing gum.

OLEUM LAVANDULÆ. U.S. Oil of Lavender

[Ol. Lavand.—Oil of Lavender Flowers]

The volatile oil distilled from the fresh flowering tops of *Lavandula Spica* Linné (*Lavandula officinalis* Chaix, *Lavandula vera* DeCandolle) (Fam. *Labiatæ*). Oil of Lavender yields not less than 30 per cent of esters calculated as linalyl acetate [$C_{10}H_{17}.C_2H_3O_2$].

Oil of lavender flowers is most largely used in perfumery. The best quality is distilled at Mitcham, England. It has the same composition and properties as oil of lavender. It is, however, more fragrant and more expensive. The principal constituent of the oil is an alcohol, $C_{10}H_{18}O$, identical with the linaloöl. This alcohol boils at from 197° to 199° C. (386.6° to 390.2° F.), and has a sp. gr. of 0.869 at 20° C. (68° F.). Besides linaloöl, lavender oil contains *linalyl acetate* (from 30 to 45 per cent in the oil from French flowers, and from 7 to 10 per cent in the oil from English flowers), the *butyric ester* of the same alcohol, *geraniol*, a very small amount of *cineol* (more in the English than in the French oil), and sometimes traces of pinene, limonene, and a sesquiterpene.

Oil of Spike Lavender is an inferior grade of lavender oil made from the flowers of *Lavandula spica*. It should be used only in cheaper perfumery, as the odor is inferior to the oil from *Lavandula vera*.

Description and Physical Properties—A colorless or yellow liquid, having the characteristic odor and taste of lavender flowers.

Tests for Identity and Purity—The oil is soluble in 3 volumes of 70 per cent alcohol by volume.

Specific gravity: 0.875 to 0.888 at 25° C.

Optical rotation: varies from −3° to −10° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4600 to 1.4640 at 20° C., page 1525.

Shake 5 cc. of Oil of Lavender with an equal volume of distilled water in a narrow, graduated 10 cc. glass-stoppered cylinder: the volume of the Oil does not diminish (*alcohol*).

Shake 20 cc. of the Oil with 40 cc. of 5 per cent alcohol in a 100 cc. glass-stoppered cylinder. When the mixture has cleared, withdraw 30 cc. of the alcoholic solution, by means of a pipette, and place it in a 125 cc. Erlenmeyer flask. Neutralize the solution with half-normal potassium hydroxide, using 2 drops of phenolphthalein T.S. as indicator, add 5 cc. of half-normal potassium hydroxide, and heat the mixture on a bath of boiling water under a reflux condenser during one hour. Allow the mixture to cool, remove the flask from the bath, and titrate the excess of alkali with half-normal hydrochloric acid: not less than 4.7 cc. is required for neutralization (*acetins*).

Assay—Proceed as directed for esters under *Oleum Menthæ Piperitæ*, page 957, using 5 cc. of Oil of Lavender, accurately weighed, and 50 cc. of half-normal alcoholic potassium hydroxide. Multiply the number of cc. of half-normal alcoholic potassium hydroxide actually used in the saponification, by 9.811, and divide the product by the weight of the Oil of Lavender taken. The result gives the per cent of esters, calculated as linalyl acetate.

This assay is explained on page 1461.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Linimentum Saponis Mollis; Spiritus Ammoniæ Aromaticus; Spiritus Lavandulæ; Tinctura Lavandulæ Composita; Unguentum Diachylon.

N. F. Preparations—Acetum Aromaticum; Linimentum Ammonii Iodidi; Mistura Ferri Composita (from Spirit); Mistura Oleo-Balsamica; Oleum Hyoscyami Compositum; in all Petroxolins; Spiritus Odoratus.

Uses—It is used as an aromatic and carminative. Dose, one and one-half minims (0.1 cc.).

OLEUM ROSMARINI. U. S. Oil of Rosemary

[Ol. Rosmar.—Rosemary Oil]

The volatile oil distilled from the fresh flowering tops of *Rosmarinus officinalis* Linné (Fam. *Labiatæ*).

Oil of Rosemary yields not less than 2.5 per cent of esters, calculated as bornyl acetate [$C_{10}H_{17}.C_2H_3O_2$], and not less than 10 per cent of total borneol [$C_{10}H_{17}OH$], free and as esters.

This oil consists principally of *pinene*, of the composition $C_{10}H_{16}$, boiling at 165° C., but there is a smaller fraction boiling at from 200° to 210° C., which at low temperatures deposits a camphor, $C_{10}H_{18}O$, identified as borneol. *Cineol* ($C_{10}H_{18}O$) has also been separated from a fraction boiling between 176° and 182° C. The oil is therefore recognized at present as containing d-pinene, camphene, cineol, borneol (10 to 15 per cent), and camphor.

Description and Physical Properties—A colorless or pale yellow liquid, having the characteristic odor of rosemary, and a camphoraceous taste.

Tests for Identity and Purity—The Oil is soluble in 10 volumes of 80 per cent alcohol by volume.

Specific gravity: 0.894 to 0.912 at 25° C.

Optical rotation: varies from 0° to +15° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4660 to 1.4720 at 20° C., page 1525.

A solution of the recently distilled Oil in 80 per cent alcohol (1 in 10) is neutral or only slightly acid to moistened litmus paper.

Assay for Esters—Proceed as directed for esters under *Oleum Menthæ Piperitæ*, page 957, using 10 cc. of Oil of Rosemary. Multiply the number of cc. of half-normal alcoholic potassium hydroxide consumed in the saponification of the Oil by 9.811, and divide the product by the weight of the Oil taken. The result shows the per cent of esters, calculated as bornyl acetate.

Assay for Total Borneol—Proceed as directed for total menthol under *Oleum Menthæ Piperitæ*, page 957, using 10 cc. of Oil of Rosemary. Use the following formula in calculating the per cent of total borneol:

$$\text{Per cent of total borneol} = \frac{A \times 7.710}{B - (A \times 0.021)} \times [1 - (E \times 0.0021)]$$

A is the result obtained by subtracting the number of cc. of half-normal sulphuric acid required in the titration from the number of cc. of half-normal alcoholic potassium hydroxide originally taken, *B* is the weight of the acetylized oil taken, and *E* is the per cent of esters calculated as bornyl acetate.

This assay is explained on page 1461.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Linimentum Chloroformi (from Soap Liniment); Linimentum Saponis; Tinctura Lavandulæ Composita.

N. F. Preparations—Acetum Aromaticum; Linimentum Saponato—Camphoratum; Oleum Hyoscyami Compositum; Spiritus Odoratus.

History—Under the name of *Aqua Reginæ Hungariæ* or *Hungary water*, a spirit made from Rosemary by distillation was very popular several centuries ago.

Uses—It is used chiefly as a local irritant in rubefacient liniments. It may be given in doses of one and one-half minims (0.1 cc.).

THYMUS. N. F. Thyme

[Garden Thyme]

Thyme consists of the dried leaves and flowering tops of *Thymus vulgaris* Linné (Fam. *Labiatæ*). Thyme contains not more than 3 per cent of stems over 1 mm. in diameter or other foreign organic matter, and yields not more than 4 per cent of acid-insoluble ash.

This drug is the source of the official oil of thyme, which is the chief constituent. Tannin and resin are also present.

Description—A low, slender, much-branched, hairy, highly aromatic perennial, the base more or less prostrate and rooting. The leaves are ovate-oblong or linear, revolute on the margin, grayish-green, glandular-punctate on both sides and pubescent beneath, the upper ones bearing in their axils small clusters of whitish or reddish flowers with exserted stamens. The nutlets are about 1 mm. ($\frac{1}{25}$ in.) in diameter, spheroidal, and finely tuberculate. The odor is agreeable, the taste warm, aromatic and pungent.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Thymi.

Uses—As a carminative, emmenagogue, and antispasmodic; doses of one drachm (4 Gm.).

OLEUM THYMI. N. F. Oil of Thyme

(U.S.P. IX)

[**Ol. Thymi**—Thyme Oil]

A volatile oil distilled from the flowering plant of *Thymus vulgaris* Linné (Fam. *Labiatæ*), and containing not less than 20 per cent, by volume, of phenols.

The oil, as prepared in the south of France, is known commercially as *oil of origanum*. It is, after one distillation, of a reddish-brown color, and is called the *red oil*, but when again distilled is colorless, and in this condition is distinguished as the *white oil*. The specific gravity of the red or common oil is stated at 0.905, but probably varies, as the oil is a complex body. The more volatile portion, that coming over below 180° C. (356° F.) in distilla-

tion, is a mixture of *cymene*, $C_{10}H_{14}$, boiling at 175° C. (347° F.), and *pinene*, $C_{10}H_{16}$, boiling at 161° C. (321.8° F.). The less volatile and most valuable portion is *thymol*, $C_{10}H_{14}O$, the stearoptene, a white, crystalline solid, melting at 50° C. (122° F.), and possessing a pungent taste. *Carvacrol*, an isomer of thymol is also present, at times replacing part or all of the thymol, and in addition *linaloöl* and *bornyl acetate* have been found in small amount. This substance is also found in oil of monarda (horsemint). (See Thymol, below.)

Official Description—A colorless or red liquid.
Odor and Taste—Characteristic.
Solubility—Soluble in two volumes of 80 per cent alcohol.
Specific gravity: 0.894 to 0.930 at 25° C.
Tests for Identity—It is slightly lævorotatory.

Shake 1 cc. of the Oil with 10 cc. of hot distilled water, and, after cooling, pass the aqueous layer through a wetted filter: the filtrate does not assume a blue or violet color upon the addition of a drop of ferric chloride T.S.

Assay—Introduce 75 cc. of sodium hydroxide T.S. into a flask with a long graduated neck (cassia flask), add 10 cc. of the Oil to be assayed, stopper the flask tightly, shake the mixture thoroughly, and set it aside for from twelve to twenty-four hours. Then add sufficient sodium hydroxide T.S. to raise the lower limit of the oily layer within the graduated portion of the neck of the flask, and, after the alkaline solution has become clear, adjust it to the temperature at which it was measured, and note the volume of the residual liquid. This measures no more than 8 cc., indicating the presence of not less than 20 per cent by volume, of phenols.

This assay is explained on page 1483.

Preserve it in well-stoppered, amber-colored bottles, in a cool place, protected from light.

N. F. Preparations—Linimentum Saponato-Camphoratum; Liquor Antisepticus; Mistura Oleo-Balsamica; Oleum Hyoscyami Compositum.

Uses—Oil of thyme is a powerful germicide but is chiefly used in liniments as a stimulant. The official preparations are given above.

THYMOL. U. S. Thymol, Thyme

A phenol [$C_6H_3.CH_3.OH.C_3H_7$ 1:3:4 = 150.16]. It occurs in the volatile oil of *Thymus vulgaris* Linné (Fam. *Labiatæ*) and some other volatile oils.

Preparation—Thymol has been made synthetically and is obtained from the volatile oils of several plants by fractional distillation, by which terpenes are separated. The portion distilling above 190° C. is collected, agitated with solution of sodium hydroxide to separate more of the terpenes, and cooled; the compound of thymol with sodium hydroxide is then decomposed by hydrochloric acid. Thymol is recrystallized from an alcoholic solution. This stearoptene has also been obtained from *Monarda didyma* Linné, *M. punctata* (horsemint), *Ammi copticum*, *Ocymum basilicum*, and *Ptychotis ajowan*.

Description and Physical Properties—Large, colorless, transparent crystals, having an aromatic, thyme-like odor and a pungent, aromatic taste.

One Gm. of Thymol is soluble in about 1000 cc. of water, about 1 cc. of alcohol, 0.7 cc. of chloroform, 1.5 cc. of ether, and in 1.7 cc. of olive oil, at 25° C. It is soluble in glacial acetic acid and in fixed or volatile oils.

Tests for Identity and Purity—Thymol melts between 48° and 51° C., remaining liquid at a considerably lower temperature.

Thymol is heavier than water, but when liquified by fusion it is lighter than water.

An alcoholic solution of Thymol (1 in 20) is neutral to litmus paper, and is optically inactive.

When Thymol is triturated with about an equal weight of camphor or menthol, the mixture liquefies.

Dissolve a very small crystal of Thymol in 1 cc. of glacial acetic acid, and add 6 drops of sulphuric acid and 1 drop of nitric acid: the liquid assumes a deep bluish-green color by reflected light.

Heat about 1 Gm. of Thymol in a test tube in a water bath with 5 cc. of a 10 per cent solution of sodium hydroxide: a clear, colorless, or pale red solution is formed, which becomes darker on standing, without the separation of oily drops. Upon the addition of a few drops of chloroform to this solution and agitating the mixture, a violet color is produced.

Volatilize about 2 Gm. of Thymol on a water bath: not more than 0.05 per cent of residue remains.

N. F. Preparations—Cataplasma Kaolini; Liquor Antisepticus; Liquor Aromaticus Alkalinus; Nebula Aromatica; Nebula Thymolis; Petroxolinum Sulphuratum Compositum; Pulvis Antisepticus.

Uses—Thymol is a powerful germicide; it is chiefly used in mouth washes. It is employed internally as an intestinal antiseptic and vermifuge, especially against the hook-worm. It liquefies, forming an *eutectic solution*, if triturated with an equal amount of chloral hydrate, menthol, or camphor, and some other substances. The dose, as an antiseptic, is two grains (0.125 Gm.); as an anthelmintic, divided into three doses, thirty grains (2 Gm.).

CATARIA. N. F. Catnep

[**Catar.**—CATMINT]

Catnep consists of the dried leaves and flowering tops of *Nepeta Cataria* Linné (Fam. *Labiatæ*).

Catnep contains not more than 5 per cent of its stems over 4 mm. in diameter or other foreign organic matter.

Description—Tops from 10 to 20 cm. long, much branched or crushed and broken; stems quadrangular, downy, up to 4 mm. in diameter; leaves opposite, the larger, petiolate, from 2 to 7 cm. long, ovate or oblong, rounded or heart-shaped at the base, pointed at the apex, pale gray-green, soft-hairy above, downy beneath, margin deeply crenate; floral leaves small, bract-like; flowers small, in dense, interrupted spikes; calyx hairy, tubular, curved obliquely and subequally 5-toothed, corolla whitish, dotted with purple, throat dilated, limb bilabiate, the upper lip erect and two cleft, the lower spreading and three cleft, the middle lobe largest, crenulate; stamens two pairs ascending under the upper lip, lower pair shorter. Odor faintly aromatic and mint-like; taste bitter, pungent and aromatic.

For further description see the N. F. V.

N. F. Preparations—Elixir Catariæ et Fœniculi; Fluidextractum Catariæ.

It contains a volatile oil and tannin.

Uses—Used popularly as a carminative stimulant, diaphoretic and emmenagogue. Dose, one drachm (4 Gm.).

SCUTELLARIA. N. F. Scutellaria

[**Scutell.**—SKULLCAP, HOODWORT, MADWEED]

Scutellaria is the dried over-ground portion of *Scutellaria lateriflora* Linné (Fam. *Labiatæ*).

Scutellaria contains not more than 3 per cent of foreign organic matter.

Description—About 50 cm. long, smooth; stem quadrangular, branched; leaves opposite, petiolate, about 5 cm. long, ovate-lanceolate or ovate-oblong, serrate; flowers in axillary, one-sided racemes, with a pale blue corolla and bilabiate calyx, closed in fruit, the upper lip helmet-shaped, odor slight; taste bitterish. For a further description see the N. F. V.

N. F. Preparations—Fluidextractum Scutellariæ; Tinctura Viburni Opuli Composita.

It contains volatile oil, tannin, and a bitter principle.

Uses—It is used as a tonic and antispasmodic. Dose, fifteen grains (1 Gm.).

Unofficial Plants of the Labiatæ

Brunella Heal-all Self heal	The herb of *B.* (*Prunella*) *vulgaris*. Found in North America, Asia, and Europe
Calamintha Wild Basil	The herb of *C. clinopodium*
Collinsonia Horsebalm	The herb of *Collinsonia canadensis*, grown in North America
Glechoma Ground Ivy	From *G. hederacea* and others, grown in Europe. It contains volatile oil, resin, etc.
Hedeoma American Pennyroyal	The dried leaves and flowering tops of *Hedeoma pulegioides* (Linné) Persoon (Fam. *Labiatæ*). It contains a volatile oil. It is stimulant and aromatic. Dose, two drachms (8 Gm.)
Hyssopus Hyssop	From *H. officinalis*, indigenous to Southern Europe. It contains about ½ per cent of volatile oil, etc.
Lavender	The flowers of *Lavandula vera*. It formerly was official, and contains a volatile oil
Leonurus Motherwort	The herb of *L. cardiaca*, grown in Europe. It contains a volatile oil and a bitter principle
Lycopus Bugleweed	The herb of *L. virginicus*, found in the United States. It contains a volatile oil, resin, etc.
Melissa Balm	The leaves and tops of *Melissa officinalis* Linné

Unofficial Plants of the Labiatæ—*Continued*

Mentha pulegium European Pennyroyal	This plant yields an oil which must not be confounded with the American oil of the same name
Monarda Horsemint	The leaves and tops of *M. punctata*, indigenous to the United States. It contains thymol and a volatile oil, etc.
Rosemary	The leaves of *Rosmarinus officinalis*. It was formerly official, and contains a volatile oil
Salvia Sage	The dried leaves of *Salvia officinalis* Linné (Fam. *Labiatæ*). It contains a terpene, $C_{10}H_{16}$, and an oxygenated portion, *salviol*, $C_{10}H_{18}O$. It is used as a condiment and an *infusion of sage* is used in sore throat. Dose, thirty grains (2 Gm.)

Official Products of the Aromatic Umbelliferæ

The aromatic plants belonging to the family Umbelliferæ are all characterized by the very distinctive properties of the volatile oils obtained by distilling their fruits (sometimes called seeds because of their seed-like appearance) with water. These oils are oxygenated, and are soluble in alcohol. Cumin and dill are unofficial oils which belong to this class.

CARUM. U.S. Caraway

[Caraway Seed, Kümmel, Caraway, Caraway (Seed) Fruit]

Caraway is the dried ripe fruit of *Carum Carvi* Linné (Fam. *Umbelliferæ*).

Caraway contains not more than 3 per cent of other fruits, seeds, or foreign organic matter, and yields not more than 1.5 per cent of acid-insoluble ash.

This fruit, commonly called caraway seed or kümmel, contains about 5 per cent of volatile oil, with a little fixed oil and other constituents.

Description—Oblong, laterally compressed, about 4 or 5 mm. long, usually separated into the two mericarps, which are curved, narrower at both ends, brown, with five yellowish, filiform ribs, and with six oil-tubes. Caraway has an agreeable odor, and a sweetish, spicy taste. For a further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Cardamomi Composita.

Uses—It is used as a carminative and stimulant. Dose, fifteen grains (1 Gm.).

OLEUM CARI. U.S. Oil of Caraway

[Ol. Cari—Caraway Oil]

The volatile oil distilled from the dried ripe fruit of *Carum Carvi* Linné (Fam. *Umbelliferæ*). Oil of Caraway yields not less than 50 per cent by volume of carvone [$C_{10}H_{14}O$ = 150.16].

It consists of two liquid oils of different boiling points and separable by distillation: one a hydrocarbon called *carvene*, $C_{10}H_{16}$, of the specific gravity 0.849 and boiling point 176° C., now recognized as identical with d-limonene, the other the valuable constituent, d-carvone, $C_{10}H_{14}O$, of the sp. gr. 0.9638 and boiling point 224° C. This latter constituent is often extracted from the oil and prepared in a pure state by taking advantage of the formation of a crystalline compound of carvone and hydrogen sulphide, which can then be decomposed by treatment with alcoholic potassium hydroxide.

Sulphides are found in the aqueous distillate which comes over with the oil, as are also several constituents which are ordinarily considered only to accompany destruction distillation products, as methyl alcohol, acetaldehyde, etc.

Description and Physical Properties—A colorless or pale yellow liquid, having the characteristic odor and taste of caraway.

Tests for Identity and Purity—The Oil is soluble in 8 volumes of 80 per cent alcohol, by volume.
Specific gravity: 0.900 to 0.910 at 25° C.
Optical rotation: varies from +70° to +80° in a 100 mm. tube at 25° C., page 1524.
Refractive index: 1.4840 to 1.4880 at 20° C., page 1525.
Oil of Caraway meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Assay—Place 10 cc. of Oil of Caraway, measured from a pipette, in a 100 cc. cassia flask and add 50 cc. of a saturated solution of sodium sulphite, which has been carefully rendered neutral to 2 drops of phenolphthalein T.S. by means of a 5 per cent sodium bisulphite solution. Heat the mixture in a bath containing boiling water, and shake the flask repeatedly, neutralizing the mixture from time to time by the addition of a few drops of the 5 per cent sodium bisulphite solution. When no coloration appears upon the addition of a few more drops of phenolphthalein T.S. and heating for fifteen minutes, cool to room temperature, and, when the liquids have separated completely, add sufficient sodium sulphite solution to raise the lower limit of the oily layer within the graduated portion of the neck. Note the volume of the residual liquid. This measures not more than 5 cc. indicating the presence of not less than 50 per cent by volume of carvone.

This assay is explained on page 1483.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

N. F. Preparations—Elixir Cardamomi Compositum (from Compound Spirit); Mistura Carminativa; Spiritus Cardamomi Compositus.

Uses—It is a valuable aromatic oil, sometimes called *oil of kümmel*, used in making caraway water and formerly in compound spirit of juniper. Dose, one and one-half minims (0.1 cc.).

FŒNICULUM. N. F. Fennel

(U.S.P. IX)

[**Foenic.**—Fennel Seed]

Fennel is the dried, ripe fruit of cultivated varieties of *Fœniculum vulgare* Miller (Fam. *Umbelliferæ*).

Fennel contains not more than 4 per cent of foreign organic matter.

Description—Oblong, nearly cylindrical, slightly curved, from 4 to 8 mm. long, brownish or greenish-brown; readily separable into the two prominent mericarps, each with five light brown, obtuse ribs, four oil-tubes on the back, and two or four oil-tubes upon the flat face; odor and taste aromatic, anise-like.

For further description see the N. F. V.

N. F. Preparations—Infusum Sennæ Compositum; Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Species Laxativæ; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe.

This fruit contains about 5 per cent of an oxygenated volatile oil, with 10 per cent of fixed oil. It is used as a flavor and to modify the action of purgatives. Dose, fifteen grains (1 Gm.).

OLEUM FŒNICULI. U. S. Oil of Fennel

[**Ol. Fœnic.**—Fennel Oil]

The volatile oil distilled from the dried ripe fruit of *Fœniculum vulgare* Miller (Fam. *Umbelliferæ*). If solid material has separated, carefully warm the Oil until completely liquefied and thoroughly mix it before dispensing.

The property of this oil of solidifying at a low temperature is used in the official test to indicate its purity. Oil of fennel consists of *anethol*, $C_{10}H_{12}O$ (a phenol-ether forming a white solid melting at 21° C. (see *Oleum Anisi*), the latter usually in amounts of about 60 per cent, d-pinene, phellandrene, dipentene, *fenchone*, $C_{10}H_{16}O$ (a liquid ketone), chavicol, anisic aldehyde, and anisic acid. Fenchone is the constituent which when present gives the disagreeable bitter taste to many of the commercial oils. Limonene is also at times present as a constituent. There is reason to believe that much of the commercial oil is adulterated with oil from which the anethol or crystalline constituent has been separated; the official solidifying point, not below 3° C., should be required.

Description and Physical Properties—A colorless or pale yellow liquid, having the characteristic odor and taste of fennel.

Tests for Identity and Purity—The Oil is soluble in 8 volumes of 80 per cent alcohol, by volume, and in 1 volume of 90 per cent alcohol, by volume.

Specific gravity: 0.0953 to 0.0973 at 25° C.
Optical rotation: varies from +12° to +24° in a 100 mm. tube at 25° C., page 1524.
Refractive index: 1.5280 to 1.5380 at 20° C., page 1525.
A solution of the recently distilled Oil in 80 per cent alcohol (1 in 8) is neutral to moistened litmus paper.
The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.
The congealing point of Oil of Fennel does not fall below 3° C. when determined by the method described on page 1524.
Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Aqua Fœniculi; Pulvis Glycyrrhizæ Compositus.
N. F. Preparations—Elixir Anisi; Elixir Catariæ et Fœniculi; Fluidglyceratum Cascaræ Sagradæ Aromaticum; Mistura Carminativa; Syrupus Ficorum Compositus; Syrupus Rhamni Catharticus.

Uses—It is used as a stimulant and flavor, and to overcome flatulence and modify the action of purgatives. The dose is one and one-half minims (0.1 cc.).

CORIANDRUM. N. F. Coriander
(U.S.P. IX)

[**Coriand.**—Coriander Seed]

Coriander is the dried ripe fruit of *Coriandrum sativum* Linné (Fam. *Umbelliferæ*). Coriander contains not more than 5 per cent of other fruits, seeds, or other organic matter and yields not more than 1.5 per cent of acid-insoluble ash, not less than 0.5 per cent of volatile ether-soluble extractive.

Description—Globular; about 4 mm. in diameter; crowned with the calyx-teeth and stylepod, brownish-yellow, with slight, longitudinal ridges; the two mericarps cohering, enclosing a lenticular cavity, and each furnished on the face with two oil-tubes; odor and taste agreeably aromatic.
For further description see the N. F. V.

N. F. Preparations—Fluidextractum Stillingiæ Compositum; Infusum Gentianæ Compositum.

Uses—This fruit furnishes an agreeable aromatic oil. The yield is about 1 per cent. It also contains about 10 per cent of fixed oil. The fruit is seldom used alone, but is often combined with other remedies, chiefly as a flavor. It is also used as a condiment and flavor in cooking. Dose, eight grains (0.5 Gm.).

OLEUM CORIANDRI. U. S. Oil of Coriander

[**Ol. Coriand.**—Coriander Oil]

The volatile oil distilled from the dried ripe fruit of *Coriandrum sativum* Linné (Fam. *Umbelliferæ*).

This is an oxygenated oil, consisting chiefly of a compound, *coriandrol*, $C_{10}H_{18}O$, which boils between 194° and 198° C. Coriandrol is now known as dextrogyrate *linaloöl*. Coriander oil also contains about 5 per cent of dextropinene.

Description and Physical Properties—A colorless or pale yellow liquid, having the characteristic odor and taste of coriander.
Tests for Identity and Purity—The Oil is soluble in 3 volumes of 70 per cent alcohol, by volume.
Specific gravity: 0.863 to 0.875 at 25° C.
Optical rotation: varies from +8° to +13° in a 100 mm. tube at 25° C., page 1524.
Refractive index: 1.4630 to 1.4760 at 20° C., page 1525.
Oil of Coriander meets the requirements of the test for *heavy metals in volatile oils*, page 1519.
Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Elixir Aromaticum (from Spirit); Fluidextractum Cascaræ Sagradæ Aromaticum; Spiritus Aurantii Compositus; Syrupus Sennæ.
N. F. Preparation—Confectio Sennæ; a flavor in emulsions.

Uses—It is used as a carminative and corrective in a dose of one and one-half minims (0.1 cc.).

SUMBUL. N. F. Sumbul
(U. S. P. IX)

[Musk-root]

Sumbul is the rhizome and roots of *Ferula Sumbul* (Kauffmann) Hooker filius or of other closely related species of *Ferula* possessing a characteristic musk-like odor (Fam. *Umbelliferæ*).

Sumbul contains not more than 2 per cent of foreign organic matter.

This Asiatic root contains about ½ per cent of volatile oil and about 10 per cent of a resinous compound having a musky odor.

Description—In transverse segments, varying in diameter from about 2 to 7 cm., and in length from 15 to 30 mm.; light, spongy, annulate or longitudinally wrinkled; bark thin, brown, more or less bristly fibrous; the interior whitish, with numerous brownish-yellow resin-dots and irregular, easily separated fibers; odor strong, musk-like; taste bitter and balsamic

For further description see N. F. V.

N. F. Preparations—Extractum Sumbul; Tinctura Sumbul.

Uses—It is used as a nervine, especially in uterine disorders. Dose, 30 grains (2 Gm.).

ANISUM. N. F. Anise
(U. S. P. IX)

[**Anis.**—Aniseed, Anise Seed, European Aniseed]

Anise is the dried ripe fruit of *Pimpinella Anisum* Linné (Fam. *Umbelliferæ*).

Anise contains not more than 3 per cent of other fruit seeds, or foreign organic matter and yields not more than 1.5 per cent of acid-insoluble ash.

Description—About 4 or 5 mm. long, ovate, compressed at the sides, grayish, finely hairy, and consisting of two mericarps, each with a flat face, and five light brownish, filiform ridges, and about fifteen thin oil-tubes, which can be seen in a transverse section by the microscope. It has an agreeable, aromatic odor, and a sweet, spicy taste.

It may be distinguished from conium fruit (which it somewhat resembles, and which has been mistaken for it) by the odor and taste, and by the conium fruit consisting usually of single mericarps, which are smooth, grooved upon the face, and have crenate ridges with wrinkles between them, and no oil-tubes.

For further description see N. F. V.

N. F. Preparations—Species Laxativæ; Species Pectorales; Tinctura Rhei Dulcis.

Uses—The flavor of this drug is very popular and is usually called licorice flavor by the laity because of the frequent association of the two. This fruit contains about 2 per cent of volatile oil and 3 per cent of fixed oil. It is a useful carminative. Dose, eight grains (0.5 Gm.)

OLEUM ANISI. U. S. Oil of Anise. Oil of Star Anise
[**Ol. Anisi**—Anise Oil]

The volatile oil distilled from the dried ripe fruit of *Pimpinella Anisum* Linné (Fam. *Umbelliferæ*) or from the dried ripe fruit of *Illicium verum* Hooker filius (Fam. *Magnoliaceæ*). The botanical source from which the Oil is derived must be stated on the label. If solid material has separated, carefully warm the Oil until completely liquefied, and mix it thoroughly before dispensing.

Oil of Illicium (*Star Anise*) has the same properties as the oil from *Pimpinella Anisum*. It consists of a small quantity of terpene, $C_{10}H_{16}$, but mainly of *anethol*, parapropenylanisol, $C_6H_4C_3H_5OCH_3$ (about 85 per cent), which is present, however, in two isomeric modifications, one solid at ordinary temperatures and heavier than water (*solid anethol*), the other liquid and more volatile (*estragol* or *methyl chavicol*). *Anethol*, both in the liquid and in the solid form, is present, and is the chief constituent of the oils of *anise*, *star anise*, and *fennel*. The solidification test of the U. S. P. is based upon the anethol content. By oxidation, by means of nitric acid, or chromic anhydride, the different forms of anethol yield *anisic acid*, $C_8H_8O_3$. Oil of anise, by exposure to air, is oxidized, with the formation of *anisic aldehyde*, *acetic aldehyde* and *anisic acid*, and becomes less disposed to congeal.

Description and Physical Properties—A colorless or pale yellow, strongly refractive liquid, having the characteristic odor and taste of anise.

Tests for Identity and Purity—The Oil is soluble with not more than a slight cloudiness in 3 volumes of 90 per cent alcohol, by volume.

Specific gravity: 0.978 to 0.988 at 25° C.

Optical rotation: varies from +1° to −2° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.5440 to 1.5600 at 20° C., page 1525.

A solution of the recently distilled Oil in 90 per cent alcohol (1 in 3) is neutral to moistened litmus paper, and develops no blue or brownish color upon the addition of 1 drop of ferric chloride T.S. to 5 cc. of the solution (*phenols*).

The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

The congealing point of Oil of Anise does not fall below 15° C., as determined by the method described on page 1524.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Aqua Anisi; Elixir Aromaticum (from Spirit); Fluidextractum Cascaræ Sagradæ Aromaticum; Spiritus Anisi; Spiritus Aurantii Compositus; Syrupus Sarsaparillæ Compositus; Tinctura Opii Camphorata.

N. F. Preparations—Elixir Phosphori; Syrupus Trifolii Compositus; Tinctura Gambir Composita.

Uses—Oil of Anise is usually shipped in lead vessels and sometimes becomes contaminated with that metal; hence the U. S. P. test for heavy metals in this oil. Oil of anise is given as a carminative in the dose of one and one-half minims (0.1 cc.). It is also a valuable flavoring agent, often associated with licorice.

ANETHOL. N. F. Anethol

The methyl ether of para-propenyl phenol [$C_6H_4.C_3H_5.OCH_3$ = 148.15]. It is the main constituent in the oils of anise, star anise, and fennel, and is usually obtained from these by fractionating, chilling and crystallizing.

Official Description—A colorless or faintly yellow, highly refractive liquid at a temperature of 23° C. or above, having a sweet taste and the aromatic odor of anise. At from 20° to 21° C. it solidifies to a white, glistening, crystalline mass which melts at from 22° to 23° C.

Solubility—Almost insoluble in water; readily soluble in ether or chloroform, and forms a clear solution with two volumes of alcohol.

Specific gravity: 0.984 to 0.986 at 25° C.

Tests for Identity and Purity—Boiling point: 235° to 236° C.

Refractive index: 1.558 to 1.561 at 25° C.

It is optically inactive or shows a deviation of not more than 0.08° in a 100 mm. tube at 25° C. due to slight traces of the oil from which the Anethol has been prepared (if prepared from oil of anise, this deviation will be lævorotatory, if from oil of fennel, dextrorotatory).

Aldehydes—Shake 10 cc. of Anethol with 50 cc. of a saturated aqueous solution of sodium bisulphite in a graduated cylinder and allow the mixture to stand for six hours. No appreciable diminution in the volume of Anethol will be observed nor does a crystalline deposit separate.

Preserve in well-stoppered, amber-colored bottles, protected from light and air.

N. F. Preparations—Elixir Anisi; Elixir Cardamomi Compositum (from Compound Spirit of Cardamom); Pulvis Rhei et Magnesiæ Anisatus; Spiritus Ammoniæ Anisatus; Spiritus Cardamomi Compositus.

Uses—Its uses are similar to those described under Oil of Anise. It is frequently sold as *Synthetic* or *Artificial Oil of Anise*.

Average dose—3 minims (0.2 cc.).

ANGELICÆ FRUCTUS. N. F. Angelica Fruit

[**Angel Fruct.**—Angelica Seed, European Angelica Seed]

Angelica fruit is the dried ripe fruit of *Angelica Archangelica* Linné and of other species of *Angelica* (Fam. *Umbelliferæ*).

Angelica Fruit contains not more than 3 per cent of foreign fruits, seeds or other foreign organic matter.

Description—The fruit is oval, about 3 to 5 mm. long, dorsally compressed, of a brown color, and separates when ripe into 2 mericarps, which are flat upon the face and somewhat convex upon the back, the 3 dorsal ribs filiform and rather sharply keeled, while the 2 lateral ones are extended into a broad light-colored membranous margin; oil-tubes 6; odor and taste strong, resembling those of caraway.

For further description see N. F. V.

N. F. Preparations—Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Tinctura Antiperiodicæ; Tinctura Antiperiodicæ sine Aloe.

Uses—It is used as an aromatic in doses of fifteen grains (1 Gm.).

ANGELICÆ RADIX. N. F. Angelica Root

[**Angel. Rad.**—GARDEN ANGELICA ROOT, ARCHANGEL]

Angelica Root consists of the dried rhizome and roots of *Angelica Archangelica* Linné and of other species of *Angelica* (Fam. *Umbelliferæ*).

Angelica Root contains not more than 5 per cent of its stem bases or other foreign organic matter and yields not more than 4 per cent of acid insoluble ash.

Description—A short, thick root-stock, which is closely annulated above, and below abruptly divided into a large number of nearly simple branches, which are about 6 mm. thick and 15 cm. or more long, longitudinally wrinkled, of a dark brown color externally, yellowish inside, with a spongy, radiated meditullium and numerous shining resin-cells in the thick bark. It has a strong aromatic odor and a sweetish, pungently aromatic and bitter taste, and breaks with a smooth, somewhat waxy fracture. The roots frequently come braided into fanciful forms.

For a further description see N. F. V.

N. F. Preparation—Fluidextractum Angelicæ Radicis.

Uses—It is used as an aromatic and emmenagogue in doses of thirty grains (2 Gm.).

APII FRUCTUS. N. F. Celery Fruit

[**Apii. Fruct.**—CELERY SEED]

Celery Fruit is the dried ripe fruit of *Apium graveolens* Linné (Fam. *Umbelliferæ*).

Description—Celery Fruit contains not more than 5 per cent of unsound or foreign fruit or other foreign organic matter and yields not more than 3 per cent of acid-insoluble ash.

It is about 1 to 1.5 mm. long, roundish-ovate, laterally flattened, brown, with lighter-colored ribs and smooth; the mericarps are usually separate, somewhat curved, flat on the face, and contain about 12 thin oil-tubes; odor and taste agreeably aromatic. The fruit yields 2 or 3 per cent of a colorless volatile oil, having the characteristic odor and taste of the plant, and small quantities of *apiol*.

For further description see N. F. V.

N. F. Preparation—Fluidextractum Apii Fructus.

Uses—Used as a condiment and medicinally as a nerve sedative. The dose is thirty grains (2 Gm.).

Unofficial Volatile Oils and Plants of the Umbelliferæ

Anethum Graveolens Dill	An umbelliferous fruit, indigenous to Southern Europe. The herb is used in flavoring the variety of salt pickles which bear the name "*dill pickles*"
Oleum Anethi Oil of Dill	An oxygenated oil. The yield is about 4 per cent
Carota Carrot Fruit	The fruit of *Daucus Carota*, indigenous to Northern Asia
Oil of Carrot	An oxygenated oil
Cicuta Water Hemlock	The herb of *Cicuta virosa*, found in Northern Canada
Cuminum Cumin	The fruit of *Cuminum Cyminum*, indigenous to Egypt
Oil of Cumin	Consists of several hydrocarbons. The yield is about ¼ per cent
Heracleum Cow Parsnip (Masterwort)	From *Heracleum lanatum*, grown in the United States. It contains a volatile oil, resin, etc.
Levisticum Lovage	The root of *Levisticum officinale*, indigenous to Southern Europe. It contains soft and pungent resins
Phellandrium Water Fennel	The fruit of *Œnanthe Phellandrium*, grown in Europe. It contains about 1½ per cent of volatile oil and resins

Official Products from the Lauraceæ

CINNAMOMUM. U. S. Cinnamon

[**Cinnam.**—CINNAMOMUM SAIGONICUM U. S. P. IX, TRUE CINNAMON, SAIGON CINNAMON, SAIGON CASSIA]

Cinnamon is the dried bark of *Cinnamomum Loureirii* Nees (Fam. *Lauraceæ*).

Cinnamon yields not less than 2 per cent of volatile ether-soluble extractive.

Description—In quills about 15 cm. long, and 10 to 15 mm. in diameter, the bark 2 or 3 mm. thick; outer surface gray or light grayish-brown with whitish patches, more or less wrought from numerous warts and some transverse ridges and fine longitudinal wrinkles; the inner surface cinnamon-brown or dark brown, granular and slightly striate; fracture short, granular, in the outer layer cinnamon-colored, having near the cork numerous whitish striæ forming an almost uninterrupted line; odor fragrant; taste sweet, warmly aromatic, somewhat astringent.

Assay—Proceed as directed under volatile ether-soluble extractive, page 1523.

Preserve in tightly-closed containers.

For a further description see the U. S. P. X.

U. S. P. Preparations—Tinctura Cardamomi Composita; Tinctura Gambir Composita; Tinctura Lavandulæ Composita; Tinctura Rhei Aromatica.

N. F. Preparations—Elixir Taraxaci Composita (from Tincture); Mistura Rhei Alkalina (from Tincture); Pulvis Aromaticus; Pulvis Aromaticus Rubefaciens; Pulvis Cretæ Aromaticus; Syrupus Cinnamomi; Syrupus Sennæ Aromaticus; Tinctura Antiperiodicæ; Tinctura Antiperiodicæ sine Aloe; Tinctura Aromatica; Tinctura Cinnamomi; Tinctura Opii Crocata; Tinctura Viburni Opuli Composita.

Uses—Cinnamon owes its virtue to a volatile oil. There are also present tannin, mannite, mucilage, sugar, etc. The tannin present often causes a fluidextract of cinnamon to gelatinize through its alteration. It is used chiefly as a vehicle, also as a local stimulant and mild astringent in certain types of diarrhea in doses of four grains (0.25 Gm.) and also as a flavor.

OLEUM CINNAMOMI. U. S. Oil of Cinnamom

[**Ol. Cinnam.**—OLEUM CASSIÆ U. S. P. IX]

The volatile oil distilled from the leaves and twigs of *Cinnamomum Cassia* (Linné) Blume (Fam. *Lauraceæ*), rectified by steam distillation. Oil of Cinnamon yields not less than 80 per cent by volume of cinnamic aldehyde [C_9H_8O].

Description and Physical Properties—A yellowish or brownish liquid, becoming darker and thicker by age or exposure to the air, and having the characteristic odor and taste of cassia cinnamon.

Tests for Identity and Purity—The Oil is soluble in an equal volume of alcohol, in 2 volumes of 70 per cent alcohol, by volume, and in an equal volume of glacial acetic acid.

Specific gravity: 1.045 to 1.063 at 25° C.

Optical rotation: varies from +1° to −1° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.6020 to 1.6060 at 20° C., page 1525.

A solution of the recently rectified oil in 70 per cent alcohol (1 in 2) is slightly acid to moistened blue litmus paper.

The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Shake 2 cc. of the Oil in a test tube with from 5 to 10 cc. of purified petroleum benzin, allow the liquids to separate, and decant the benzin layer into another test tube: this liquid is but slightly colored, and does not assume a green color upon shaking with an equal volume of copper acetate solution (1 in 1000) (*rosin or rosin oils*).

Rinse the interior surface of a well-cleaned, 1000 cc. beaker with distilled water, and pass the washings through a small filter until the addition of 1 drop of silver nitrate T.S. to a portion of the filtrate, acidulated with 1 drop of nitric acid, shows no turbidity. Place 3 or 4 drops of the Oil on a clean watch glass supported on a triangle, ignite, and immediately cover with the moistened beaker. Wash the products of combustion from the sides of the beaker through the washed filter with from 10 to 20 cc. of distilled water, and acidulate the filtrate with 1 drop of nitric acid; the addition of 1 drop of silver nitrate T.S. produces no turbidity (*chlorinated products*).

Assay—Proceed as directed under *Oleum Cari*, page 965, using 10 cc. of Oil of Cinnamon, measured from a pipette. The volume of the residual oily layer measures not more than 2 cc., indicating the presence of not less than 80 per cent by volume of cinnamic aldehyde.

For a description of this assay see page 1483.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparations—Acidum Sulphuricum Aromaticum; Aqua Cinnamomi; Fluidextractum Cascaræ Sagradæ Aromaticum; Infusum Digitalis (from Water); Mistura Cretæ (from Water); Spiritus Cinnamomi; Syrupus Rhei (from Spirit).

N. F. Preparations—Acetum Aromaticum; Dentifricium; Elixir Cardamomi Compositum (from Compound Spirit); Elixir Vanillini Compositum (from Compound Spirit); Fluidglyceratum Cascaræ Sagradæ Aromaticum; Lavatio Ori; Liquor Pepsini Aromaticus; Mistura Oleo-Balsamica; Nebula Aromatica; Nebula Mentholis Composita; Odontalgicum Oleum Ricini Aromaticum; Spiritus Cardamomi Compositus; Spiritus Vanillini Compositus; Syrupus Ipecacuanhæ et Opii (from Spirit); Syrupus Rhamni Catharticæ.

There are two oils of cinnamon in commerce: one procured from the Ceylon cinnamon, the other from the Chinese cinnamon. The latter (*oil of cassia*) is now the only official one. The Chinese cinnamon is much the cheaper and more abundant of the two and will probably continue to be generally employed, notwithstanding the fact that the Ceylon product has the finer flavor. The value of cassia oil depends upon the percentage of cinnamic aldehyde which it contains. Cinnamyl acetate and cinnamic acid are also present, as well as small amounts of phenyl propyl acetate and orthocumaric aldehyde. In the oil of Ceylon cinnamon, cinnamic aldehyde is the chief constituent, but eugenol is present to the extent of over 5 per cent, and phellandrene has also been reported. Cinnamon leaf oil contains much eugenol and very little cinnamic aldehyde, safrol and benzaldehyde being present as minor constituents. Moderate oxidation of the oil yields the corresponding cinnamic acid, $C_9H_8O_2$, but by more energetic oxidation yields benzoic acid, $C_7H_6O_2$.

Oil of Ceylon cinnamon has a slightly acid reaction. Specific gravity between 1.024 and 1.040. It is readily soluble in alcohol, and contains between 65 and 75 per cent of cinnamic aldehyde and from 4 to 8 per cent of eugenol. When cooled to $-10°$ C. it remains clear, but at a lower temperature a solid portion separates from it. *Oil of Chinese cinnamon* (oil of cassia) has similar properties, the marked difference being that its specific gravity is between 1.045 and 1.063, the aldehyde content being 80 per cent or above, and that it contains no eugenol. The odor and taste are not quite so agreeable as that of the Ceylon variety.

Oil of Ceylon cinnamon when not very fresh contains cinnamic acid in sufficient quantity to give a permanent cloudiness to cinnamon water made from it. Dose, one minim (0.05 cc.).

Cinnamic Aldehyde (C_9H_8O), known as *Synthetic Oil of Cassia*, was official in the U. S. P. VIII, but has not been admitted to subsequent revisions. It was described as an aldehyde obtained from Oil of Cinnamon or prepared synthetically, containing not less than 95 per cent of pure cinnamic aldehyde [$C_6H_5.CH:CH.COH$]. It is nearly identical with the oil distilled from Cassia Cinnamon, and should be kept in small, amber-colored, well-stoppered bottles. This liquid is found in both oil of cassia and oil of Ceylon cinnamon, and can be separated by treatment with solution of sodium sulphite. It may also be made synthetically by saturating a mixture of acetaldehyde and benzaldehyde with hydrochloric acid gas. It is a colorless liquid. Optically inactive, with a cinnamon-like odor and a burning, aromatic taste. The specific gravity is about 1.047 at 25° C. Sparingly soluble in water, miscible in all proportions with alcohol, ether and fixed and volatile oils. It boils at about 250° C. with partial decomposition. Cinnamic aldehyde should partially solidify when the temperature is reduced by a freezing mixture of ice and salt, and should melt again at $-7.5°$C. If the looped end of a piece of clean copper wire be held in a non-luminous flame until it glows, then cooled, and the loop dipped into cinnamic aldehyde, ignited, and held so that the liquid burns outside of the flame, then if the loop be slowly brought in contact with the lower outer edge of the flame, no green tinge should be discernible (*chlorinated products*). It may be assayed as directed under oil of cinnamon. Cinnamic aldehyde is often used to replace oil of cassia as a flavor.

Uses—Oil of cinnamon is used as a flavor and to modify the action of griping or drastic drugs. Also used in flatulent colic. Dose, one to three minims (0.06 to 0.2 cc.). Like oil of anise this oil is usually shipped in lead vessels from China and a test for heavy metals is therefore necessary.

Official Products from the Myrtaceæ

CARYOPHYLLUS. U. S. Clove

[Caryoph.—Cloves]

Clove is the dried flower-buds of *Caryophyllus aromaticus* Linné (Fam. *Myrtaceæ*).

Clove contains not more than 5 per cent of its stems and not more than 1 per cent of other foreign organic matter, and yields not less than 15 per cent of volatile ether-soluble extractive, not more than 10 per cent of crude fiber, and not more than 0.75 per cent of acid-insoluble ash.

Description—About 15 mm. long, dark brown, consisting of a subcylindrical solid and glandular calyx-tube, terminated by four teeth, and surmounted by a globular head, formed by four petals, which cover numerous curved stamens, and one style. Clove emits oil, when scratched, and has a strong, aromatic odor, and a pungent, spicy taste.

Assay—Proceed as directed under volatile ether-soluble extractive, page 1523.

For further description see the U. S. P. X.

U. S. P. Preparations—Tinctura Lavandulæ Composita; Tinctura Rhei Aromatica.

N. F. Preparations—Pulvis Aromaticus Rubefaciens; Pulvis Cretæ Aromaticus; Pulvis Myrciæ Compositus; Syrupus Sennæ Aromaticus; Tinctura Aromatica; Tinctura Opii Crocata; Tinctura Viburni Opuli Composita.

Clove contains about 16 per cent of volatile oil, 10 per cent of tannin, *Caryophyllin*, $C_{10}H_{16}O$, a crystalline principle, and *eugenin*, $C_{10}H_{12}O_2$, also crystalline.

Uses—It is used as an aromatic in doses of four grains (0.25 Gm.).

OLEUM CARYOPHYLLI. U. S. Oil of Clove

[Ol. Caryoph.—Clove Oil, Oil of Cloves]

The volatile oil distilled from the dried flower-buds of *Caryophyllus aromaticus* Linné (Fam. *Myrtaceæ*). Oil of Clove yields not less than 82 per cent by volume of eugenol [$C_{10}H_{12}O_2 = 164.15$].

Oil of clove, when recently distilled, is a thin fluid, clear, and colorless, but becomes yellowish by exposure, and ultimately reddish-brown. Oil of clove contains small amounts of vanillin, methyl alcohol, and furfurol, but is mainly composed of an unsaturated phenol termed eugenol, which is now an official product, and its acetic derivative (see *Eugenol*), and a sesquiterpene, *caryophyllene*. Eugenol acetyl salicylate has also been reported. The U. S. P. contains an assay process for the eugenol content. *Eugenol* has been shown to be the methyl ether of allyldioxybenzene,

$$C_6H_3\begin{cases} C_3H_5 \\ OCH_3 \\ OH \end{cases}$$

. One of its most important reactions is its conversion into *vanillin*. For this purpose it is boiled with acetic anhydride, whereby *aceteugenol* is formed, which, oxidized in weak acid solution by potassium permanganate, yields *acetvanillic acid*, and this with weak potassium hydroxide solution is changed into vanillin, which is then extracted by acidifying and shaking up with ether. The characteristic aromatic odor of oil of clove is due to *methylamylketone*, $CH_3.CO.C_5H_{11}$, which has been found to be present only in minute quantity. The proportion of eugenol in oil of clove is regarded as an index of the quality of the oil (see official assay below).

Description and Physical Properties—A colorless or pale yellow liquid, becoming darker and thicker by age or exposure to the air, and having the characteristic odor and taste of clove.

Tests for Identity and Purity—The Oil is soluble in 2 volumes of 70 per cent alcohol, by volume.
Specific gravity: 1.038 to 1.060 at 25° C.
Optical rotation: does not exceed −1° 10′ in a 100 mm. tube at 25° C., page 1524.
Refractive index: 1.5300 to 1.5350 at 20° C., page 1525.
The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.
A solution of the recently distilled Oil in 70 per cent alcohol (1 in 2) is slightly acid to moistened blue litmus paper.
Shake 1 cc. of the Oil with 20 cc. of hot distilled water; the water shows not more than a scarcely perceptible acid reaction with blue litmus paper. Cool the mixture and pass the aqueous layer through a wetted filter: the clear filtrate, with 1 drop of ferric chloride T.S., yields only a transient, grayish-green color, but not a blue or violet color (*phenol*).
Assay—Place 10 cc. of Oil of Clove, measured from a pipette, in a 100 cc. cassia flask, add 50 cc. of potassium hydroxide T.S., shake the mixture for five minutes, and heat it for ten minutes in a bath containing boiling water. Remove it from the bath, and cool to room temperature. When the liquids have separated completely, add sufficient potassium hydroxide T.S. to raise the lower limit of the oily layer within the graduated portion of the neck, and note the volume of the residual liquid. This measures not more than 1.8 cc., indicating the presence of not less than 82 per cent by volume of eugenol.
This assay is explained on page 1483.
Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

N. F. Preparations—Acetum Aromaticum; Dentifricium; Elixir Cardamomi Compositum (from Compound Spirit); Fluidglyceratum Cascaræ Sagradæ Aromaticum; Lavatio Ori; Liquor Pepsini Aromaticus; Nebula Aromatica; Oleum Ricini Aromaticum; Spiritus Cardamomi Compositus; Syrupus Eriodictyi Aromaticus.

Uses—Oil of clove is a powerful germicide but is too irritant for most purposes. It is largely used as a remedy for toothache. It produces relief if the pain is caused by an exposed dentine, and may be used by applying a little upon cotton to the affected tooth. Dose, one and one-half minims (0.1 cc.).

EUGENOL. U. S. Eugenol

[Synthetic Oil of Cloves]

A phenol [$C_6H_3.C_3H_5.OCH_3.OH$ 1:3:4 = 164.15] obtained from clove and other sources.

Preparation—Eugenol is found in the volatile oils from clove, pimenta, bay leaves, Ceylon cinnamon, camphor, sassafras, massoy bark, canella, culilawan and others. It is principally obtained, however, from oil of clove. It may be made by treating oil of clove with an excess of solution of sodium hydroxide and shaking the mixture with ether to remove terpenes. The aqueous solution of sodium eugenol is decomposed by hydrochloric acid, and the eugenol purified by repeated washing.

Description and Physical Properties—A colorless or pale yellow, thin liquid, having a strongly aromatic odor of clove and a pungent, spicy taste. Exposure to air causes it to become darker and thicker.
Eugenol is slightly soluble in water, but is miscible with alcohol, chloroform, ether, and with fixed oils. It is soluble in twice its volume of 70 per cent alcohol.
Specific gravity: 1.064 to 1.070 at 25° C.
Tests for Identity and Purity—Eugenol boils between 250° and 255° C.
It is optically inactive and strongly refractive.
A mixture of 1 cc. of Eugenol and 20 cc. of hot distilled water is only very slightly acid to litmus paper.
Dissolve 1 cc. of Eugenol in 12 cc. of sodium hydroxide T.S., and add 18 cc. of distilled water: a clear solution results which becomes turbid when exposed to air (*hydrocarbons*).
Shake 1 cc. of Eugenol with 20 cc. of distilled water, filter, and add 1 drop of ferric chloride T.S. to 5 cc. of the clear filtrate; a transient grayish-green color, but not a blue or violet color, is produced (*phenol*).
Preserve in well-stoppered containers, in a cool place, protected from light.

N. F. Preparation—Mistura Oleo-Balsamica.

Uses—Eugenol is used extensively to replace oil of clove. It is also used by dentists, for its disinfectant action. in filling root canals. The dose is one and one-half minims (0.1 cc.).

OLEUM MYRCIÆ. N. F. Oil of Myrcia

[Ol. Myrc.—Oil of Bay]

A volatile oil distilled from the leaves of *Pimenta acris* (Swartz) Kostel (Fam. *Myrtaceæ*).

Official Description—A yellow or brownish-yellow liquid.

Odor, Taste and Reaction—A pleasant, aromatic odor and a pungent, spicy taste. An alcoholic solution is slightly acid to litmus paper.

Solubility—With an equal volume of alcohol, glacial acetic acid, or carbon disulphide, it yields slightly turbid solutions.

Specific gravity: 0.962 to 0.990 at 25° C.

Tests for Identity and Purity—It is lævorotatory, the angle of rotation not exceeding −3°, in a 100 mm. tube, at 25° C.

When mixed with an equal volume of a concentrated solution of sodium hydroxide, it forms a semi-solid mass.

Dissolve 2 drops of the Oil in 4 cc. of alcohol, and add a drop of ferric chloride T.S.: a light green color is produced. If the same test is made with a drop of dilute ferric chloride T.S., prepared by diluting the test solution with four times its volume of distilled water, a light bluish coloration is produced, which soon disappears.

Shake 1 cc. of the Oil with 20 cc. of hot distilled water and filter: the filtered aqueous solution does not give more than a scarcely perceptible acid reaction with litmus paper and on adding a drop of ferric chloride T.S. it yields only a transient, grayish-green but not a blue or violet color (*phenol*).

Preserve in small, well-stoppered, amber-colored bottles, in a cool place, protected from light.

N. F. Preparation—Spiritus Myrciæ Compositus.

Uses—A perfume, used chiefly in the preparation of *Bay Rum*. (See page 313.)

PIMENTA. N. F. Pimenta

[Piment.—Allspice]

Pimenta is the dried, nearly ripe fruit of *Pimenta officinalis* Lindley (Fam. *Myrtaceæ*).

Pimenta contains not more than 3 per cent of foreign organic matter and not more than 0.4 per cent of acid-insoluble ash.

Description—About 5 mm. in diameter, nearly globular, crowned with the short, four-parted calyx or its remnants, and a short style; brownish or brownish-gray, granular and glandular, two-celled; each cell containing one brown, plano-convex, roundish-reniform seed; odor and taste pungently aromatic, clove-like.

For further description see N. F. V.

N. F. Preparation—Tinctura Guaiaci Composita.

Uses—This aromatic fruit contains about 3 per cent of volatile oil, with tannin, fat, resin, gum, sugar, etc. It is used chiefly in medicine as an adjuvant to tonics and purgatives. The dose is fifteen grains (1 Gm.).

OLEUM PIMENTÆ. N. F. Oil of Pimenta

(U. S. P. IX)

[Ol. Piment.—Pimento Oil, Oil of Allspice]

A volatile oil distilled from the fruit of *Pimenta officinalis* Lindley (Fam. *Myrtaceæ*), yielding not less than 65 per cent, by volume, of eugenol [$C_{10}H_{12}O_2$ = 164.15].

Official Description—A colorless, yellow or reddish liquid, becoming darker with age.

Odor and Taste—Characteristic odor and taste of allspice.

Solubility—Soluble in an equal volume of 90 per cent alcohol; also soluble in 2 volumes of 70 per cent alcohol.

Specific gravity: 1.018 to 1.048 at 25° C.

Tests for Identity and Purity—The optical rotation varies from 0° to −4° in a 100 mm. tube at 25° C.

Assay—Introduce 10 cc. of the oil into a flask with a long graduated neck (cassia flask), add 50 cc. of potassium hydroxide T.S., shake the mixture for five minutes, and then heat it on a water bath during ten minutes, cool, and when the liquids have separated completely add sufficient potassium hydroxide T.S. to raise the lower limit of the oily layer within the graduated portion of the neck, and note the volume of the residual liquid. The residual liquid measures not more than 3.5 cc. indicating the presence of not less than 65 per cent by volume, of eugenol.

An explanation of this assay will be found on page 1483.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

N. F. Preparations—Liquor Pepsini Aromaticus; Spiritus Myrciæ Compositus.

Uses—The oil is used as a stimulant and carminative in doses of three minims (0.2 cc.).

VANILLA. N. F. Vanilla

[Vanill.—Vanilla Bean]

Vanilla is the cured, full-grown, unripe fruit of *Vanilla planifolia* Andrews (Fam. *Orchidaceæ*).

This valuable drug contains a trace of a volatile oil, 10 per cent of fixed oil, resin, sugar, etc., and *vanillin*. $C_8H_8O_3$, which is the aldehyde of methylprotocatechuic acid, and is now official (see page 977).

The agrecable odor and taste of " vanilla bean " is due to a fermentation occurring during the curing process; the fruit when first plucked from the plant has little odor or taste.

Description—From 15 to 35 cm. long, and about 8 mm. thick, linear, narrowed and bent or hooked at the base, rather oblique at the apex, wrinkled, somewhat warty, dark brown, glossy-leathery, one-celled, and containing a blackish-brown pulp, with numerous, minute seeds, and more or less acicular crystals; odor and taste peculiar, fragrant.

For further description see N. F. V.

N. F. Preparations—Elixir Ammonii Valeratis (from Tincture); Syrupus Bromidorum; Tinctura Vanillæ.

Uses—It is used as a flavor.

Flavoring Extracts—A brief review of the legal requirements for other flavoring extracts will be found in a footnote[1].

---

[1] **Flavoring Extracts**

Flavoring Extracts—By tradition, training, and experience the pharmacist is peculiarly well fitted to manufacture and dispense flavoring extracts. Before the passage of the Food and Drugs Act the flavoring extracts obtainable at the average pharmacy were far superior to similar products procurable at the average grocery. That this condition is no longer true is no reflection upon the quality of the extracts made by the pharmacist, but is an evidence of the effectiveness of legislation in improving the quality of commercial products made upon a large scale. Substandard or adulterated flavoring extracts are now rarely reported in the lists of products upon which prosecutions are based for violation of food laws.

According to the definition given by the U. S. Department of Agriculture in Circular 136, entitled *Standards of Purity for Food Products, a Flavoring Extract is a solution in ethyl alcohol of proper strength, of the sapid and odorous principles derived from an aromatic plant or parts of the plant, with or without its coloring matter, and conforms in name to the plant used in its preparation.*

The strengths of flavoring extracts as established in this list of standards are given below:

The volatile oil extracts, made by dissolving the proper amount of the volatile oil in alcohol of appropriate concentration, are of the following strengths:

Almond	1 per cent of oil of almond, free from hydrocyanic acid	Peppermint	3 per cent of oil of peppermint
Anise	3 per cent of oil of anise	Rose	0.4 per cent of oil of rose
Celery	0.3 per cent of oil of celery	Savory	0.35 per cent of oil of savory
Cassia	2 per cent of oil of cassia	Spearmint	3 per cent of oil of spearmint
Cinnamon	2 per cent of oil of cinnamon	Star Anise	3 per cent of oil of star anise
Clove	2 per cent of oil of clove	Sweet Basil	0.1 per cent of oil of sweet basil
Lemon	5 per cent of oil of lemon	Sweet Marjoram	1 per cent of oil of sweet marjoram
Lemon (terpeneless)	0.2 per cent of terpeneless oil of lemon	Thyme	0.2 per cent of oil of thyme
Nutmeg	2 per cent of oil of nutmeg	Wintergreen	3 per cent of oil of wintergreen
Orange	5 per cent of oil of orange		
Orange (terpeneless)	0.2 per cent of terpeneless oil or orange		

The extracts made directly from the plant materials are as follows:

Ginger	Must contain in each 100 cc. the alcohol soluble matters from not less than 20 Gm. of ginger
Tonka	Prepared from tonka bean, with or without sugar or glycerin, and containing not less than 0.1 per cent of coumarin, together with the soluble constituents of the tonka bean
Vanilla	Prepared from vanilla bean, with or without sugar or glycerin, and containing in 100 cc. the soluble matters from not less than 10 Gm. of vanilla bean.

The standards quoted above for ginger and vanilla extracts are in conformity with the standards for Tincture of Ginger U. S. P. and Tincture of Vanilla N. F., respectively. A ruling of the Federal Prohibition Director makes the sale of U. S. P. Tincture of Ginger illegal except upon prescription; double strength tincture was for a time permitted to be sold under this regulation. This is complicated in some states by the fact that no preparation of ginger may legally be sold unless it be of U. S. P. strength. In Pennsylvania no Tincture of Ginger sales whatever are legal, as this is one of the states in which such legislation has been passed.

In labeling flavoring extracts care must be taken to avoid such descriptive terms as " concentrated," " double strength," etc., unless they are actually true. Extracts which are not of full standard strength must be labeled correctly as " half strength " or whatever they happen to be. Extracts which are not made from the genuine flavoring materials in any particular case must be labeled " imitation " or " substitute". A vanilla extract which contains added vanillin, tonka, or coumarin, may not be labeled " vanilla compound, but must be labeled, " imitation vanilla " or " vanilla substitute". Any other method of labeling is in violation of the law and subjects the seller to the risk of prosecution.

VANILLINUM. U.S. Vanillin

[Vanillin.—Vanilla Crystals]

Methylprotocatechuic aldehyde [$C_6H_3.CHO.OCH_3.OH$ 1:3:4 = 152.10].

Preparation—Vanillin may be obtained from vanilla, which contains from 2 to 3 per cent. It is also found in many substances, and in the tissues of certain plants, in crude beet sugar, asparagus, and even in asafetida. The vanillin of commerce is made artificially, and, while chemically identical with the product obtained from the "vanilla bean", owing to the fact that the vanilla contains other odorous products, "flavoring preparations", made from vanillin, never equal in flavor the preparation in which vanilla alone is used. Vanillin is made synthetically by oxidizing either coniferin or eugenol, by treating guaiacol with chloroform in the presence of an alkali, and by other methods. It is frequently adulterated. Some of the substances which have been detected are acetanilid, boric acid, benzoic acid, sugar, and coumarin.

Description and Physical Properties—Fine, white, or only very slightly yellowish, needle-like crystals, having an odor and taste resembling vanilla.

One Gm. of Vanillin is soluble in 100 cc. of water and in about 20 cc. of glycerin, at 25° C. One Gm. is soluble in 16 cc. of water at 80° C. It is freely soluble in alcohol, chloroform, and ether.

Tests for Identity and Purity—Vanillin is easily dissolved by aqueous solutions of alkali hydroxides, and from these solutions, when not too dilute, it is precipitated at once by the addition of acids.

Vanillin melts between 80° and 82° C.

Its aqueous solution is acid to litmus paper and is optically inactive.

A saturated aqueous solution of Vanillin gives a blue color with ferric chloride T.S. On boiling the mixture, the blue color changes to brown, and on cooling, a white, or nearly white precipitate of dihydrodivanillin separates.

Vanillin is extracted completely from its solution in ether by shaking with a saturated, aqueous solution of sodium bisulphite, from which it is precipitated by the addition of sulphuric acid.

A cold aqueous solution of Vanillin gives with lead acetate T.S. a white precipitate of a lead compound of vanillin, which is soluble in hot water.

Ash: not more than 0.5 per cent.

Warm 0.1 Gm. of Vanillin with a concentrated alcoholic solution of sodium hydroxide, add a drop of chloroform, and again warm; the odor of phenylisocyanide is not perceptible (*acetanilid*).

Preserve in well-closed containers, protected from light.

N. F. Preparations—Elixir Amygdalæ Compositum; Elixir Vanillini Compositum (from Compound Spirit); Liquor Ferri Peptonati; Liquor Ferri Peptonati et Mangani; Oleum Ricini Aromaticum; Spiritus Vanillini Compositus; Tabellæ Santonini; Tabellæ Santonini Compositæ.

Uses—Vanillin is used as a flavoring agent. Dose of one-half to one grain (0.03 to 0.65 Gm.).

COUMARINUM. N. F. Coumarin

[Coumar.—Cumarin]

The anhydride of ortho-oxycinnamic acid [$C_6H_4(CH)_2OCO$ = 146.09], occurring naturally in tonka, melilot, and other plants, or prepared synthetically.

Official Description—In colorless, prismatic crystals.

Odor and Taste—Characteristic, fragrant odor and a bitter, aromatic and burning taste.

Solubility—Sparingly soluble in cold water, more readily soluble in hot water, freely soluble in alcohol, ether, or chloroform; also soluble in fixed or volatile oils.

Tests for Identity and Purity—When heated to between 67° and 68° C. it melts, and at about 100° C. commences to sublime; at from 290° to 291° C. it boils without decomposition.

Coumarin dissolves in solution of sodium or potassium hydroxide, producing a yellow color and forming sodium or potassium coumarate, from which carbon dioxide precipitates the Coumarin. Coumarin is precipitated in colorless needles on the addition of hydrochloric acid to its hot concentrated sodium or potassium hydroxide solution.

A saturated aqueous solution of Coumarin forms a precipitate upon the addition of iodine T.S. The precipitate is at first brown and flocculent and afterwards on shaking, clots together, forming a dark green curdy mass and leaving the liquid clear (distinction from *vanillin*).

Coumarin is not extracted from its solution in ether by ammonia water (distinction from *vanillin*).

Acetanilid—Warm 0.1 Gm. of Coumarin with 1 cc. of an alcoholic solution of sodium hydroxide (1 in 4), add a few drops of chloroform, and again warm; the mixture does not possess the disagreeable odor of phenylisocyanide.

N. F. Preparation—Oleum Ricini Aromaticum.

Uses—As a flavor, fixative, and perfume, having the odor known as *new-mown hay.*

OLEUM CAJUPUTI. U. S. Oil of Cajuput

[**Ol. Cajup.**—Cajuput Oil, Oil of Cajeput]

The volatile oil distilled from the fresh leaves and twigs of several varieties of *Melaleuca Leucadendron* Linné, especially the var. *Cajeputi* (Roxburgh) Niedenzu and the var. *minor* (Smith) Duthie (Fam. *Myrtaceæ*), rectified by steam distillation.

This aromatic oil has a penetrating odor, analogous to that of cardamom, and a warm, pungent taste. Its chief constituent has the formula $C_{10}H_{18}O$, and by repeated distillation over phosphoric oxide the hydrocarbon, $C_{10}H_{16}$, called *cajuputene*, can be obtained. The oil is, therefore, said to contain *cajuputene hydrate*, or *cajuputol*. The identity of cajuputol with *cineol* and *eucalyptol* from *Eucalyptus Globulus* in both chemical and physical properties has been established. It boils at 175° C. A second constituent of the formula, $C_{10}H_{18}O$, is the solid *terpineol*, which is present both in the free state and as acetic ester. A small amount of *l-pinene* and traces of aldehydes have been found, including *valeraldehyde* and *benzaldehyde*. When oil of cajuput is distilled, a light, colorless liquid first comes over, and afterwards a green and denser one. The green color has been ascribed to a salt of copper derived from the vessels in which the distillation is performed, and various investigators have found traces of copper present in it. Others, again, have carefully tested the green oil and proved its absence. A fair inference is that the oil of cajuput is naturally green, but as found in commerce it sometimes contains copper, either accidentally present, or added with a view of imitating or maintaining the fine color of the oil.

Description and Physical Properties—A colorless or yellowish liquid, having a peculiar, agreeable, distinctly camphoraceous odor, and an aromatic, slightly bitter taste.

Tests for Identity and Purity—The Oil is soluble in 1 volume of 80 per cent alcohol.

Specific gravity: 0.912 to 0.925 at 25° C.

Optical rotation: does not exceed −4° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4660 to 1.4710 at 20° C., page 1525.

Oil of Cajuput meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Uses—Oil of cajuput is used chiefly as a local application in skin diseases. Sometimes it is employed in place of oil of eucalyptus as a stimulating expectorant, and is given in doses of eight minims (0.5 cc.).

EUCALYPTUS. U. S. Eucalyptus

[**Eucalypt.**—Blue Gum Leaves, Eucalyptus Leaves, Gum Wood, Blue Gum Tree, Fever Tree, Woody But.]

Eucalyptus is the dried, scythe-shaped leaf of *Eucalyptus Globulus* Labillardière (Fam. *Myrtaceæ*).

Eucalyptus contains not more than 3 per cent of stems, fruits, or other foreign organic matter.

Description—Petiolate, lanceolately scythe-shaped, from 15 to 30 cm. long, rounded below, tapering above, entire, leathery, grayish-green, glandular, feather-veined between the midrib and marginal veins; odor strongly camphoraceous; taste pungently aromatic and somewhat cooling, bitter, and astringent.

For further description see the U. S. P. X.

U. S. P. Preparation—Fluidextractum Eucalypti.

The virtues of eucalyptus leaves depend upon a volatile oil which should contain about 70 per cent of eucalyptol. There are also present resin, tannin, chlorophyl, fatty acid, etc.

Uses—The leaves are rarely used. Their virtues are the same as those of oil of eucalyptus. Dose, thirty grains (2 Gm.).

OLEUM EUCALYPTI. U. S. Oil of Eucalyptus

[**Ol. Eucalypt.**—Eucalyptus Oil]

The volatile oil distilled from the fresh leaves of *Eucalyptus Globulus* Labillardière, and from some other species of *Eucalyptus* (Fam. *Myrtaceæ*). Oil of Eucalyptus yields not less than 70 per cent of eucalyptol (cineol) [$C_{10}H_{18}O$].

The oil from *eucalyptus globulus* contains *pinene*, $C_{10}H_{16}$, and *eucalyptol* (or *cineol*), $C_{10}H_{18}O$, also several of the aldehydes of the fatty series, notably *valeraldehyde*, and probably *butyraldehyde* and *capronaldehyde*. The most valuable portion of the oil consists of *eucalyptol*, which is very soluble in alcohol. The proportion of eucalyptol is recognized as a useful test for the quality of the oil (see official assay below).

Description and Physical Properties—A colorless or pale yellow liquid, having a characteristic, aromatic, somewhat camphoraceous odor, and a pungent, spicy, cooling taste.

Tests for Identity and Purity—The Oil is soluble in 4 volumes of 70 per cent alcohol, by volume.

Specific gravity: 0.905 to 0.925 at 25° C.

Optical rotation: varies from −10° to +10° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4600 to 1.4690 at 20° C., page 1525.

A solution of the recently distilled Oil in 70 per cent alcohol (1 in 4) is neutral to moistened litmus paper.

Mix 2 cc. of Oil of Eucalyptus with 4 cc. of glacial acetic acid, and gradually add 3 cc. of a 20 per cent aqueous solution of sodium nitrite. When the mixture is gently stirred with a glass rod, crystals of phellandrene nitrite do not form (*eucalyptus oils containing large amounts of phellandrene*).

The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Assay—The congealing point of Oil of Eucalyptus does not fall below −15.4° C., as determined by the method described on page 1524.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Uses—Oil of eucalyptus is used as an expectorant in chronic bronchitis in doses of eight minims (0.5 cc.). Eucalyptol is preferred by some to oil of eucalyptus (see below).

EUCALYPTOL. U. S. Eucalyptol

[Cineol, Cajeputol]

A substance [$C_{10}H_{18}O = 154.19$] obtained from oil of eucalyptus and from other sources.

Preparation—Eucalyptol may be obtained from many volatile oils, and for that reason chemists prefer to call it *cineol*. It may be separated from the purified volatile oils by taking advantage of its property of forming crystals when subjected to a low temperature (−1° C.; 30.2° F.).

Description and Physical Properties—A colorless liquid, having a characteristic, aromatic, distinctly camphoraceous odor, and a pungent, spicy taste.

Eucalyptol is very slightly soluble in water. It is miscible with alcohol, chloroform, ether, glacial acetic acid, and with fixed or volatile oils.

Specific gravity: 0.921 to 0.923 at 25° C.

Tests for Identity—It boils between 174° and 177° C.

Congealing point: not below 0° C., page 1524.

Place 1 cc. of Eucalyptol in a freezing mixture, and gradually add an equal volume of phosphoric acid: a solid, white, crystalline mass of eucalyptol-phosphoric acid forms, and upon the addition of warm water, the Eucalyptol separates.

Tests for Purity—Its alcoholic solution (1 in 10) is neutral to moistened litmus paper.

Eucalyptol is optically inactive (*difference from oil of eucalyptus and many other volatile oils*).

Shake 5 cc. of Eucalyptol with 5 cc. of sodium hydroxide T.S.: the volume of the Eucalyptol is not diminished (*phenols, etc*).

Shake 1 cc. of Eucalyptol with 20 cc. of distilled water, and allow the liquids to separate. To 10 cc. of the aqueous layer, separated from the Eucalyptol, add 1 drop of ferric chloride T.S.: no violet color is produced (*phenols*).

U. S. P. Preparation—Fluidextractum Eucalypti.

N. F. Preparations—Liquor Antisepticus; Liquor Aromaticus Alkalinus; Liquor Pepsini Antisepticus; Nebula Aromatica; Nebula Eucalyptolis; Nebula Mentholis Composita; Petroxolinum Eucalyptolis; Petroxolinum Sulphuratum Compositum; Pulvis Antisepticus.

Uses—Eucalyptol is used internally as a stimulating expectorant. Locally it is employed for its antiseptic effect in inflammations of the nose and throat and in certain skin diseases. It is sometimes used also by inhalation in bronchitis. Dose, five minims (0.3 cc.).

Official Products from the Myristicaceæ

MYRISTICA. U. S. Myristica

[**Myrist.**—Nutmeg]

Myristica is the dried ripe seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceæ*), deprived of its seed coat and with or without a thin coating of lime.

Myristica yields not less than 25 per cent of non-volatile, ether-soluble extractive and not more than 0.5 per cent of acid-insoluble ash.

Description—Oval or roundish-ovate, about 25 mm. long, light brown, reticulately furrowed, with a circular scar on the broad end; internally pale brownish, with dark orange-brown veins, and of a fatty luster; odor strongly aromatic; taste aromatic, warm, and somewhat bitter. (For further description and tests see U. S. P. X.)

Assay—Proceed as directed under non-volatile ether-soluble extractive, page 1523.

For further description see the U. S. P. X.

U. S. P. Preparations—Tinctura Lavandulæ Composita; Tinctura Rhei Composita.

N. F. Preparations—Pulvis Aromaticus; Pulvis Cretæ Compositus; Syrupus Sennæ Aromaticus.

Uses—This valuable spice owes its activity to the presence of an oxygenated volatile oil. Nutmeg contains about 25 per cent of fixed oil, with proteins, starch, etc. It is used as a stimulating aromatic and as a flavor. Dose, eight grains (0.5 Gm.).

OLEUM MYRISTICÆ. U. S. Oil of Myristica

[**Ol. Myrist.**—Myristica Oil, Oil of Nutmeg]

The volatile oil distilled from the dried kernels of the ripe seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceæ*).

This oil consists chiefly of pinene, with probably some dipentene, also *myristicol*, $C_{10}H_{16}O$, and *myristicin*, $C_{11}H_{12}O$, linaloöl, borneol, terpineol, geraniol, eugenol, and a number of organic acids.

Expressed oil of nutmeg, or *oil of mace*, is made by expressing nutmegs between hot plates, or macerating them in carbon disulphide, and distilling the liquid to get rid of the solvent. It has been reported as containing the glyceride of myristic acid, $C_{14}H_{28}O_2$. It contains both fixed and volatile oil and is said to contain a toxic principle.

Description and Physical Properties—A colorless, or pale yellow liquid, having the characteristic odor and taste of nutmeg.

Tests for Identity and Purity—The Oil is soluble in an equal volume of alcohol and in 3 volumes of 90 per cent alcohol, by volume.

Specific gravity: 0.859 to 0.924 at 25° C.

Optical rotation: varies from +12° to +30° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4780 to 1.4895 at 20° C., page 1525.

A solution of the recently distilled Oil in an equal volume of alcohol is neutral or only slightly acid to moistened litmus paper.

Evaporate 3 Gm. of the Oil in a small tared dish on a bath of boiling water: the weight of the residue does not exceed 0.06 Gm.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparation—Spiritus Ammoniæ Aromaticus.

N. F. Preparations—Elixir Pepsini et Rennini Compositum; Mistura Oleo-Balsamica.

Uses—Oil of myristica is used in aromatic spirit of ammonia. In overdoses it acts as a narcotic poison. This oil is very difficult to keep and even if slightly terebinthinate is unfit for flavoring purposes. Dose, one-half minim (0.03 cc.).

Official Products from the Lauraceæ

SASSAFRAS. N. F. Sassafras

(U. S. P. IX)

[Sassaf.]

Sassafras is the dried bark of the root of *Sassafras variifolium* (Salisbury) O. Kuntze (Fam. *Lauraceæ*).

Sassafras contains not more than 4 per cent of adhering wood, outer corky tissues, or foreign organic matter and yields not more than 5 per cent of acid-insoluble ash.

Description—In irregular fragments, deprived of the gray, corky layer; bright rust-brown, soft, fragile, with a short, corky fracture; the inner surface smooth; strongly fragrant; taste sweetish, aromatic, and somewhat astringent.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Sarsaparillæ Compositum; Decoctum Sarsaparillæ Compositum; Syrupus Pini Albæ Compositus; Syrupus Pini Albæ Compositus cum Morphina.

This well known bark contains volatile oil (mainly safrol), sassafrid, tannin, starch, resin, etc.

Uses—It is principally used on account of its aromatic oil, largely in domestic practice, and as an addition to proprietary medicines for the purpose of covering the taste of disagreeable substances. Dose, two and one-half drachms (10 Gm.).

OLEUM SASSAFRAS. U. S. Oil of Sassafras

[Ol. Sassaf.—Sassafras Oil]

The volatile oil distilled from the root of *Sassafras variifolium* (Salisbury) O. Kuntze (Fam. *Lauraceæ*). If the Oil has solidified in whole or in part, carefully warm it until liquefied, then thoroughly mix it before dispensing.

This oil was formerly largely produced in New Jersey and Maryland from the wood and bark of the sassafras tree; the yield is about 2 per cent. It consists of a terpene, $C_{10}H_{16}$ (*safrene*), and an oxygenated portion, $C_{10}H_{10}O_2$, *safrol*, is the methylene ether of allyl pyrocatechol and is made on a large scale by chilling the oils of camphor and other safrol-containing oils; the crystals are separated, and allowed to melt, forming liquid safrol. It has also been made synthetically. It is a colorless or faintly yellow liquid with a sassafras-like odor. Specific gravity, 1.098 to 1.100 at 25° C. It is soluble in about an equal volume of strong alcohol, and in about 30 parts of 70 per cent alcohol. Miscible in all proportions with ether and chloroform. Boiling point: about 233° C.; optically inactive. On cooling to −20° C. or below, it solidifies to a mass of crystals,

which do not melt below 11° C. It is used for scenting soaps and as a substitute for oil of sassafras.

The oil is officially described as follows:

Description and Physical Properties—A yellow or reddish-yellow liquid, having the characteristic odor and taste of sassafras.

Tests for Identity and Purity—The Oil is soluble in 2 volumes of 90 per cent alcohol, by volume.

Specific gravity: 1.065 to 1.077 at 25° C.

Optical rotation: varies from +3° to +4° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.5250 to 1.5350 at 20° C., page 1525.

A solution of the recently distilled Oil in 90 per cent alcohol (1 in 2) is neutral to moistened litmus paper.

Oil of Sassafras meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

U. S. P. Preparation—Syrupus Sarsaparillæ Compositus.

N. F. Preparations—Syrupus Eriodictyi Aromaticus; Syrupus Pini Albæ Compositus; Syrupus Pini Albæ Compositus cum Morphina; Syrupus Trifolii Compositus.

Uses—Oil of sassafras is largely used as a flavoring agent by confectioners. It is a powerful antiseptic and is sometimes used as a local application in nose and throat diseases. The official preparations are given above. It may be given in the dose of one and one-half minims (0.1 cc.).

Official Products from the Betulaceæ

METHYLIS SALICYLAS. U. S. Methyl Salicylate

[**Methyl. Salicyl.**—Oil of Gaultheria, Oil of Wintergreen, Oil of Betula, Oil of Sweet Birch, Oil of Teaberry, Artificial Oil of Wintergreen, Synthetic Oil of Wintergreen]

Methyl Salicylate is produced synthetically or is obtained by distillation from the leaves of *Gaultheria procumbens* Linné (Fam. *Ericaceæ*) or from the bark of *Betula lenta* Linné (Fam. *Betulaceæ*). The label must indicate whether the Methyl Salicylate has been made synthetically or distilled from either of the above mentioned plants. It contains not less than 98 per cent of $C_6H_4(OH)CO_2CH_3$(152.10).

Preparation—In the U. S. P., oil of gaultheria, oil of betula, and methyl salicylate are combined under the latter title, as it is difficult to distinguish between them chemically, and practically the same tests apply to all. The most important differences in the tests are found in the specific gravity and optical rotation but these factors are not sufficiently characteristic to enable the detection of either in a mixture. The U. S. P. directs that the label shall indicate the source of the product and whether synthetic or natural. Methyl Salicylate is found naturally in the oils of gaultheria and betula and in many other plants, but the commercial product is usually made by distilling salicylic acid or a salicylate with methyl alcohol and strong sulphuric acid.

Description and Physical Properties—A colorless, yellowish, or reddish liquid, having the characteristic odor and taste of gaultheria.

Methyl Salicylate is slightly soluble in water, but is miscible with alcohol and with glacial acetic acid. It is soluble in about 7 volumes of 70 per cent alcohol at 25° C. with not more than a slight cloudiness.

Tests for Identity—Specific gravity at 25° C.: synthetic, 1.180 to 1.185; from gaultheria or betula, 1.176 to 1.182.

It boils between 219° and 224° C.

Synthetic Methyl Salicylate, or that from betula, is optically inactive. Methyl Salicylate from gaultheria is slightly levorotatory, not exceeding −1.5° in a 100 mm. tube at 25° C.

A deep violet color is produced by shaking a drop of Methyl Salicylate with about 5 cc. of distilled water and adding a drop of ferric chloride T.S.

Tests for Purity—An alcoholic solution of Methyl Salicylate is neutral or slightly acid to moistened litmus paper.

Add 10 cc. of potassium hydroxide T.S. to 1 cc. of Methyl Salicylate contained in a capacious test tube, and agitate the mixture: a clear, or slightly cloudy, and colorless or faintly yellowish solution results without the separation of any oily drops either on the surface or at the bottom of the liquid (*other volatile oils or petroleum products*).

Methyl Salicylate meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Assay—Place about 2 cc. of Methyl Salicylate, accurately weighed, in a tared flask, add 50 cc. of half-normal alcoholic potassium hydroxide, connect the flask with a reflux condenser, and heat the mixture on a water bath for two hours. Add a few drops of phenolphthalein T.S., and titrate the excess of alkali with half-normal hydrochloric acid. Each cc. of half-normal alcoholic potassium hydroxide corresponds to 0.07605 Gm. of $C_6H_4(OH)CO_2CH_3$.

This assay is explained on page 1461.

Preserve in well-stoppered, amber-colored bottles, in a cool place.

U. S. P. Preparations—Emulsum Olei Morrhuæ; Fluidextractum Cascaræ Sagradæ Aromaticum; Syrupus Sarsaparillæ Compositus.

N. F. Preparations—Cataplasma Kaolini; Dentifricium; Inunctum Mentholis Compositum; Liquor Antisepticus; Liquor Aromaticus Alkalinus; Liquor Ferri Salicylatis; Liquor Pepsini Antisepticus; Nebula Aromatica; Nebula Mentholis Composita; Odontalgicum; Petroxolinum Methylis Salicylatis; Syrupus Trifolii Compositus; Trochisci Ulmi.

Uses—Methyl salicylate is used in place of salicylic acid in rheumatism, neuralgia, and kindred diseases. The synthetic product has largely replaced the natural oils, and by many is believed to be identical in its medical properties. As a flavoring agent it is equal in every respect to oil of wintergreen or oil of sweet birch. Care must be taken to select a product conforming to the official tests. Dose, twelve minims (0.75 cc.).

Official Products from the Zingiberaceæ

CARDAMOMI SEMEN. U. S. Cardamom Seed

[**Cardam. Sem.**—Cardamom, Ceylon or Malabar Cardamom]

Cardamom Seed is the dried ripe seed of *Elettaria Cardamomum* Maton (Fam. *Zingiberaceæ*), recently removed from the capsules.

Cardamom Seed yields not more than 5 per cent of acid-insoluble ash.

Description—The seeds are about 4 mm. long, reddish-brown, angular, rugose, depressed at the hilum, surrounded by a thin, membranous arillus, and have an agreeable odor and a pungent aromatic taste.

For further description see the U. S. P. X.

U. S. P. Preparations—Extractum Colocynthidis Compositum; Tinctura Cardamomi; Tinctura Cardamomi Composita; Tinctura Gentianæ Composita; Tinctura Rhei.

N. F. Preparations—Pulvis Aromaticus; Pulvis Cretæ Aromaticus; Elixir Gentianæ Glycerinatum (from Compound Tincture); Syrupus Eriodictyi Aromaticus (from Compound Tincture); Tinctura Aromatica; Tinctura Rhei Dulcis.

This valuable aromatic is imported from India. The seeds contain 5 per cent of an oxygenated volatile oil, of the sp. gr. 0.943, 10 per cent of fixed oil, starch, mucilage, etc. Owing to the presence of the fixed oil, the seeds are very difficult to powder alone, hence the practice in preparing compound powders containing cardamom of mixing the other ingredients with it, so that they may absorb the oil. An oil of cardamom which is a mixture of both volatile and fixed oils, is sometimes made by percolation with ether. This must not be confused with the official volatile oil.

Uses—It is a flavor, aromatic, stomachic, and carminative. Dose, fifteen grains (1 Gm.).

OLEUM CARDAMOMI. N. F. Oil of Cardamom

[**Ol. Cardam.**]

A volatile oil distilled from the seeds of *Elettaria Cardamomum* White et Maton (Fam. *Zingiberaceæ*).

Official Description—A colorless or very pale yellow liquid.

Odor and Taste—Characteristic, aromatic, penetrating and somewhat camphoraceous odor of cardamom, and a persistent, pungent, and strongly aromatic taste.

Solubility—Soluble in alcohol and readily soluble in four volumes of 70 per cent alcohol, forming a clear solution.

Specific gravity: 0.924 to 0.947 at 25° C.

Tests for Identity and Purity—It is dextrorotatory, the angle of rotation varying from +22° to +44°, in a 100 mm. tube, at 25° C.

Preserve it in small, well-stoppered, amber-colored bottles, in a cool place, protected from light.

N. F. **Preparations**—Elixir Cardamomi Compositum (from Compound Spirit); Elixir Vanillini Compositum (from Compound Spirit); Spiritus Cardamomi Compositus; Spiritus Vanillini Compositus.

Uses—It is used as a flavor and as a stomachic.

ZINGIBER. U. S. Ginger

[**Zingib.**—Jamaica Ginger, African Ginger, Cochin Ginger, Ginger Root, Black Ginger]

Ginger is the dried rhizome of *Zingiber officinale* Roscoe (Fam. *Zingiberaceæ*), known in commerce as Jamaica Ginger, Cochin Ginger, and African Ginger. The outer cortical layers are often either partially or completely removed.

Ginger yields not less than 2 per cent of non-volatile, ether-soluble extractive and not less than 12 per cent of cold water-extractive.

Descriptions—

Jamaica Ginger—Rhizome horizontal, laterally compressed, irregularly branched, from 4 to 16 cm. in length and from 4 to 20 mm. in thickness; the cork wholly removed; externally light brown, longitudinally striate, ends of the branches with depressed stem-scars; fracture short, fibrous, starchy and resinous; internally yellowish to light brown; odor agreeably aromatic; taste aromatic and pungent.

Cochin Ginger—Cork almost or wholly removed on the flattened sides, light brown to grayish-yellow, fracture shorter, less fibrous and more starchy than other varieties; internally yellowish-white; oil and resin cells vary from yellowish to brownish-red; odor aromatic, taste pungent.

African Ginger—Cork partly removed on the flattened sides, leaving light brownish areas; portions with cork, longitudinally or reticulately wrinkled and grayish-brown; internally light yellow to brown; taste aromatic and strongly pungent; otherwise resembling Jamaica Ginger.

Assay—Place 4 Gm. of ground Ginger in a 200 cc. flask, fill to the mark with distilled water, and agitate at half-hour intervals during eight hours. Then allow the mixture to stand for sixteen hours and filter. Evaporate 50 cc. of the filtrate, representing 1 Gm. of the drug, on a water bath, dry to constant weight at 100° C., and weigh. It yields not less than 12 per cent of cold water-extractive.

For non-volatile, ether-soluble extractive, proceed as directed on page 1523.

For further description see the U. S. P. X.

U. S. P. **Preparations**—Fluidextractum Zingiberis; Pulvis Rhei Compositus; Syrupus Zingiberis (from Fluidextract); Tinctura Zingiberis.

N. F. **Preparations**—Pulvis Aromaticus; Pulvis Aromaticus Rubefaciens; Pulvis Myricæ Compositus; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe; Tinctura Aromatica.

Uses—This well-known and largely used rhizome owes its virtues to about 4 per cent of volatile oil, having the composition $C_{10}H_{16}$, and therefore a terpene, and a soft, pungent, aromatic resin, which is soluble in alcohol and ether. Ginger is used as an intestinal stimulant and carminative in colic and diarrhea in doses of eight grains (0.5 Gm.).

ZEDOARIA. N. F. Zedoary

[**Zedoar.**]

Zedoary is the dried rhizome of *Curcuma Zedoaria* (Bergius) Roscoe (Fam. *Zingiberaceæ*).

Zedoary contains not more than 2 per cent of foreign organic matter.

Description—The rhizome, or, more properly, tuber, is terete and somewhat thicker than curcuma, and, to facilitate drying is sliced, mostly transversely. It occurs in nearly circular (occasionally oval) disks, from 1 to 4 cm. broad, and 4 to 10 mm. thick, the thickness almost uniform at margin and center. The edges are grayish-brown and wrinkled, the cut surfaces white or grayish-white and smooth, with a dark endodermal circle near the margin.

For further description see the N. F. V.

N. F. **Preparations**—Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Tinctura Amara; Tinctura Antiperiodicæ; Tinctura Antiperiodicæ sine Aloe.

Uses—It is a stimulating aromatic in colic and digestive debility. The dose is fifteen grains (1 Gm.).

Official Product from the Aristolochiaceæ

ASARUM. N. F. Asarum

[Asar.—Canada Snakeroot, Wild Ginger]

Asarum consists of the dried rhizome and roots of *Asarum canadense* Linné (Fam. *Aristolochiaceæ*).

Asarum contains not more than 5 per cent of foreign organic matter. Its chief constituent is a volatile oil largely used in perfumery.

Description—From 7 to 15 cm. long and about 3 mm. thick, somewhat bent and curved, with few branches and few thin, nearly simple roots, which are 5 to 7 cm. long; nodes often presenting a pointed appearance from the remains of the petioles; externally deep purple-brown, internally whitish; the bark occupying about $\frac{1}{6}$ of the diameter and containing the oil cells, the wood in about twelve small wedge-shaped bundles, forming an interrupted circle and enclosing a large pith; odor aromatic, taste pungent and bitter.

For further description see the N. F. V.

N. F. Preparation—Syrupus Asari Compositus.

Uses—A feeble aromatic, dose thirty grains (2 Gm.).

Unofficial Terpenes

Oil of Burgundy Pitch	From *Abies excelsa*. Fam. Coniferæ. Habitat, Europe
Calamus	From the rhizome of *Acorus calamus*. Fam. Araceæ. Habitat, North America
Canada Turpentine	From the oleoresin of *Abies balsamea*. Fam. Coniferæ
Cedrat	From *Citrus medica*. Fam. Rutaceæ. Used in perfumery
Elemi	From *Canarium commune*. Fam. Burseraccæ. Habitat, Philippine Islands
Gurjun Balsam	From *Dipterocarpus turbinatus*. Fam. Dipterocarpaceæ. Habitat, India
Hemlock Spruce	From *Abies canadensis*. Fam. Pinaceæ. Habitat, Canada
Hungarian Turpentine	From *Pinus pumilio*. Fam. Pinaceæ
Jaborandi	From the leaflets of *Pilocarpus pinnatifolius*. Fam. Rutaceæ. Habitat, Brazil
Oil of Myrtle	From *Myrtus communis*. Fam. Myrtaceæ
Sage	From the leaves of *Salvia officinalis*. Fam. Labiatæ
Strassburg Turpentine	From *Abies pectinata*. Fam. Pinaceæ
Templin	From the shoots of *Pinus pumilio*. It is a colorless or yellowish-green oil, of an agreeable, somewhat terebinthinate odor

Unofficial Oxygenated Oils

Oil of Absinthium	From *Artemisia absinthium*. Fam. Compositæ
Angustura	From the bark of *Galipea cusparia*. Fam. Rutaceæ. Habitat, South America. Composition, $C_{13}H_{24}O$
Anthemis	From the flower heads of *Anthemis nobilis*. Fam. Compositæ. Habitat, Europe
Arnica	From the root and flowers of *Arnica montana*. Fam. Compositæ. Habitat, Europe
Asarum	From the rhizome of *Asarum canadense*. It is used to give permanence to the odors of some cologne waters
Buchu	From the leaves of *Barosma betulina, B. crenulata, and B. serratifolia*. Fam. Rutaceæ. Habitat, Southern Africa
Camphor	From the preparation of crude camphor. Fam. Laurineæ. Habitat, Asia
Canella	From the bark of *Canella alba*. Fam. Canellaceæ. Habitat, Southern United States
Capsicum	From the fruit of *Capsicum fastigiatum*. Fam. Solanaceæ. Habitat, Southern and Central America
Carrot	From the fruit of *Daucus carota*. Fam. Umbelliferæ. Indigenous to Northern Asia
Cascarilla	From the bark of *Croton eluteria*. Fam. Euphorbiaceæ. Indigenous to the Bahama Islands
Catnep	From the leaves and tops of *Nepeta cataria*. Fam. Labiatæ. Habitat, Europe
Celery	From the fruit of *Apium graveolens*. Fam. Umbelliferæ. Habitat, Europe
Citronella	From the leaves of *Andropogon nardus*. Habitat, Ceylon. Contains a terpene, citronellol, and a heptoic aldehyde. Used in perfumery
Curcuma	From the rhizome of *Curcuma longa*. Fam. Zingiberaceæ. Habitat, India
Cyna	From the flowers of *Artemisia maritima*. Fam. Compositæ. Habitat, Asia. A pale yellow oil
Dahlia	From the tubers of *Dahlia pinnata*
Elder (European)	From the flowers of *Sambucus nigra*. Fam. Caprifoliaceæ. Habitat, Europe
Feverfew	From *Pyrethrum parthenium*. Fam. Compositæ. Habitat, Europe
Galangal	From the rhizome of *Alpinia officinarum*. Fam. Zingiberaceæ. Habitat, China
Ginger	From the rhizome of *Zingiber officinale*. Fam. Zingiberaceæ. Habitat, Jamaica
Ginger Grass	From the flowers of *Andropogon Schœnanthus*
Golden Rod	From the leaves of *Solidago odora*
Hedeoma	A volatile oil distilled from the leaves and flowering tops of Hedeoma, the dried
Oil of Pennyroyal	leaves and flowering tops of *Hedeoma pulegioides* (Linné) Persoon (Fam. *Labiatæ*). A pale yellow limpid liquid of characteristic, pungent, mint-like odor and taste. Sp. gr. 0.920 to 0.935 at 25° C. It forms a clear solution with 2 volumes or more of 70 per cent alcohol. Dextrogyrate, the angle of rotation varying from about +18° to +22° in a 100 mm. tube, at a temperature of 25° C. (77° F.). This is an oxygenated oil, and is used principally to protect the exposed parts of the body from the bites of flies, mosquitoes, fleas, etc. It is employed sometimes in amenorrhea, in doses of one to three minims (0.06 to 0.2 cc.). The drug was official in the U. S. P. VIII. It is a stimulant and aromatic. Dose, two drachms (8 Gm.).
Oil of Heliotrope	From the flowers of *Heliotropium peruvianum* and *H. grandiflorum*
Hop	From the strobiles of *Humulus lupulus*. Fam. Urticaceæ. Habitat, North America

Unofficial Oxygenated Oils—*Continued*

Horsemint	From the leaves and flowers of *Monarda punctata*. Fam. Labiatæ. Habitat, United States
Hyssop	From the herb of *Hyssopus officinalis*. Fam. Labiatæ. Habitat, Southern Europe
Indian Cannabis	From *Cannabis sativa*. Fam. Moraceæ. Habitat, Asia
Inula	From the root of *Inula helenium*. Fam. Compositæ. Habitat, Europe
Jessamine	From the flowers of *Jasminium grandiflorum* and *J. fragrans*. Fam. Jasmineæ. Used in perfumery
Laurel	From *Laurus nobilis*. Fam. Lauraceæ. Habitat, Southern Europe
Lilac	From the flowers of *Syringa vulgaris*. Fam. Oleaceæ. Used in perfumery
Lily of the Valley	From the flowers of *Convallaria majalis*. Fam. Liliaceæ. Used in perfumery
Oil of Linden	From the inflorescence of different species of *Tilia*. Fam. Tiliaceæ. Habitat, Europe and America.
Lovage	From the root of *Levisticum officinale*. Fam. Umbelliferæ. Habitat, Europe
Marrubium	From *Marrubium vulgare*. Fam. Labiatæ. Habitat, Europe and Asia
Marsh Tea	From the leaves of *Ledum palustre*. Fam. Ericaceæ. Habitat, Europe and Asia
Masterwort	From *Heracleum lanatum*. Fam. Umbelliferæ. Habitat, United States
Matico	From the leaves of *Piper angustifolium*. Fam. Piperaceæ. Habitat, tropical America
Matricaria	From the flowers of *Matricaria chamomilla*. Fam. Compositæ. Habitat, Europe and United States
Melissa	From the leaves and tops of *Melissa officinalis*. Fam. Labiatæ. Habitat, Europe and United States
Mignonette	From the flowers of *Reseda odorata*. Fam. Resecaceæ. Habitat, Southern France. The yield is very small. Used in perfumery
Mountain Balm	From the leaves of *Eriodictyon californicum*. Fam. Hydrophyllaceæ. Habitat, California
Myrrh	From the gum-resin of *Commiphora myrrh*. Fam. Burseraceæ. Habitat, Arabia
Olibanum	From *Boswellia Carterii*. Fam. Burseraceæ. Habitat, Arabia.
Parsley	From the fruit of *Petroselinum sativum*. Fam. Umbelliferæ. Habitat, Southern Europe
Patchouly	From *Pogostemon Patchouly*. Fam. Labiatæ. Habitat, East India
Phellandrium	From the fruit of *Œnanthe phellandrium*. Fam. Umbelliferæ
Red Cedar	From *Juniperus virginiana*. Fam. Pinaceæ. Habitat, Canada and United States
Rhodium	From the root of *Convolvulus Scoparius*. Habitat, Canary Islands. The oil *of rhodium* sold in pharmacy is usually a factitious article, made by mixing 1 part of oil of rose with 20 parts of oil of copaiba. It is used as a lure for rats
Saffron	From *Crocus sativus*. Fam. Irideæ. Habitat, Europe
Serpentaria	From the rhizome and roots of *Aristolochia Serpentaria* and *A. reticulata*. Fam. Aristolochiaceæ. Habitat, Virginia
Summer Savory	From the herb of *Satureja hortensis*. Fam. Labiatæ
Sweet Basil	From *Ocymum basilicum*. Fam. Labiatæ. Habitat, Asia and Africa
Sweet Cicely	From *Osmorhiza longistylis*. Fam. Umbelliferæ
Sweet Marjoram	From *Origanum marjorana*. Fam. Labiatæ
Sweet Violet	From the flowers of *Viola odorata*. Fam. Violaceæ
Tansy	From the leaves of *Tanacetum vulgare*. Fam. Compositæ. Habitat, Europe and North America
Tea	From the leaves of *Thea sinensis*. Fam. Ternstræmiaceæ. Habitat, China
Thuja	From the branches of *Thuja occidentalis*. Fam. Coniferæ. Habitat, Canada and United States
Tuberose	From the flowers of *Polianthes tuberosa*. Fam. Amaryllidaceæ
Verbena (Lemongrass)	From *Andropogon citratis*. A grass cultivated in Ceylon and Singapore
Wormwood	From the herb of *Artemisia absinthium*. Fam. Compositæ. Habitat, Europe
Ylang-Ylang	An annonaceous tree (*Canangium odoratum*) of Malaysia, the Philippines, etc. It has greenish-yellow, very fragrant flowers, and is often planted for shade. Also the name for an essence or perfume distilled from the flowers of this tree (see Part VI).
Zedoary	From the rhizome of *Curcuma Zedoaria*. Fam. Zingiberaceæ. Habitat, East India Islands

Stearoptenes from Volatile Oils

CAMPHORA. U.S. Camphor

[**Camph.**—Gum Camphor, Powdered Camphor]

A dextrorotatory ketone [$C_9H_{16}CO$], obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*).

Preparation—Refined camphor is usually made by subliming in circular cakes the crude granular camphor imported from China and Japan. The vessels in which the camphor is sublimed are of cast iron, circular, from twelve to fifteen inches or more in diameter, and four inches deep, with perpendicular sides, and a ledge at the top, on which the cover rests. This consists of sheet iron, with a hole through the center about an inch in diameter, over which a small hollow cone of sheet iron is placed loosely. The crude camphor, mixed with lime—the object of which is to combine with the moisture present

which would interfere with the subsequent solidification of the camphor vapor—is placed in the iron vessels described, of which from twenty to fifty are arranged in a long sand bath. Heat is then applied until the camphor melts, after which the heat is kept as nearly uniform as possible, so that the vaporization may take place regularly, without violent ebullition. The camphor sublimes on the lower surface of the lid in a solid circular cake, care being taken, by the occasional removal of the iron cone and clearing of the opening by means of a knife, to allow the escape of any excess of the vapor; the round hole in the cakes is thus accounted for. Camphor is sometimes sublimed in powder by conducting the vapor into a large cold chamber (see Sublimation, page 146). This powder is often compressed into oblong cakes, forming *compressed camphor*. Japanese camphor, refined in Formosa, and put up in ounce cakes and pound packages is now supplied. Camphor is now made synthetically by the interaction of oil of turpentine and anhydrous oxalic acid, the resulting mixture being treated with lime, and then distilled. This product is optically inactive and, not being chemically identical with the natural article, is not recognized by the U. S. P.

When camphor is triturated in nearly molecular proportions, with menthol, thymol, phenol or hydrated chloral, liquefaction ensues, the solution being known as a *eutectic solution.*

Description and Physical Properties—White, translucent, tough masses or granules. It has a penetrating, characteristic odor, and a pungent aromatic taste. It is readily pulverizable in the presence of a little alcohol, ether, or chloroform. It slowly volatilizes at ordinary temperatures.

One Gm. of Camphor is soluble in about 800 cc. of water, 1 cc. of alcohol, 0.5 cc. of chloroform, and in 1 cc. of ether, at 25° C. It is freely soluble in carbon disulphide, petroleum benzin, and in fixed or volatile oils.

Tests for Identity—Specific gravity: about 0.990 at 25° C.

Camphor melts between 174° and 177° C.

The specific rotation $[\alpha]_D$ of Camphor, determined at 25° C. in a solution containing 10 Gm. of Camphor in 100 cc. of alcohol and using a 200 mm. tube, is between +41° and +42°.

Tests for Purity—A solution of Camphor in petroleum benzin (1 in 10) is clear (*water*).

Gradually heat about 2 Gm. of Camphor: it sublimes without carbonization and without leaving more than 0.05 per cent of non-volatile matter.

Wind the end of a copper wire into a spiral about 6 mm. in diameter and 6 mm. in length, and hold it in a non-luminous flame until it glows without coloring the flame green. Dip the spiral in the Camphor, ignite, allow it to burn outside of the flame, and then bring the spiral into contact with the lower, outer edge of a non-luminous flame: not even a transient green color is imparted to the flame (*chlorinated products*).

Preserve in well-closed containers, in a cool place.

U. S. P. Preparations—Aqua Camphoræ; Collodium Flexile; Linimentum Camphoræ; Linimentum Chloroformi (from Soap Liniment); Linimentum Saponis; Spiritus Camphoræ; Tinctura Opii Camphorata.

N. F. Preparations—Ampullæ Camphoræ; Ceratum Camphoræ (from Liniment); Ceratum Plumbi Subacetatis; Chloral Camphoratum; Emplastrum Fuscum Camphoratum; Linimentum Belladonnæ; Linimentum Opii Compositum; Linimentum Saponato-Camphoratum; Linimentum Sinapis Compositum; Lotio Ammoniacalis Camphorata (from Spirit of Camphor); Menthol Camphoratum; Mistura Opii et Chloroformi Composita (from Spirit); Mistura Opii et Rhei Composita (from Spirit); Nebula Aromatica; Nebula Mentholis Composita; Petroxolinum Chloroformi Camphoratum; Petroxolinum Phenolis Camphoratum; Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Pilulæ Opii et Camphoræ; Tinctura Antiperiodicæ; Tinctura Antiperiodicæ sine Aloe; Unguentum Camphoræ.

Uses—Camphor is used internally in hysteria and neuralgic headaches. Hypodermically it is a valuable heart stimulant. Locally it is employed in nose and throat diseases as a counterirritant in liniments. Doses of two to ten grains (0.125 to 0.6 Gm.) by the mouth, and in one-half to two grains (0.03 to 0.125 Gm.) hypodermically. When it is required as a diffusible stimulant in threatened collapse, it is injected hypodermically and a sterile 10 per cent solution in olive oil is used. There are numerous official preparations, the list being given above.

CAMPHORA MONOBROMATA. U. S. P. IX. Monobromated Camphor

Ortho-monobromcamphor [$C_{10}H_{15}C_9H_{15}Br.CO$ = 231.09].

Preparation—This compound of camphor may be made by adding 4 ounces of bromine gradually to a retort in which thirteen ounces of camphor have been previously placed. In fifteen or twenty minutes a brisk reaction will commence. When this subsides, eight or nine ounces more of bromine are to be poured in, in four portions, waiting after each addition until the reaction ceases. The liquid in the retort is now heated to about 132° C., then cooled and sufficient petroleum benzin added to dissolve the crystalline mass. The crystals which are formed on cooling may be purified by recrystallization from petroleum benzin or hot alcohol.

Description—In colorless, prismatic needles or scales, or as a powder.

Odor and Taste—It has a mild but characteristic, camphoraceous odor and taste. Permanent in the air. It is decomposed by prolonged exposure to the sunlight.

Solubility—One Gm. of Monobromated Camphor dissolves in 6.5 cc. of alcohol, 0.5 cc. of chloroform, and in 1.6 cc. of ether at 25° C. (77° F.); almost insoluble in water.

Tests for Identity and Purity—It melts between 74° and 76° C.

Heat a mixture of about 0.1 Gm. each of Monobromated Camphor and silver nitrate and 2 cc. each of nitric acid and sulphuric acid until nitrous vapors are no longer evolved: a yellowish precipitate of silver bromide is obtained.

Incinerate about 2 Gm. of Monobromated Camphor: not more than 0.05 per cent of ash remains.

Soluble Bromide—Shake about 0.5 Gm. of powdered Monobromated Camphor with 10 cc. of distilled water and filter. The filtrate is neutral to litmus and is not rendered more than slightly opalescent by the addition of a few drops of silver nitrate T.S.

Preserve it in well-closed containers, protected from light.

Uses—Monobromated camphor is given as a nerve sedative, especially in neuralgic headaches in doses of two to five grains (0.125 to 0.3 Gm.).

Unofficial Preparations of Camphor

Cream of Camphor

Castile Soap, dry and grated	120 gr.
Ammonium Carbonate (translucent)	120 gr.
Powdered Camphor	120 gr.
Oil of Thyme	1 fl. dr
Oil of Turpentine	2 fl. oz.
Tincture of Opium	2 fl. oz.
Water, a sufficient quantity	
To make	1 pint

Dissolve the soap and the ammonium carbonate in 10 fl. oz. of hot water and pour in a pint bottle. Dissolve the camphor in the mixed oils, add to the soap solution, shaking the mixture. Add the tincture of opium and sufficient water to make 1 pint.

Camphoric Acid, $C_8H_{14}(COOH)_2$, which was official in the U. S. P. VIII, is an oxidation product of camphor, obtained by treating camphor with hot nitric acid. It is used in the treatment of bronchitis and phthisis in doses of fifteen grains (1 Gm.).

Official Substances Containing Nitrogenated or Sulphurated Oils with Allied Products

OLEUM AMYGDALÆ AMARÆ. U. S. Oil of Bitter Almond

[Ol. Amygd. Amar.—Bitter Almond Oil]

The volatile oil is obtained by maceration with water and subsequent distillation with steam from the dried ripe kernels (deprived of fixed oil) of *Amygdalus communis* Linné (Fam. *Rosaceæ*), or from other kernels containing amygdalin. The botanical source from which the Oil is derived must be stated on the label.

Oil of Bitter Almond yields not less than 85 per cent of benzaldehyde [C_7H_6O] and not less than 2 per cent and not more than 4 per cent of hydrocyanic acid (HCN). Oil in which crystals have formed must not be dispensed.

Note—This Oil is intended for medicinal use and neither it nor its solution should be used or sold for flavoring foods. The oil from which the hydrocyanic acid has been removed is used for this purpose.

Preparation—Oil of bitter almond is produced as the result of the reaction of emulsin on amygdalin in aqueous mixture of ground almond; it therefore does not preëxist in the almond and cannot be obtained from sweet almond, because amygdalin is not present in the latter. It is now permitted to be made from other kernels containing amygdalin, such as peach and apricot kernels, but the source must be stated upon the label.

$$\underset{\text{amygdalin}}{C_{20}H_{27}NO_{11}} + \underset{\text{water}}{2H_2O} = \underset{\text{benzaldehyde}}{C_7H_6O} + \underset{\text{dextrose}}{2C_6H_{12}O_6} + \underset{\text{hydrocyanic acid}}{HCN}$$

The process consists in taking a mixture of the bitter almond press cake (obtained after the fixed oil has been extracted) with water, and distilling it by passing a current of steam through it. The proportions of benzaldehyde and hydrocyanic acid in the oil are recognized as valuable tests (see official assay below, also Benzaldehydum, page 990).

Description and Physical Properties—A clear, colorless or yellow, strongly refractive liquid, having the characteristic odor and taste of benzaldehyde.

When first prepared, the Oil is neutral to moistened litmus paper, but afterward develops an acid reaction, due to the formation of benzoic acid.

Tests for Identity and Purity—The Oil is slightly soluble in water and is soluble in all proportions in alcohol and in ether. It forms a clear solution with 2 volumes of 70 per cent alcohol, by volume.

Specific gravity: 1.038 to 1.060 at 25° C.

Optical rotation: varies from inactive to +0° 10′ in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.5428 to 1.5439 at 20° C., page 1525.

The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Rinse the interior surface of a well-cleaned, 1000 cc. beaker, with distilled water, and pass the washings through a small filter until the addition of 1 drop of silver nitrate T.S. to a portion of the filtrate, acidulated with 1 drop of nitric acid, shows no turbidity. Place 3 or 4 drops of the Oil on a clean watch glass supported on a triangle, ignite, and immediately cover with the moistened beaker. Wash the products of combustion from the sides of the beaker through the washed filter with 10 to 20 cc. of distilled water, and acidulate the filtrate with 1 drop of nitric acid: the addition of 1 drop of silver nitrate T.S. produces no turbidity (*chlorinated products*).

Add 10 drops of Oil of Bitter Almond to 5 cc. of alcohol, then add a small amount of zinc dust and 2 cc. of acetic acid, and boil the mixture for about ten seconds: no odor of phenylisocyanide develops after rendering the liquid strongly alkaline with sodium hydroxide T.S. and then adding a few drops of chloroform and heating (*nitrobenzene*).

Assay for Benzaldehyde—Dissolve about 3 cc. of freshly redistilled phenylhydrazine in about 60 cc. of alcohol, and titrate 25 cc. of this solution, which must be freshly prepared, with half-normal hydrochloric acid, using 1 drop of methyl orange T.S. as indicator. To about 1 Gm. of Oil of Bitter Almond, accurately weighed, add another 25 cc. portion of the phenylhydrazine solution, and allow the mixture to stand thirty minutes. Add 1 drop of methyl orange T.S., and acidify the mixture by adding a measured excess of half-normal hydrochloric acid. Filter the mixture and wash the precipitate with small portions of distilled water until the washings cease to redden moistened blue litmus paper. Then titrate the excess of hydrochloric acid in the combined filtrates with half-normal sodium hydroxide and subtract the number of cc. of half-normal hydrochloric acid consumed from the number of cc. of half-normal hydrochloric acid used in titrating 25 cc. of the phenylhydrazine solution. The difference, multiplied by 0.05304, gives the weight of benzaldehyde.

This assay is explained on page 1460.

Assay for Hydrocyanic Acid—Dissolve 0.75 Gm. of magnesium sulphate in 45 cc. of distilled water, add 5 cc. of half-normal sodium hydroxide and 2 drops of potassium chromate T.S., and titrate the solution with tenth-normal silver nitrate to the production of a permanent reddish tint. Pour this mixture into a 100 cc. flask, containing about 1 Gm. of Oil of Bitter Almond, accurately weighed, mix well, and titrate again with tenth-normal silver nitrate until a red tint, which does not disappear on shaking, is reproduced. Conduct this titration as rapidly as possible. Each cc. of tenth-normal silver nitrate corresponds to 0.002702 Gm. of hydrocyanic acid.

This assay is explained on page 1464.

Preserve in small, well-stoppered, completely filled, amber-colored bottles, in a cool place, protected from light.

N. F. Preparations—Elixir Amygdalæ Compositum; Elixir Anisi (from Spirit); Spiritus Amygdalæ Amaræ; the N. F. Emulsions.

Uses—Oil of bitter almond is used chiefly as a flavor. It is actively poisonous, as it contains hydrocyanic acid. The dose is one-half minim (0.03 cc.). It must not be used for flavoring foods, but should always be replaced by the natural oil from which the HCN has been removed, or by benzaldehyde, neither of which involve the danger from hydrocyanic acid poisoning.

BENZALDEHYDUM. U.S. Benzaldehyde

[Benzaldehyd.]

Benzaldehyde contains not less than 85 per cent of $C_6H_5.CHO$ (106.08).

Preparation—Artificial benzaldehyde, which is identical with the product obtained from the almond, is now made from toluene, C_7H_8. By the action of chlorine upon the hot toluene, there is produced benzyl chloride, $C_6H_5CH_2Cl$, and benzal chloride, $C_6H_5CHCl_2$, and these yield benzaldehyde upon treatment with manganese dioxide or other oxidizing agents. Artificial benzaldehyde is free from hydrocyanic acid, but is liable to retain traces of chlorine compounds. *This product must not be confounded with nitrobenzene (nitrobenzol), or oil of mirbane, which is made by reaction on benzene with nitric acid.* Nitrobenzene is made in large quantities for perfuming soap, polishing compounds, etc. Its odor is similar to, but by no means identical with, that of oil of bitter almond or benzaldehyde.

Description and Physical Properties—A colorless or yellowish, strongly refractive liquid, having an odor resembling that of oil of bitter almond, and a burning aromatic taste.

Benzaldehyde is soluble in about 350 volumes of water, and is miscible with alcohol, ether, and with fixed or volatile oils.

Tests for Purity—Specific gravity: about 1.045 at 25° C.

Shake 0.5 cc. of Benzaldehyde with 5 cc. of distilled water, add 0.5 cc. of sodium hydroxide T.S. and 0.1 cc. of ferrous sulphate T.S., and warm the mixture gently. Upon the addition to the mixture of a slight excess of hydrochloric acid, no greenish-blue color or blue precipitate is produced within fifteen minutes (*hydrocyanic acid*).

Wind the end of a copper wire into a spiral about 6 mm. in diameter and 6 mm. in length, and hold it in a non-luminous flame until it glows without coloring the flame green. Cool the wire, dip the spiral in the Benzaldehyde, ignite, allow it to burn outside of the flame, and then bring the spiral into contact with the lower, outer edge of the non-luminous flame: not even a transient green color is imparted to the flame (*chlorinated compounds*).

Dissolve 1 cc. of Benzaldehyde in 20 cc. of alcohol, and add distilled water until a slight turbidity is produced. Add zinc and diluted sulphuric acid, maintaining a brisk evolution of hydrogen for one hour. Filter, evaporate the liquid to about 20 cc., and boil 10 cc. of the evaporated liquid with 1 drop of potassium dichromate T.S.: no violet color is produced (*nitrobenzene*).

Assay—Dissolve about 3 cc. of freshly redistilled phenylhydrazine in 60 cc. of alcohol, and titrate 25 cc. of the solution (this solution must always be freshly prepared) with half-normal hydrochloric acid, using 1 or 2 drops of methyl orange T.S. as indicator. To about 1 Gm. of the Benzaldehyde, accurately weighed, add 25 cc. of the phenylhydrazine solution, and allow the mixture to stand for thirty minutes. Add 1 or 2 drops of methyl orange T.S., acidify with a measured excess of half-normal hydrochloric acid, and add 20 cc. of distilled water. Filter, and wash the precipitate with small portions of distilled water until the washings cease to redden blue litmus paper. Titrate the excess of hydrochloric acid in the filtrate with half-normal sodium hydroxide. Subtract the number of cc. of half-normal hydrochloric acid consumed from the number of cc. of half-normal hydrochloric acid used in titrating the 25 cc. of phenylhydrazine solution. The difference, multiplied by 0.05304, indicates the weight of $C_6H_5.CHO$ present.

This assay is explained on page 1460.

Preserve in small, well-stoppered bottles, protected from light.

Uses—Benzaldehyde is used in place of oil of bitter almond for flavoring purposes; it is much safer than the latter because it contains no hydrocyanic acid. The dose is one-half minim (0.03 cc.).

PRUNUS VIRGINIANA. U. S. Wild Cherry

[Prun. Virg.—Wild Black Cherry Bark, Prunus Serotina]

Wild Cherry is the stem bark of *Prunus serotina* Ehrhart (Fam. *Rosaceæ*), collected in autumn and carefully dried. Borke, if present, should be removed.

Description—In curved pieces or irregular fragments, 2 mm. or more thick, outer surface greenish-brown, or yellow-brown, smooth and somewhat glossy, marked with transverse scars; if the bark is collected from old wood and deprived of the corky layer, the outer surface is nut-brown and uneven; inner surface somewhat striate or fissured. Upon maceration in water it develops a distinct bitter-almond odor; its taste is astringent, aromatic, and bitter.

For further description see the U. S. P. X.

U. S. P. Preparations—Syrupus Pruni Virginianæ.

N. F. Preparations—Elixir Taraxaci Compositum (from Fluidextract); Fluidextractum Pruni Virginianæ; Syrupus Pini Albæ Compositus; Syrupus Pini Albæ Compositus cum Morphina.

Uses—This bark contains a glucoside, l-mandelonitrile, emulsin, tannin, bitter principle, starch, resin, etc. This drug will be found referred to in the British Pharmacopœia and in English literature as Virginian Prune—a literal but incorrect translation of the older botanical name.

As with bitter almond, contact with water results in the production of benzaldehyde and hydrocyanic acid; as both of these principles are volatile and active, all preparations of wild cherry should be made without heat. An insoluble precipitate of altered tannin is often noticed in an old fluidextract. Wild cherry is often used in cough syrups but is of little value except as a flavoring agent. Dose, thirty grains (2 Gm.).

ACIDUM HYDROCYANICUM DILUTUM. U. S. P. IX. Diluted Hydrocyanic Acid

[Acid. Hydrocyan. Dil.—Diluted Prussic Acid, Acidum Hydrocyanicum Dilutum P. I.]

An aqueous solution containing not less than 1.9 per cent and not more than 2.1 per cent of HCN (27.02) and not more than 0.1 per cent of HCl. Preserve it in small, dark amber-colored, well-stoppered vials.

Preparation—It may be prepared extemporaneously by the following process:

	Metric	Alternative
Silver Cyanide	**6.00 Gm.**	93 gr.
Diluted Hydrochloric Acid	**15.54 cc.**	252 min.
Distilled Water	**44.10 cc.**	1½ fl. oz.

Mix the diluted hydrochloric acid with the distilled water, add the silver cyanide, and shake the whole together in a glass-stoppered bottle. When the precipitate has subsided, pour off the clear liquid.

Diluted Hydrocyanic Acid may also be made by mixing a solution of potassium ferrocyanide in a retort with diluted sulphuric acid, heating, and then condensing the hydrocyanic acid, collecting it in a well-cooled receiver; the distillate must be assayed and diluted with sufficient water to make a 2 per cent solution.

$$\underset{\text{potassium ferrocyanide}}{(K_4FeCN_6)_2} + \underset{\text{sulphuric acid}}{(H_2SO_4)_6} = \underset{\text{potassium ferrous ferrocyanide}}{K_2Fe_2CN_6} + \underset{\text{potassium acid sulphate}}{(KHSO_4)_6} + \underset{\text{hydrocyanic acid}}{6HCN}$$

Description—A colorless liquid. On account of its poisonous character *it must be handled with great caution.*

Odor and Taste—A characteristic odor resembling that of bitter almond; it is acid to litmus.

Tests for Identity—Render 1 cc. of the Acid alkaline with potassium hydroxide T.S., add a few drops of ferrous sulphate T.S., boil the mixture, and then acidulate with hydrochloric acid; a blue precipitate is formed.

Impurities and Tests for Impurities—Not more than 0.002 Gm. of residue remains on evaporating 10 cc. of Diluted Hydrocyanic Acid to dryness on a water bath.

Hydrogen Chloride—Pour 5 cc. of Diluted Hydrocyanic Acid into a tared, 100 cc. glass-stoppered flask containing 25 cc. of distilled water, accurately determine the weight of the Acid added and then add 50 cc. of tenth-normal silver nitrate and enough distilled water to make 100 cc. Agitate it well and filter through a dry filter, rejecting the first 10 cc. of the filtrate. In 50 cc. of the clear filtrate determine the excess of silver nitrate by titration with tenth-normal potassium

sulphocyanate, previously adding 2 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S. From the number of cc. of tenth-normal silver nitrate consumed in this assay subtract twice the number of cc. of tenth-normal silver nitrate consumed in the assay of the same quantity of diluted Hydrocyanic Acid as ascertained below. The difference when calculated to free hydrogen chloride, using the factor 0.003647, does not amount to more than one-tenth of 1 per cent of the weight of Diluted Hydrocyanic Acid originally taken for the determination.

Assay—Pour about 5 cc. of Diluted Hydrocyanic Acid into a 100 cc. flask containing 25 cc. of distilled water and 5 cc. of potassium hydroxide T.S., the whole having been previously tared, and weigh the Acid accurately. Then add 3 drops of potassium iodide T.S. and titrate with tenth-normal silver nitrate, to the production of a slight permanent precipitate. It shows not less than 1.9 per cent nor more than 2.1 per cent of HCN. Each cc. of tenth-normal silver nitrate V.S. used corresponds to 0.005404 Gm. of HCN. Each gram of Diluted Hydrocyanic Acid corresponds to not less than 3.5 cc. nor more than 3.9 cc. of tenth-normal silver nitrate.

This solution consists of the very poisonous compound HCN in water. *Cyanogen*, CN or Cy, does not exist free in nature, but compounds of it are found in plants and these compounds are called cyanogenetic. It was the first compound radical discovered. It is more closely related to the halogens in the character of its combinations than any other class of bodies. It unites with hydrogen to form hydrocyanic acid, HCN, and its compounds with metals and bases are termed cyanides. These have been considered in previous chapters.

Scheele's hydrocyanic acid is a stronger solution, containing about 5 per cent of the anhydrous acid. Its use should be discouraged as unnecessary, tending to create confusion, and dangerous. Diluted hydrocyanic acid frequently decomposes upon keeping, a black insoluble precipitate (*paracyanogen*) forming in the bottle. This decomposition may be prevented by the addition of a small quantity of hydrochloric acid. The use of cork-stoppered vials is said to be an advantage.

Uses—Diluted hydrocyanic acid is used as a cough sedative in doses of one to three minims (0.05 to 0.2 cc.). Potassium or sodium cyanide is often prescribed in combination with an acid and syrup, so that hydrocyanic acid may be generated and dissolved.

SINAPIS NIGRA. U. S. Black Mustard

[**Sinap. Nig.**—Brown Mustard, Black Mustard Seed, Red Mustard Seed]

Black Mustard is the dried ripe seed of *Brassica nigra* (Linné) Koch and *Brassica juncea* (Linné) Cosson and varieties related to these species (Fam. *Cruciferæ*).

Black Mustard contains not more than 5 per cent of other seeds or other foreign organic matter, and yields not less than 0.6 per cent of volatile oil of mustard (calculated as allyl isothiocyanate).

Description—About 2 mm. in diameter, almost globular, with a circular hilum; testa blackish-brown or grayish-brown, finely pitted, hard; embryo oily, with a curved radicle, and two cotyledons, one folded over the other; free from starch; inodorous when dry, but when triturated with water, of a pungent, penetrating irritating odor; taste pungent and acrid.

For further description see the U. S. P. X.

U. S. P. Preparation—Emplastrum Sinapis.

Black mustard contains *sinigrin* or potassium myronate ($KC_{10}H_{19}NS_2O_{10}$), *myrosin*, a ferment, 25 per cent of fixed oil, mucilage, etc. Under the influence of the myrosin and water, the potassium myronate is converted into *allyl isothiocyanate*, or volatile oil of mustard. This action takes place at ordinary temperature, and explains the pungent odor and taste of aqueous mixtures of ground mustard. *Mustard Plaster* is official (see *Emplastrum Sinapis*)

Uses—It is used as a condiment, stimulant, and emetic; externally, it is rubefacient. When Brown Mustard is prepared as a condiment by the addition of vinegar, salt, and water, the product is known as *German Prepared Mustard*. Both white and black mustard are used in making home made poultices. It is chiefly used as a counter-irritant in the form of "*mustard plasters*", made by mixing it with varying amounts of wheat flour and adding sufficient tepid water to make a paste. It is occasionally used as a gastric and intestinal stimulant. In doses of one to three drachms (4 to 12 Gm.) it is an active, although unpleasant emetic, especially useful in certain poisonings.

SINAPIS ALBA. U.S.P. IX. White Mustard

[Sinap. Alb.—Yellow Mustard]

The ripe seeds of *Sinapis alba* Linné (Fam. *Cruciferæ*), without the presence or admixture of more than 5 per cent of other seeds or other foreign matter.

Official Description—Sub-globular, from 1.5 to 2.5 mm. in diameter; testa yellowish nearly smooth; embryo yellowish, oily, with two large cotyledons.

Odor and Taste—Inodorous, taste mildly pungent, acrid.

Tests for Identity and Purity—The powder is light yellowish or pale brownish-yellow, developing a slight odor when moistened; examined under the microscope, it exhibits numerous tissues of the embryo containing small aleurone grains and a fixed oil, the latter forming in large globules on the addition of chloral hydrate T.S.; fragments of seed-coat comparatively few, nearly colorless, with small characteristic stone cells and large epidermal cells, the outer walls being mucilaginous. The powder contains few or no starch grains.

White Mustard does not yield allyl isothiocyanate upon distillation with steam (distinction from *black mustard*).

White Mustard yields not more than 9 per cent of ash.

Preserve powdered White Mustard in tightly-closed containers.

White mustard seed contains *sinalbin*, $C_{30}H_{44}N_2O_{16}S_2$, a crystalline glucoside, which, under the influence of a peculiar ferment, *myrosin*, and water, is split into *acrinyl isothiocyanate*, C_8H_7NOS, which is a pungent, non-volatile substance (this is not the official oil of mustard), *sinapine sulphate*, $C_{16}H_{23}NO_5H_2SO_4$, and glucose. The seed contains in addition 20 per cent of fixed oil, mucilage, gum, etc., but no starch.

Uses—It is used as a stimulant, condiment, and emetic; externally, it is rubefacient, but it is inferior to the black mustard. Hot water destroys the ferment myrosin, and prevents the development of the pungent principle. The emetic dose is two and one-half drachms (10 Gm.) mixed with a little water.

When prepared as a condiment with vinegar, salt, and water, the product is commonly known as *English Prepared Mustard.*

OLEUM SINAPIS VOLATILE. U.S. Volatile Oil of Mustard

[Ol. Sinap. Vol.—Mustard Oil]

The volatile oil obtained by maceration with water and subsequent distillation of the dried ripe seed (freed from fixed oil) of *Brassica nigra* (Linné) Koch or of *Brassica juncea* (Linné) Cosson (Fam. *Cruciferæ*), or prepared synthetically. The label must state the botanical source or that it was made synthetically.

Volatile Oil of Mustard yields not less than 93 per cent of allyl isothiocyanate [C_3H_5NCS = 99.13].

Caution—Great care must be exercised in smelling this Oil. It should be tasted only when highly diluted.

Preparation—Chemically, this oil is *allyl isothiocyanate*, or *allyl thiocarbamide* $CS.NC_3H_5$; it is also called *allyl sulphocyanide.* Its production is explained in the preceding article. It is prepared artificially by the action of *allyl iodide* upon a solution of *potassium sulphocyanate.*

Description and Physical Properties—A colorless or pale yellow, strongly refractive liquid, having a very pungent, irritating odor, and an acrid taste.

Tests for Identity and Purity—Volatile Oil of Mustard is soluble in all proportions in alcohol, ether, and carbon disulphide.

Specific gravity: 1.013 to 1.020 at 25° C.

Optical rotation: inactive, page 1524.

Refractive index: 1.5268 to 1.5280 at 20° C., page 1525.

An alcoholic solution of the recently distilled oil is neutral to moistened litmus paper.

The addition of 1 drop of ferric chloride T.S. to 1 cc. of the Oil, diluted with 5 volumes of alcohol, does not produce a blue coloration (*phenols*).

The Oil distils completely between 148° and 154° C. Both the first and last 10 per cent portions of the distillate have practically the same specific gravity as the original Oil (*alcohol, chloroform, petroleum, or fatty oils*).

Assay—Dilute about 4 cc. of Volatile Oil of Mustard, accurately weighed, with sufficient alcohol to make exactly 100 cc. Transfer 5 cc. of this solution by means of a pipette to a 100 cc. measuring flask, and add 50 cc. of tenth-normal silver nitrate and 5 cc. of ammonia T.S. Connect the flask to a reflux condenser, and heat it on a bath of boiling water for one hour. Allow the liquid to cool to room temperature, disconnect the flask from the condenser, add sufficient distilled water to measure 100 cc., mix well, and filter. To 50 cc. of the filtrate, accurately measured

add about 5 cc. of nitric acid and 2 cc. of ferric ammonium sulphate T.S., and titrate the excess of silver nitrate with tenth-normal potassium thiocyanate. Each cc. of tenth-normal silver nitrate corresponds to 0.004957 Gm. of allyl isothiocyanate.

This assay is explained on page 1463.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

N. F. Preparations—Linimentum Sinapis Compositum; Spiritus Sinapis; Unguentum Sinapis.

Uses—Volatile oil of mustard is used as a powerful rubefacient; it must be handled with great care; it is rarely given internally. Dose, one-eighth minim (0.008 cc.).

ALLIUM. N. F. Garlic

Garlic is the fresh bulb of *Allium sativum* Linné (Fam. *Liliaceæ*).

It contains a sulphuretted volatile oil having an exceedingly pungent odor and a strong acrid taste.

Official Description—Bulb sub-globular, from 4 to 6 cm. in diameter, compound, consisting of from eight to fifteen bulbels and surrounded by one or two dry, whitish, membranaceous scales and attached to a flattened circular base, from the lower portion of which arise numerous yellowish-white roots; bulbels more or less ovoid, in transverse section three to four sided, the outer surface being convex, summit acute and narrowed into a thread-like fibrous portion, base, truncate, each bulbel covered by one or two layers of whitish, membranaceous, scale-like leaves, beneath which is the light brown or pinkish, thin and coriaceous layer of epidermis, cohering but easily separable from the solid portion of the bulbel.

Odor and Taste—Odor of broken or bruised bulbels powerfully alliaceous; taste intensely pungent and persistent.

Tests for Identity and Purity—Under the microscope, transverse sections of the bulbel show three distinct portions: (a) the large fleshy scale consisting chiefly of parenchyma enclosing scattered vascular bundles, epidermis in both ventral and dorsal surfaces consisting of small tubular cells; (b) the middle layer nearly circular in outline, about 0.75 mm. in diameter, the tissues resembling those of the outer fleshy scale, but the cells containing numerous yellowish-brown plastids; (c) an innermost bright green layer consisting of a single leaf folded lengthwise along the midrib so that the ventral surfaces lie close together.

N. F. Preparation—Syrupus Allii.

Uses—It is sometimes employed as a rubefacient, carminative and condiment. The syrup is used as an expectorant. The dose is thirty grains (2 Gm.).

Unofficial Nitrogenated or Sulphurated Volatile Oils, Drugs, and Allied Products

Oil of Asafetida	From *Asafetida*. Fam. *Umbelliferæ*. Habitat, Western Tibet. The yield is about 6 to 9 per cent
Bitter Candytuft	*Iberis amare* contains a sulphurated volatile oil
Common Scurvy Grass	From the herb of *Cochlearia officinalis*. Fam. *Cruciferæ*. Habitat, Europe
Cress	The seed of *Lepidium sativum*. Fam. *Cruciferæ*. Contains a sulphurated volatile oil
Oil of Garlic Allyl sulphide $(C_3H_5)_2S$	Obtained artificially by decomposing allyl iodide with an alcoholic solution of potassium sulphide
Hedge Garlic	*Alliaria officinalis*. Fam. *Cruciferæ*. Contains a sulphurated oil
Horseradish	From the root of *Cochlearia Armoracia*. Fam. *Cruciferæ*. Habitat, Europe. The yield is about $\frac{1}{10}$ per cent
Mace (N. F. IV)	The arillode of the seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceæ*). A flavor and aromatic; dose, eight grains (0.5 Gm.)
Parsley Fruit (U. S. P. IX)	The dried ripe fruit of *Petroselinum sativum* Hoffman (Fam. *Umbelliferæ*). The oleoresin is known as *Apiol*
Parsley Root (N. F. IV)	The dried root of *Petroselinum sativum* Hoffman (Fam. *Umbelliferæ*)
Radish	*Raphanus sativa* contains a sulphurated volatile oil
Sagapenum	From *Ferula persica*. The yield of volatile oil is small
Shepherd's Purse	The seeds of *Capsella bursa-pastoris* contain a sulphurated volatile oil
Wallflower	The seed of *Cheiranthus annuus* contains a sulphurated volatile oil
Wild Mustard	The seed of *Sisymbrium nasturtium* contains a sulphurated volatile oil
Wild Radish	The seed of *Raphanus Raphanistrum* contains a sulphurated volatile oil
Allyl Tribromide $C_3H_5Br_3$	A slightly yellowish liquid, identical with *Tribromhydrin;* sedative and anodyne in its action. Dose, five to six drops
Camphoric Acid $H_2C_{10}H_{14}O_4$ (U. S. P. VIII)	A dibasic organic acid [$C_8H_4(COOH)_2$], obtained by the oxidation of camphor. Used in the treatment of bronchitis and phthisis in doses of fifteen grains (1 Gm.)
Thiosinamin Allyl-sulpho-urea Allyl-sulpho-carbamide $CS\begin{cases}NH_2\\NH(C_3H_5)\end{cases}$	Used in tuberculous diseases, by subcutaneous injection, of four and one-half to seven grains (0.3 to 0.45 Gm.), in 15 per cent alcoholic solution

CHAPTER LXVIII

OFFICIAL DRUGS AND PRODUCTS CONTAINING VOLATILE OIL WITH SOFT RESIN

CUBEBA. U. S. Cubeb

[**Cubeb.**—Cubeb Berries, Java Pepper, Tailed Cubebs, Tailed Pepper]

Cubeb is the dried, nearly full-grown, unripe fruit of *Piper Cubeba* Linné filius (Fam. *Piperaceæ*).

Cubeb contains not more than 5 per cent of its shriveled fruits or stems, not more than 2 per cent of other foreign organic matter, and yields not less than 10 per cent of volatile ether-soluble extractive.

Description—Globular, about 4 to 5 mm. in diameter, contracted at the base into a rounded stipe about 6 or 8 mm. long, reticulately wrinkled, blackish-gray, internally whitish and hollow; odor strong, spicy; taste aromatic and pungent.

Assay—Proceed as directed under volatile ether-soluble extractive, page 1523.

For further description see the U. S. P. X.

N. F. Preparations—Elixir Buchu Compositum (from Compound Fluidextract of Buchu); Fluidextractum Buchu Compositum; Fluidextractum Cubebæ; Oleoresina Cubebæ; Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe; Tinctura Cubebæ.

History—Cubeb, being a close relative of pepper, was originally used as a popular and costly condiment. Later it came to be used as an ingredient in the preparation of the complex antidotal confections called *mithridates*. More than one hundred years ago it was used in a proprietary form of bronchial troche.

Uses—This useful fruit or berry, as it is commonly called, contains about 10 per cent of a volatile oil, 3 per cent of resin, *cubebin*, *cubebic acid*, wax, fat, etc. The virtues of cubeb reside in the cubebic acid, resin, and oil, cubebin when pure being destitute of activity. In dispensing the oleoresin of cubeb, any sediment should be discarded, as it consists of this inert cubebin. Cubebic acid, cubebic resin, and cubebin are all colored red by strong sulphuric acid. Cubeb is used as a stimulant in inflammatory states of the genito-urinary tract. It is also employed in the form of lozenges, for its local stimulating action, in relaxed conditions of the throat. It is sometimes used, either in the form of cigarettes or internally, in bronchitis in doses of fifteen to sixty grains (1 to 4 Gm.).

OLEUM CUBEBÆ. U. S. P. IX. Oil of Cubeb

[**Ol. Cubeb.**—Cubeb Oil]

A volatile oil distilled from the unripe fruit of *Piper Cubeba* Linné filius (Fam. *Piperaceæ*). Preserve it in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Description—A colorless or a pale green to yellowish-green liquid.

Odor, Taste, and Reaction—Characteristic odor and taste of cubeb. Its alcoholic solution is neutral to litmus.

Specific gravity: 0.905 to 0.925 at 25° C.

Test for Identity and Purity—Its optical rotation varies from −20° to −40° in a 100 mm. tube at 25° C. (77° F.).

The oil consists chiefly of sesquiterpenes which distil over between 250° and 280° C., one of which is *cadinene*, $C_{15}H_{24}$, with some dipentene, and probably pinene or camphene. Upon standing, it sometimes deposits rhomboidal prismatic crystals of a stearoptene which is formed by the prolonged action of the air and therefore does not occur in the oil distilled from new berries.

Uses—Oil of cubeb is used for the same purposes as cubeb. Dose, eight minims (0.5 cc.).

CAPSICUM. U. S. Capsicum

[**Capsic.**—Cayenne Pepper, African Chillies, Mexican Pepper, African Pepper, Sierra Leone Pepper, Red Pepper, Chillies, Zanzibar Capsicum, Zanzibar Chillies, Mombassa Chillies, African Bird Pepper]

Capsicum is the dried ripe fruit of *Capsicum frutescens* Linné (Fam. *Solanaceæ*), grown in Africa.

Capsicum contains not more than 3 per cent of its stems, calyxes, and not more than 1 per cent of other foreign organic matter, yields not less than 12 per cent of non-volatile ether-soluble extractive, and not more than 1.25 per cent of acid-insoluble ash.

Description—Oblong-conical, from 10 to 25 mm. long, supported by a flattish, cup-shaped, five-toothed calyx, with a red, shining, membranous and translucent pericarp, enclosing two cells and containing flat, reniform, yellowish seeds attached to a thick, central placenta. It has a peculiar odor, and an intensely hot taste.

Capsicum should meet the requirements of the following test: Mix well 1 Gm. of powdered Capsicum in 50 cc. of alcohol in a stoppered flask and macerate for twenty-hour hours. Dilute 0.1 cc. of the clear, supernatant liquid with 140 cc. of distilled water containing 10 per cent of sucrose; 5 cc. of this dilution swallowed at once will produce a distinct sensation of the pungency of Capsicum in the throat of at least two out of three individuals.

Assay—For non-volatile ether-soluble extractive proceed as directed on page 1523.

For further description see the U. S. P. X.

U. S. Preparations—Oleoresina Capsici; Tinctura Capsici.

N. F. Preparations—Mistura Chloroformi et Morphinæ Composita (from Tincture); Mistura Opii et Chloroformi Composita (from Tincture); Mistura Opii et Rhei Composita (from Tincture); Pulvis Aromaticus Rubefaciens; Pulvis Myricæ Compositus; Tinctura Capsici et Myrrhæ.

The principal constituents of capsicum are capsaicin, $C_9H_{14}O_2$, traces of a volatile alkaloid and a volatile oil, fixed oil, resin, coloring matter, etc. *Capsaicin* is in colorless crystals, volatile, intensely acrid, and soluble in alcohol, ether, and fixed oils.

Uses—Capsicum is used internally as a gastric and intestinal stimulant. Externally it is much used as a rubefacient and is the basis of numerous liniments and stimulating salves. Dose, one grain (0.06 Gm.).

COPAIBA. U. S. Copaiba

[**Copaib.**—Balsam of Copaiba, Copaiva, Balsam Capaiba, Balsam Capaiva]

An oleoresin derived from South American species of *Copaiba* (Fam. *Leguminosæ*).

Copaiba is mostly imported from Para in Brazil, Maracaibo in Venezuela, and other South American ports. It contains *copaivic acid*, a volatile oil, and a bitter principle. Copaivic acid, $C_{20}H_{30}O_2$, the resinous mass left after distilling the oil, forms a series of amorphous salts. (See Massa Copaibæ.) It may be obtained pure by exposing a mixture of nine parts of copaiba and two parts of aqueous ammonia (sp. gr. 0.95) to a temperature of 10° C. Copaiba is often adulterated.

Oil of copaiba was official in the U. S. P. VIII and was described as a colorless or pale yellow liquid having the characteristic odor of copaiba and an aromatic, slightly bitter and pungent taste. The specific gravity is from 0.985 to 0.905 at 25° C., increasing with age. It is levogyrate. It is used as a stimulant, and for the same purposes as copaiba. Dose, five to ten minims (0.3 to 0.6 cc.).

The U. S. P. description and tests for Copaiba are as follows:

Description and Physical Properties—A pale yellow to brownish-yellow, more or less viscid liquid, either without fluorescence or with only a slightly greenish fluorescence. It has a peculiar aromatic odor, and a persistent, bitter, acrid taste.

Copaiba is insoluble in water, partly soluble in alcohol, more completely soluble in dehydrated alcohol. It is soluble in carbon disulphide and in fixed or volatile oils, completely soluble in chloroform and in ether; also soluble in an equal volume of petroleum benzin, the further addition of the solvent producing a flocculent precipitate.

Specific gravity: 0.940 to 0.995 at 25° C.

Tests for Purity—Heat about 2 Gm. of Copaiba, accurately weighed, in a shallow dish on a water bath: no odor of oil of turpentine is evolved. Continue the heating until all of the volatile oil has been driven off; a resin remains, corresponding to not less than 36 per cent of the original weight of the Copaiba taken. This resin when cooled is hard and brittle (*paraffin or fatty oils*). Its acid number is not less than 28 and not more than 95, page 1512.

Shake 5 cc. of Copaiba with 15 cc. of alcohol, boil the mixture for one minute, and cool: no oil separates after standing for one hour (*paraffin oils*).

Mix one drop of nitric acid and 3 cc. of glacial acetic acid in a test tube, and carefully add four drops of the oil separated from the Copaiba by distillation with steam; no reddish zone appears, nor does the liquid become red or purple after being shaken (*gurjun balsam*).

Dissolve 2 Gm. of Copaiba in 40 cc. of dehydrated alcohol, filter on counterbalanced filters or with the aid of a Gooch crucible, and wash with small portions of dehydrated alcohol until the washings are colorless or nearly so: the residue dried at 80° C. does not exceed 5 per cent.

The volatile oil separated from Copaiba by distillation with steam does not boil below 250° C., and shows an angle of rotation in a 100 mm. tube of not less than −7° at 25° C. (*African copaiba*).

N. F. Preparations—Massa Copaibæ; Mistura Copaibæ; Mistura Copaibæ et Opii.

Uses—Copaiba has a stimulant action upon the mucous membranes of the urinary passages. Dose, from fifteen minims to one fluidrachm (1 to 4 cc.).

MASSA COPAIBÆ. N. F. Mass of Copaiba

See page 488 for the formula and uses.

SANTALUM ALBUM. N. F. Sandalwood

[**Santal. Alb.**—White Sandalwood, Yellow Sandalwood]

Sandalwood is the heart-wood of *Santalum album* Linné (Fam. *Santalaceæ*).

Sandalwood yields not less than 3.5 per cent of volatile oil and contains not more than 1 per cent of foreign organic matter. It contains a volatile oil (see *Oleum Santali*).

Description—In billets, pieces or chips of varying shapes and sizes, heavy, hard but splitting easily, color light yellow to light brown. Odor characteristic, aromatic, persistent; taste peculiar strongly aromatic.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Santali Albi; Tinctura Sabal et Santali.

Uses—Used as a perfume, especially in sachet powders.

OLEUM SANTALI. U. S. Oil of Santal

[**Ol. Santal.**—Santalwood Oil, Oil of Sandalwood]

The volatile oil distilled from the dried heart-wood of *Santalum album* Linné (Fam. *Santalaceæ*).

Oil of Santal yields not less than 90 per cent of alcohols calculated as santalol [$C_{15}H_{24}O = 220.27$].

Description and Physical Properties—A pale yellow, somewhat viscid, oily liquid, having the characteristic odor and taste of sandalwood.

Tests for Identity and Purity—The Oil is soluble in 5 volumes of 70 per cent alcohol, by volume.

Specific gravity: 0.965 to 0.980 at 25° C.

Optical rotation: varies from −15° to −20° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.5040 to 1.5080 at 20° C., page 1525.

A solution of the recently distilled Oil in 70 per cent alcohol (1 in 5) is slightly acid to moistened blue litmus paper.

Assay—Proceed as directed for total menthol under *Oleum Menthæ Piperitæ*, page 1461, using 10 cc. of Oil of Santal. Use the following formula in calculating the per cent of santalol.

$$\text{Per cent of santalol} = \frac{A \times 11.01}{B - (A \times 0.021)}$$

A is the result obtained by subtracting the number of cc. of half-normal sulphuric acid required in the titration from the number of cc. of half-normal alcoholic potassium hydroxide originally taken, and *B* is the weight of the acetylized oil taken.

This assay is explained on page 1461.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This is an oxygenated oil containing two constituents, one of which is called *santalol*, $C_{15}H_{26}O$, boiling at 310° C., and the other *santalal*, $C_{15}H_{24}O$, boiling at 300° C. Both of these are decomposed by distilling over phosphoric anhydride, the one yielding $C_{15}H_{24}$, boiling at 260° C., and the other $C_{15}H_{22}$, boiling at 245° C. Sesquiterpenes are also believed to be present in oil of santal. It is often grossly adulterated; the proportion of santalol is recognized by an official assay (see above).

Uses—It is eliminated chiefly by the kidneys and is a fairly effective urinary antiseptic. It is used particularly in subacute or chronic urethritis and cystitis. The oil, at times, is disturbing to the stomach and medicinal doses may cause irritation of the bladder with dysuria and pain in the kidney region and urethra. It is also less frequently employed in bronchitis. It is generally administered in capsules or pearls. Dose, five to fifteen minims (0.3 to 1 cc.).

Spurious oils are sometimes sold under the name of *West India Sandalwood Oil*. An *Australian Sandalwood* oil has recently been introduced largely for perfumery purposes. It is being used abroad to some extent medicinally but has not been recognized by the U. S. P.

Unofficial Sandalwood Oil Derivatives

The advantage claimed for the new derivatives of santal oil is that they are less irritating than the oil itself.

Arheol, N.N.R.—Santalol—A sesquiterpenic alcohol, the chief constituent of sandalwood oil. Arheol contains not less than 98 per cent of santalol.

Arheol Capsules—Arheol 0.2 Gm. (3 grains).

A colorless, oily liquid; specific gravity about 0.968 at 15° C. It is insoluble in water but soluble in alcohol. It boils under 11 mm. pressure at 169° C., and under ordinary pressure at about 300° C.

Uses—The action of Arheol is the same as that of sandalwood oil. It is used in urethritis, cystitis and vesical catarrh, especially from gonorrhea.

The dose is from 6 to 10 grains (0.4 to 0.6 Gm.).

Manufactured by P. Astier Laboratories, Paris and New York (George J. Wallau, Inc., New York).

Santyl, N.N.R.—Santalolis Salicylas—Salicylic Ester of Santalol—Santalyl Salicylate—$C_6H_4OH.COO(C_{15}H_{23})$—The salicylic acid ester of santalol.

Uses—It is said that Santyl passes the stomach unchanged, but is slowly split up in the intestines into its constituents, santalol and salicylic acid. Santyl is claimed to have the same action as sandalwood oil, except that because of the slow liberation of santalol, it produces less irritation of the gastro-intestinal tract or of the kidneys and urinary passages, and no unpleasant odor or eructations.

It is claimed to be useful in the same manner as santal oil for gonorrheal urethritis.

The dose is 24 minims (1.5 cc.), usually given in 4 capsules of 6 minims each, three times a day. It is incompatible with alkalies and with the usual incompatibilities of the sandalwood oil and of salicylates.

Manufactured by E. Bilhuber, Inc., New York.

BUCHU. U.S. Buchu

[Buchu Leaves, Long and Short Buchu, Bookoo]

Buchu is the dried leaf of *Barosma betulina* (Thunberg) Bartling et Wendland, or of *Barosma crenulata* (Linné) Hooker, known in commerce as Short

Buchu; or of *Barosma serratifolia* (Curtis) Willdenow, known in commerce as Long Buchu (Fam. *Rutaceæ*).

Buchu contains not more than 8 per cent of its stems and not more than 2 per cent of other foreign organic matter.

Description—*Short Buchu*—Rhomboidally oval or obovate from 9 to 30 mm. in length and from 4 to 20 mm. in breadth; apex obtuse or rounded and sometimes recurved, base wedge-shaped or obtuse, margin finely dentate, glandular punctate, with an oil gland at the base of each tooth, papillose, longitudinally striate beneath, coriaceous and with a petiole about 1 mm. in length: color bright green to yellowish-green, occasionally olive-gray; odor aromatic and mint-like; taste camphoraceous.

Long Buchu—Linear-lanceolate from 12 mm. to 4 cm. in length and from 4 to 10 mm. in breadth; apex acute, somewhat rounded; margin sharply serrate. Otherwise resembles Short Buchu.

U. S. P. Preparation—Fluidextractum Buchu.

N. F. Preparations—Elixir Buchu (from Fluidextract); Elixir Buchu Compositum (from Compound Fluidextract); Elixir Buchu et Potassii Acetatis (from Elixir of Buchu); Fluidextractum Buchu Compositum.

This drug owes its valuable properties to the presence of a volatile oil and a resin. It also contains a bitter principle, mucilage, etc. The stearoptene, *diosphenol*, is colored dark green by ferric chloride.

Uses—Buchu is used chiefly in cystitis. Dose, thirty grains (2 Gm.).

SERPENTARIA. U. S. Serpentaria

[**Serpent.**—Texas Snakeroot, Virginia Snakeroot]

Serpentaria consists of the dried rhizome and roots of *Aristolochia Serpentaria* Linné, known in commerce as Virginia Snakeroot, or of *Aristolochia reticulata* Nuttall, known in commerce as Texas Snakeroot (Fam. *Aristolochiaceæ*).

Serpentaria contains not more than 10 per cent of its over-ground stems and not more than 2 per cent of other foreign organic matter, and yields not more than 10 per cent of acid-insoluble ash.

Description—The rhizome is about 25 mm. long, thin, bent; on the upper side with approximate, short stem-bases; on the lower side with numerous, thin, branching roots about 10 cm. long; dull yellowish-brown, internally whitish; the wood-rays of the rhizome longest on the lower side; odor aromatic, camphoraceous; taste warm, bitterish, and camphoraceous.

For further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Cinchonæ Composita.

N. F. Preparations—Fluidextractum Serpentariæ; Tinctura Serpentariæ.

This rhizome, when fresh, contains 1 per cent of volatile oil, a bitter principle, starch, sugar, etc. It yields its virtues to hydroalcoholic menstrua.

Uses—It is a bitter tonic. Dose, fifteen grains (1 Gm.).

CANNABIS. U. S. Cannabis

[**Cannab.**—Cannabis Indica, Guaza, Ganjah, Bhang, Hasheesh, Charas, Indian Hemp, Hemp, American Indian Hemp, Foreign Indian Hemp, Bangue Hemp, Halish (with specification as to origin), Cannabis American Indian Hemp]

Cannabis is the dried flowering tops of the pistillate plants of *Cannabis sativa* Linné (Fam. *Moraceæ*).

Cannabis, in the form of the fluidextract, administered by the mouth to dogs in doses not exceeding 0.1 cc. for each kilogram of body weight of dog, produces a degree of incoördination equivalent to that caused by the same dose of the standard fluidextract of cannabis, prepared as directed on page 408. It contains not more than 10 per cent of its fruits, large foliage leaves, stems over 3 mm. in diameter, and not more than 2 per cent of other foreign organic

matter. It yields not more than 5 per cent of acid-insoluble ash, and not less than 8 per cent of alcohol-soluble extractive.

Description—In separate tops or more or less agglutinated masses or fragments, consisting of the short stems with their leaf-like bracts and pistillate flowers or more or less developed fruits; color green to dark green or greenish-brown; odor agreeable, somewhat heavy and narcotic; taste somewhat acrid and pungent.

Leaves digitately compound, usually broken. Leaflets when entire, linear lanceolate, nearly sessile, margin deeply serrate. Bracts ovate, pubescent, each enclosing 1 or 2 pistillate flowers or more or less developed fruits. Calyx dark green, pubescent and somewhat folded around the ovary. Styles, 2, filiform and pubescent. Ovary with a single campylotropous ovule. Stems cylindrical, longitudinally furrowed, light green to light brown, strigose-pubescent.

Structure of Stem—Cortex composed of collenchyma and, in the larger stems, of numerous strands of more or less lignified bast-fibers; strongly lignified wood with medullary rays 1-cell wide; pith, often hollow; rosette aggregates of calcium oxalate numerous.

Assay—Prepare a fluidextract and proceed as directed under Biological Assays (Chapter LXXXIX).

The details of this assay and an explanation will be found on page 1507.

U. S. P. Preparations—Extractum Cannabis; Fluidextractum Cannabis.

N. F. Preparations—Collodium Salicylici Composita (from Fluidextract); Mistura Chlorali et Potassii Bromidi Composita (from Extract); Mistura Chloroformi et Morphinæ Composita (from Tincture); Tinctura Cannabis.

Cannabis contains a resinous substance, *cannabinine*, volatile oil, *cannabinol*, and *tetanocannabinine*. Alcohol is the best solvent for the active principles. The Pharmacopœia has permitted the use of cannabis sativa, no matter where grown, provided it conforms to the biological standard. Much cannabis is now cultivated in America and in tropical countries. The standardization of the drug and all of its preparations is required.

Uses—It is used as an anodyne and nerve sedative. Dose, one grain (0.06 Gm.).

VALERIANA. U. S. Valerian

[**Valer.**—Garden Valerian]

Valerian consists of the dried rhizome and roots of *Valeriana officinalis* Linné (Fam. *Valerianaceæ*).

Valerian contains not more than 5 per cent of foreign organic matter and yields not more than 10 per cent of acid-insoluble ash.

Description—Rhizome from 2 to 4 cm. long, and 1 to 2 cm. thick, upright, sub-globular or obconical, truncate at both ends, brown or yellowish-brown, internally whitish or pale brownish, with a narrow circle of white wood under the thin bark. Roots numerous, slender, brittle, brown, with a thick bark, and slender ligneous cord. Odor peculiar, becoming stronger and unpleasant on keeping; taste camphoraceous and somewhat bitter.

For further description see the U. S. P. X.

U. S. P. Preparations—Tinctura Valerianæ; Tinctura Valerianæ Ammoniata.

N. F. Preparation—Fluidextractum Valerianæ.

Valerian contains about 1 per cent of volatile oil, valeric acid, resin, starch, tannin, etc.; there are also present some acetic and formic acids. Alcohol and ether are good solvents for the active principles.

Uses—It is used as a nervine. Dose, thirty grains (2 Gm.).

OLEUM CHENOPODII. U. S. Oil of Chenopodium

[**Ol. Chenopod.**—Oil of American Wormseed]

The volatile oil distilled with steam from the fresh, over-ground parts of the flowering and fruiting plant of *Chenopodium ambrosioides* var. *anthelminticum* (Linné) A. Gray (Fam. *Chenopodiaceæ*). Oil of Chenopodium yields not less than 65 per cent of ascaridol [$C_{10}H_{16}O_2$ = 168.18].

Description and Physical Properties—A colorless or pale yellowish liquid, having a peculiar, disagreeable odor, and a bitter, burning taste.

Tests for Identity and Purity—The Oil is soluble in not more than 8 volumes of 70 per cent alcohol, by volume.

Specific gravity: 0.955 to 0.980 at 25° C.

Optical rotation: varies from −4° to −10° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4723 to 1.4770 at 20° C., page 1525.

The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Assay—Place 10 cc. of Oil of Chenopodium, measured from a pipette, in a 100 cc. cassia flask, add 50 cc. of a solution of acetic acid, made by diluting 60 cc. of glacial acetic acid with distilled water, to measure 100 cc. Shake the mixture well, add sufficient of the acetic acid solution to raise the lower limit of the oily layer within the graduated portion of the neck, and allow the liquids to separate, rotating the flask from time to time. Note the volume of the oily layer. It measures not more than 3.5 cc., indicating the presence of not less than 65 per cent by volume of ascaridol.

This assay is explained on page 1483.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil consists of two distinct portions, separable by distillation; one of these has the formula $C_{10}H_{16}$, and is probably limonene; the other is heavier and possesses the formula $C_{10}H_{16}O_2$. This constitutes over 50 per cent of the commercial oil and has been given the name *ascaridol*, which is an unstable organic oxide, decomposing with explosive violence with inorganic acids.

Uses—It is used as an anthelmintic, and is best administered as an emulsion, first mixing the oil with twice its volume of olive oil. Its taste is so offensive to children, to whom it is almost exclusively given in the treatment against intestinal worms, that the emulsion should be flavored with methyl salicylate, aromatic oils, or other substances. The oil has caused death in doses of half a fluidrachm. In some cases the diluted oil may be given in capsules. Dose, fifteen minims (1 cc.).

OLEUM JUNIPERI. U. S. Oil of Juniper

[Ol. Junip.—Juniper Oil, Oil of Juniper Berries]

The volatile oil distilled from the dried ripe fruit of *Juniperus communis*, Linné (Fam. *Pinaceæ*).

Description and Physical Properties—A colorless or faintly green or yellow liquid, having the characteristic odor and taste of juniper berries.

Tests for Identity and Purity—The Oil is soluble in 4 volumes of alcohol, with not more than a slight cloudiness.

Specific gravity: 0.854 to 0.879 at 25° C.

Optical rotation: varies from 0° to −15° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4790 to 1.4840 at 20° C., page 1525.

A solution of the recently distilled Oil in alcohol (1 in 4) is neutral or only slightly acid to moistened litmus paper.

The Oil meets the requirements of the test for *heavy metals in volatile oils*, page 1519.

Preserve in well-stoppered, completely filled, amber-colored bottles, in a cool place, protected from light.

Oil of juniper (berries) is composed essentially of two hydrocarbons, the more abundant of which, boiling at 160° C., has been shown by Wallace to be *pinene*, $C_{10}H_{16}$. Above 175° C. another oil is obtained, which seems to be *cadinene*, $C_{15}H_{24}$. It also contains a small amount of an ester to which the peculiar juniper-like odor and taste was supposed to be due, but this cannot be the case, as the odor persists after the complete saponification of the small amount of ester. *Juniper camphor* is also present, its melting point being 165° to 166° C. It was formerly used in making the spirit and compound spirit of juniper (see page 315).

N. F. Preparation—Acetum Aromaticum.

Uses—It has diuretic and stimulant properties. Dose, one and one-half minims (0.1 cc.).

ARALIA. N. F. Aralia

[**Aral.**—American Spikenard, Spignet]

Aralia is the dried rhizome and root of *Aralia racemosa* Linné (Fam. *Araliaceæ*).

Aralia contains not over 5 per cent of its stems, bases, or other foreign organic matter.

Description—Rhizome of oblique growth, about 12 cm. in length and 5 cm. in thickness, somewhat flattened, tortuous, externally pale brown, somewhat annulately roughened, frequently cut longitudinally, whitish internally; nodes approximate, each with a prominent stem scar about 3 cm. in breadth; fracture fibrous; roots numerous, of varying length, from 5 to 25 mm. in thickness, usually cut longitudinally and furrowed, sometimes with transverse ridges and corky patches; light brown or purplish-brown externally, whitish and spongy or porous internally; fracture of the cortex short, of the wood short and fibrous. Odor aromatic; taste mucilaginous, pungent, and slightly acrid.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Araliæ; Syrupus Pini Albæ Compositus; Syrupus Pini Albæ Compositus cum Morphina.

The principal constituents are resin, a little volatile oil, starch, and pectin.

Uses—A mild aromatic and diaphoretic. Dose, thirty grains (2 Gm.).

CANELLA. N. F. Canella

[**Canel.**—White Cinnamon, Wild Cinnamon]

Canella is the dried rossed bark of *Canella Winterana* (Linné) Gaertner (Fam. *Canellaceæ*).

Canella contains not more than 2 per cent of foreign organic matter. It contains an acrid volatile oil, resin, and a bitter extractive.

Description—In quills usually from 1 to 3 cm. in length and from 1 to 4 cm. in thickness, occasionally two or three times this size, or in irregular fragments of quills, from 1.5 to 5 mm. in thickness and 2 to 3 cm. in width, the outer periderm mostly removed; outer surface light brownish-yellow or pale orange-brown, more or less scaly with a few very shallow fissures, often more or less reticulate with slight ridges; inner surface paler, somewhat smooth, but showing coarse, longitudinal striæ; fracture short and sharp, pale yellow, with an irregular, slightly darker band just inside of the center. Odor slight unless the bark is heated, then aromatic, resembling that of cinnamon; taste aromatic, warm, somewhat bitter and mucilaginous.

For further description see the N. F. V.

N. F. Preparation—Pulvis Aloes et Canellæ.

Uses—A mild, aromatic tonic in doses of thirty grains (2 Gm.).

GALANGA. N. F. Galangal

[East India Root, East India Catarrh Root]

Galangal is the dried rhizome of *Alpina officinarum* Hance (Fam. *Zingiberaceæ*).

Description—Irregularly branched, from 2 to 10 cm. in length and from 1 to 2 cm. in thickness, the branches thinner toward the base; marked with the fine annuli of the leaf bases, which are from 3 to 10 mm. apart and of lighter color than the general surface; externally reddish- or rusty-brown; internally of a lighter orange-brown; cut ends of the branches circular, with recurved margin; fracture fibrous. Odor aromatic and agreeable; taste hot, spicy, resembling ginger.

N. F. Preparation—Tinctura Aromatica.

It contains about 0.5 per cent of a volatile oil, containing cineol, also a soft acrid resin, a fixed oil, and certain active principles known as *galangin*, $C_{15}H_{10}O_5$, and *galangol*.

Uses—Employed as an aromatic and carminative. The dose is fifteen grains (1 Gm.).

HUMULUS. N. F. Hop

(U. S. P. IX)

[**Humul.**]

Hop is the carefully dried strobile of *Humulus Lupulus* Linné (Fam. *Moraceæ*), bearing their glandular trichomes. Hop contains not more than 2 per cent of stems, leaves, or other foreign matter, and yields not more than 5 per cent of acid-insoluble ash.

Description—Ovate, about 3 cm. long, consisting of a thin, hairy, undulated axis, and many obliquely ovate, membranous scales, in the upper part reticulately veined, and towards the base parallel-veined, glandular, and surrounding a sub-globular achene; color of the scales greenish, free from reddish or brownish spots; odor aromatic; taste bitter, aromatic, and slightly astringent.

For further description see the N. F. V.

Uses—Hops are an aromatic bitter, useful in atonic dyspepsia. Dose, thirty grains (2 Gm.).

IRIS. N. F. Orris

[Orris Root, Florentine Orris, Verona Orris]

Orris is the dried rhizome of *Iris florentina* Linné, *Iris germanica* Linné, or *Iris pallida* Lamarck (Fam. *Iridaceæ*), freed from the roots, peeled, and dried.

Orris contains not more than 1 per cent of foreign organic matter.

It contains a peculiar, fat-like volatile oil and a soft, acrid resin. The oil is known as *orris butter* and contains the ketone *irone*. It also contains a glucoside *iridin*, $C_{24}H_{26}O_{13}$.

Description—In pieces of various forms and sizes, usually jointed and branched, from .5 to 10 cm. in length and from 1.5 to 3 cm. in width, rounded or flattened, with knotty enlargements; under surface shows numerous root scars, the upper with leaf scars; externally yellowish-white; internally light yellow; fracture hard, rough and at times mealy, showing a narrow cortex, a distinct endodermis and a large stele with numerous fibro-vascular bundles, especially near the endodermis. Odor fragrant, resembling that of violet flowers; taste slightly aromatic, bitterish, somewhat irritating.

For further description see the N. F. V.

N. F. Preparation—Species Pectorales.

Uses—Rarely employed in medicine, although it has been used as a diuretic and errhine. Largely used in perfumery and tooth preparations.

JUNIPERUS. N. F. Juniper Berry

[**Junip.**—Horse Savin Berries]

Juniper berry is the carefully dried, ripe fruit of *Juniperus communis* Linné (Fam. *Pinaceæ*). Juniper Berry contains not more then 10 per cent of immature or discolored berries and not more than 3 per cent of foreign organic matter.

They contain a volatile oil which is official, also about 10 per cent of resin, and a yellow coloring matter called *juniperin*.

Description—Nearly globular, about 8 mm. in diameter; externally smooth, shining black-brown to purplish-black with a blue-gray bloom, at the apex a three-rayed furrow marks the cohesion of the three fleshy bracts forming the pericarp; internally loosely fleshy, greenish-brown, containing numerous large schizogenous cavities; seeds three, triangular ovate, hard, brown, with large uneven oil glands on the surface. Odor aromatic; taste sweet, pleasant, terebinthinate, slightly bitter.

For further description see the N. F. V.

N. F. Preparation—Elixir Buchu Compositum (from Compound Fluidextract of Buchu); Fluidextractum Buchu Compositum; Fluidextractum Juniperi.

Uses—A stimulant diuretic in doses of one drachm (4 Gm.).

LUPULINUM. N. F. Lupulin

Lupulin consists of the glandular trichomes separated from the strobiles of *Humulus Lupulus* Linné (Fam. *Moraceæ*).

Lupulin yields not less than 60 per cent of ether-soluble extractive and not more than 10 per cent of acid-insoluble ash.

Description—Bright brownish-yellow, becoming yellowish-brown, resinous, consisting of minute granules, which, as seen under the microscope, are sub-globular, or rather hood-shaped, and reticulate; aromatic and bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Lupulini.

Lupulin contains 10 per cent of volatile oil, which, on exposure, yields valeric acid trimethylamine, a bitter principle (lupamaric acid), $C_{82}H_{50}O_7$, resin, wax, and an alkaline liquid termed *lupuline*. Alcohol and ether are the best solvents. An oleoresin was official in the N. F. IV (see page 447).

Uses—As an antispasmodic and nerve sedative. Dose, five to eight grains (0.3 to 0.5 Gm.).

MATICO. N. F. Matico

[**Matic.**]

Matico is the dried leaf of *Piper angustifolium* Ruiz et Pavon (Fam. *Piperaceæ*).

Matico contains not more than 5 per cent of stems, flower spikes, or other foreign organic matter, and yields not more than 6 per cent of acid-insoluble ash.

Matico leaves contain about 2 per cent of volatile oil, a pungent resin, a crystalline principle, *artanthic acid*, and tannin.

Description—Usually in compressed, matted masses with leaves more or less broken; leaves sub-sessile, lanceolate, from 10 to 20 cm. in length and from 2 to 5 cm. in breadth; summit tapering and acute; base slightly unequal, cordate, margin finely crenulate; upper surface dark green, tesselated; lower surface pale green, reticulate, with prominent, yellowish-brown midrib and veins forming small quadrangular meshes clothed with matted pubescence. Odor distinct, aromatic; taste pungent, pepper-like.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Matico.

Uses—It is used as a stimulant and hemostatic in doses of one drachm (4 Gm.).

MYRICA. N. F. Bayberry Bark

[**Myric.**—Wax Myrtle Bark, Candleberry Bark]

Bayberry bark is the dried bark of the root of *Myrica cerifera* Linné or *Myrica caroliniensis* Miller (Fam. *Myricaceæ*).

Bayberry bark contains not more than 5 per cent of adhering wood or other foreign organic matter.

It contains volatile oil, an acrid resin, tannin, and *myricinic acid.*

Description—In quills or quilled pieces or strips, of variable length and up to 20 mm. in breadth, the bark rarely exceeding 2 mm. in thickness; outer surface varying from dark brown to gray-brown, occasionally slightly silvery, somewhat lustrous, at least in patches, bearing occasional warts or slight transverse ridges, the periderm frequently much wrinkled; inner surface deep rusty-brown, finely short-striated and somewhat roughened; fracture short and weak, light brown in the outer layer, yellowish-brown in the inner layer. Odor characteristic, rather disagreeable; taste astringent, mildly bitter and slightly acrid.

For further description see the N. F. V.

N. F. Preparation—Pulvis Myricæ Compositus.

Uses—It is a sialogogue when chewed and has been used in toothache. It is an active errhine and has been employed as a tonic and astringent in doses of eight grains (0.5 Gm.).

PIPER. N. F. Pepper

(U. S. P. IX)

[Black Pepper]

Pepper is the dried, unripe fruit of *Piper nigrum* Linné (Fam. *Piperaceæ*). Pepper contains not more than 2 per cent of stems or other foreign matter.

Description—Globular, about 4 mm. in diameter, reticulately wrinkled, brownish-black or grayish-black, internally lighter, hollow, with an undeveloped embryo; odor aromatic; taste pungently spicy.

For further description see the N. F. V.

N. F. Preparations—Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe.

Black pepper contains piperine, 2 per cent of volatile oil, and a pungent resin soluble in alcohol and in ether. The oleoresin was formerly official, see page 447. The volatile oil is a terpene, $C_{10}H_{16}$.

Uses—The principal use of pepper is as a condiment and intestinal stimulant, and for the making of the oleoresin. Dose, eight grains (0.5 Gm.).

Piperine was official in the U. S. P. VIII and was described as a feebly basic substance ($C_{17}H_{19}NO_3$), obtained from pepper and other plants of the *Piperaceæ*. It is obtained by treating pepper with alcohol, evaporating the tincture to the consistence of an extract, submitting the extract to the action of an alkaline solution, by which the oleaginous matter is converted into soap, washing the undissolved portion with cold water, separating the liquid by filtration, treating the matter left on the filter with alcohol, and allowing the solution thus obtained to evaporate spontaneously, or by a gentle heat. Crystals of piperine are deposited and may be purified by alternate solution in alcohol or ether and crystallization. Piperine is decomposed by alkalies in alcoholic solution into *piperic acid*, $C_{12}H_{10}O_4$, and *piperidine*, $C_5H_{11}N$. It is considered to be an alkaloid of feeble power. It consists of colorless or pale yellowish, glistening, monoclinic crystals; permanent in the air and containing no water of crystallization. Optically inactive. When put into the mouth, it is at first tasteless, but on prolonged contact develops a sharp, biting taste; odorless; neutral reaction; insoluble in water; soluble in 15 parts of alcohol at 25° C.; in 4.4 parts of alcohol at 60° C.; also soluble in 36 parts of ether and 1.7 parts of chloroform at 25° C.

Uses—Piperine has been used as a stimulant and as an antiperiodic. When absolutely pure it has but little medicinal action. Dose, three grains (0.2 Gm.).

POPULI GEMMÆ. N. F. Balsam Poplar Buds

[**Popul. Gem.**—Balm of Gilead Buds, Black Poplar Buds, Willow Poplar Buds]

Balsam Poplar Buds consist of the air-dried, closed, winter leaf-buds of *Populus nigra* Linné or *Populus candicans* Aiton, or *Populus balsamifera* Linné (Fam. *Salicaceæ*).

Balsam Poplar Buds contain not more than 10 per cent of flower buds and yield not more than 1 per cent of acid-insoluble ash.

They contain volatile oil and resin.

Description—Conical, pointed, up to 2 cm. in length and from 2 to 5 mm. in thickness, consisting of closely imbricated scales, externally brown and glossy, glutinous with fragrant resin. Odor pleasant, balsamic; taste aromatic and bitter.

N. F. Preparations—Syrupus Pini Albæ Compositus; Syrupus Pini Albæ Compositus cum Morphina.

Uses—A stimulating expectorant; also used in an ointment for application to sluggish sores.

SAMBUCUS. N. F. Sambucus

[**Sambuc.**—Elder Flowers]

Sambucus is the air-dried flowers of *Sambucus canadensis* Linné or of *Sambucus nigra* Linné (Fam. *Caprifoliaceæ*).

Sambucus contains not more than 2 per cent of foreign organic matter.

It contains small amounts of volatile oil, resin, sugar, and mucilage.

Description—Small, from 2 to 3 mm. in breadth, shriveled; calyx superior, five-lobed; corolla cream colored to brownish-yellow, rotate, flat, or slightly campanulate, regularly five-lobed; stamens five inserted at the base of the corolla and alternating with its lobes, filaments slender, anthers oblong, yellow; pollen ellipsoidal or tetrahedral and rounded, covered with finely punctate markings and having three pores. Odor faintly sweet and aromatic; taste slightly bitter.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Stillingiæ Compositum; Species Laxativæ.

Uses—It has little medicinal virtue, but is used in domestic practice in the form of infusion, ointment, or poultice, and for preparing *elder flower water* by distillation.

THUJA. N. F. Thuja

[Arbor Vitæ, White Cedar]

Thuja consists of the dried, leafy, young twigs of *Thuja occidentalis* Linné (Fam. *Pinaceæ*).

Thuja contains not more than 2 per cent of its stems over 4 mm. in diameter or other foreign organic matter. Only the recently dried drug should be used.

It contains a volatile oil, resin, tannin, *pinipicrin*, and *thujin*.

Description—Twigs, fan-shaped, flattened, bearing the scale-like leaves appressed in four rows; leaves of the edges boat-shaped, the intermediate flat, those at the tips of the twigs very broad, the lower elongated, all bearing conspicuous glands on the back. Odor strongly balsamic, aromatic and pungent; taste camphoraceous, terebinthinate and bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Thujæ.

Uses—A stimulant diuretic, and emmenagogue; dose thirty grains (2 Gm.)

Unofficial Substances Containing Volatile Oil and Resin

Alisma Water Plantain	From *Alisma plantago*—aquatica. Fam. *Alismaceæ*, indigenous to Europe. Contains an acrid resin
Oil of Water Plantain	A pungent oil
Cascarilla Sweet Bark (N. F. IV)	The dried bark of *Croton Eluteria* (Linné) Bennett (Fam. *Euphorbiaceæ*) without the presence of more than 5 per cent of adhering wood. It contains tannin, a bitter principle called *cascarillin*, resin, and about 1.6 per cent of volatile oil, greenish-yellow in color, of a sp. gr. of about 0.938. Aromatic and tonic in doses of 30 grains (2 Gm.)
Chenopodium American Wormseed	The fruit of *Chenopodium ambrosioides* Linné, and variety anthelminticum Gray (Fam. *Chenopodiaceæ*) and contains a volatile oil which is official, resin and a bitter principle. Used as an anthelmintic
Cunila Dittany	From *C. Mariana*, found in the United States. It contains volatile oil and resin
Juniperus Virginiana Red Cedar	The tops of *J. Virginiana*, grown in Canada and the United States. It contains volatile oil, resin, etc.
Oil of Red Cedar	Distilled from the wood of *Juniperus virginiana*

Unofficial Substances Containing Volatile Oil and Resin—*Continued*

Laserpitium White Gentian	From *L. latifolium*, found in Europe. It contains volatile oil and a bitter principle
Laurocerasus Cherry Laurel	From *Prunus laurocerasus*, found in Western Asia. It contains volatile oil, resin, etc.
Laurus Laurel	The leaves and fruit of *L. nobilis*, indigenous to the Levant. It contains volatile and fixed oils, also resin, etc.
Oil of Laurel	A pale yellow oxygenated oil, sp. gr. 0.91. The yield is about 2 per cent
Levisticum Lovage	From *L. officinale*, found in Europe. It contains volatile oil, resins, etc.
Liatris Liatris	From different species of *Liatris*, indigenous to North America
Myrtus Myrtle	From *M. communis*, found along the Mediterranean. It contains a volatile oil, resin, etc.
Ava-Kava	An intoxicating liquid, made from the root of *Piper methysticum*
Pimpernel Root (N. F. IV)	The dried rhizome and roots of *Pimpinella saxifraga* Linné, or *Pimpinella magna* Linné (Fam. *Umbelliferæ*). It contains resin and a volatile oil having a disagreeable odor and a bitter, acrid taste. Tonic, carminative, and diuretic effects. The dose is fifteen grains (1 Gm.)
Psoralea Psoralea	From different species of *Psoralea*, found in the United States. It contains a volatile oil and resin
Ptelea Shrubby Trefoil	From *P. Trifoliata*, found in North America. It contains a volatile oil and pungent resin
Ruta Graveolens Rue	The herb of *R. graveolens*
Oleum Rutæ Oil of Rue	A volatile oil from *Ruta graveolens*, sp. gr. 0.880, more soluble in water than most volatile oils. It is methyl-nonyl-ketone, $CH_3.CO.C_9H_{19}$
Sabina, Savin	The tops of *Juniperus sabina* Linné (Fam. *Coniferæ*). It contains a terpene, resin, and a trace of tannin. The dose is eight grains (0.5 Gm.)
Oleum Sabinæ, Oil of Savin	A volatile oil distilled from the fresh tops of savin. Used as a stimulant and emmenagogue and has frequently been used to produce abortion. It should never be sold except upon the order of a physician. Dose, one to five minims (0.06 to 0.03 cc.)
Wintera Winter's Bark	The bark of *Drimys Winteri*, grown in South America
Oil of Winter's Bark	The yield of volatile oil is about 1½ per cent.

CHAPTER LXIX

OFFICIAL DRUGS AND PRODUCTS CONTAINING VOLATILE OIL ASSOCIATED WITH BITTER PRINCIPLE OR EXTRACTIVE

ASPIDIUM. U.S. Aspidium

[Male Fern, Malefern Root, Male Shield Fern, Bear's Paw Root, Sweet Brake, Knotty Brake, Shield Root]

Aspidium consists of the rhizome and stipes of *Dryopteris Filix-mas* (Linné) Schott (Fam. *Polypodiaceæ*).

Aspidium yields not less than 6.5 per cent of oleoresin, and not more than 3 per cent of acid-insoluble ash. Only such portions as have retained their internal green color should be used.

Description—From 5 to 15 cm. long, 10 to 25 mm. in thickness, and, together with the closely imbricated, dark brown, roundish, and slightly curved stipe-remnants, 50 to 75 mm. in diameter, densely covered with brown, glossy, transparent, and soft, chaffy scales; internally pale green, rather spongy, vascular bundles about ten (*Dryopteris Filix-mas*) or six (*Dryopteris marginalis*) in number, arranged in an interrupted circle; odor slight, but disagreeable; taste sweetish, acrid, somewhat bitter, astringent, and nauseous.

For further description see the U. S. P. X.

U. S. P. Preparation—Oleoresina Aspidii.

Aspidium is said to contain the following constituents, in approximately the amount indicated: *filicic acid*, 3.5 per cent; *flavaspidic acid*, 2.5 per cent; *albaspidin*, 0.05 per cent; *aspidinol*, 0.10 per cent; *flavaspidin*, 0.10 per cent; *amorphous acid*, 5.0 per cent, and *filicic nigrine*, 60 per cent. These substances are, for the greater part, derivatives of phloroglucinol, and some of them are ketones possessing acid characters.

The various formulas assigned to the filicic acids and the different results reported regarding their physiologic activity have given rise to much confusion, leaving the chemistry in an unsettled condition. One of the first formulas assigned to filicic acid is that of Luck ($C_{26}H_{30}O_9$), which differs considerably from the formula $C_{14}H_{18}O_5$, given this substance by Grabowski, and $C_{14}H_{16}O_5$, as suggested by Dacoma. More recently, Gallas has stated the formula for both the crystalline and the amorphous filicic acid to be $C_{18}H_{22}O_6$.

The knowledge on the subject is very imperfect; but the majority of authors still accept filicic acid as one of the active constituents of aspidium.

In the case of oleoresin of aspidum any sediment which has separated consists of active constituents and should be incorporated before dispensing.

The oleoresin may be administered in the form of an emulsion made with the aid of acacia.

History—Male fern was first known to medicine in a patent medicine about 1770 called *Madame Nouffers cure for Tapeworm*. King Louis XVI of France gave the proprietress a sum equal to about $3500 for the secret, which was then given freely to the physicians of France. It had been mentioned as far back as the time of Dioscorides but had fallen into disuse for many centuries.

Uses—It is used as a tænifuge. Dose, one drachm (4 Gm.).

ERIODICTYON. U. S. Eriodictyon

[Eriodict.—Yerba Santa, Consumptives' Weed, Mountain Balm]

Eriodictyon is the dried leaf of *Eriodictyon californicum* (Hooker et Arnott) Bentham et Torrey (Fam. *Hydrophyllaceæ*).

Eriodictyon contains not more than 5 per cent of its stem or more than 2 per cent of other foreign organic matter.

Description—Oblong, lanceolate, 5 to 15 cm. long, acute at the apex, and below, narrowed into a short petiole, the margin sinuately toothed to nearly entire; upper surface green, smooth, and covered with a brownish resin; lower surface reticulate and minutely white-tomentose; odor somewhat aromatic; taste balsamic and sweetish.

For further description see the U. S. P. X.

U. S. P. Preparation—Fluidextractum Eriodictyi.

N. F. Preparations—Elixir Eriodictyi Aromaticum (from Fluidextract); Syrupus Eriodictyi Aromaticus (from Fluidextract).

Eriodictyon contains a bitter resin, volatile oil, and extractive. Its preparations are often used to disguise the taste of quinine.

Uses—It is given in doses of fifteen to sixty grains (1 to 4 Gm.) as a stimulating tonic.

MEZEREUM. N. F. Mezereum
(U. S. P. IX)

[Mezer.—Mezereon, Spurge Olive]

Mezereum is the dried bark from aerial portions of *Daphne Mezereum* Linné, *Daphne Gnidium* Linné, or of *Daphne Laureola* Linné (Fam. *Thymeleaceæ*).

Mezereum contains not more than 2 per cent of foreign organic matter.

Description—In long, thin bands, usually folded or rolled into disks; outer surface yellowish, brownish-yellow with transverse scars, and minute, blackish dots, underneath of a light greenish color; inner surface whitish, silky; bast in transverse layers, very tough; inodorous; taste very acrid.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Mezerei; Fluidextractum Sarsaparillæ Compositum; Linimentum Sinapis Compositum (from Fluidextract).

Uses—Mezereum contains *daphnin*, $C_{15}H_{16}O_9.2H_2O$, a glucoside, associated with an acrid soft resin and oil. Alcohol is the best menstruum for extracting the activity. Locally it is sometimes employed to stimulate sluggish ulcers. Mezereum is rarely given internally alone being usually combined with other drugs as an alterative, especially in the compound fluidextract of sarsaparilla. The dose is eight grains (0.5 Gm.).

PYRETHRUM. U. S. P. IX. Pyrethrum

[Pyreth.—Pellitory Root, Roman Pyrethrum, Pellitory]

The dried root of *Anacyclus Pyrethrum* (Linné) De Candolle (Fam. *Compositæ*). Preserve Pyrethrum in tightly closed containers, adding a few drops of chloroform or carbon tetrachloride, from time to time, to prevent attack by insects.

Official Description—Nearly cylindrical, slightly tapering, usually in pieces from 2.5 to 10 cm. in length and from 5 to 20 mm. in diameter; externally dark brown, deeply longitudinally furrowed and somewhat wrinkled, occasionally bearing short, tough, hair-like rootlets, crown more or less annulate, and occasionally tufted with coarse fibers or with long, soft-woolly, nearly straight, 1-celled hairs; fracture short; bark dark brown with 1 or 2 circular rows of resin ducts, closely adhering to the light yellow, radiate, porous wood, in the medullary rays of which occur 1 to 3 rows of resin ducts.

Odor and Taste—Odor distinct; taste sweetish, pungent, very acrid, tingling, and producing a strong sialogogue effect.

Tests for Identity and Purity—The powder is light to dark brown; when examined under the microscope it exhibits numerous spherical or irregular masses of inulin, the nature of which is especially seen with polarized light, and lignified fragments of the woody tissues and stone cells associated with cork; inulin in spherical granules or irregular masses, from 0.01 to 0.1 mm.

in diameter, which is not affected by the addition of iodine T.S.; tracheæ with simple pores and reticulate or scalariform thickenings, usually associated with wood parenchyma and with few or no wood fibers .stone cells in groups, the cells more or less tubular in outline and with thick, yellowish porous walls, cork in yellowish brown or dark brown fragments.

Pyrethrum yields not more than 5 per cent of ash.

Uses—A powerful irritant, employed as a sialogogue in certain forms of headache and neuralgic affections of the face, toothache, etc. Dose, 20 grains, (1.3 Gm.). The tincture was formerly official.

CIMICIFUGA. U.S. Cimicifuga

[**Cimicif.**—Black Cohosh, Black Snakeroot, Macrotys]

Cimicifuga consists of the dried rhizome and roots of *Cimicifuga racemosa* (Linné) Nuttall (Fam. *Ranunculaceæ*).

Cimicifuga contains not more than 2 per cent of its stems or other foreign organic matter, and yields not more than 4 per cent of acid-insoluble ash.

Description—The rhizome is of horizontal growth, hard, 5 cm. or more long, about 25 mm. thick, with numerous stout, upright or curved branches, terminated by a cup-shaped scar, and with numerous wiry-brittle, obtusely quadrangular roots, about 2 mm. thick; the whole brownish-black, of a slight but heavy odor, and a bitter, acrid taste.

For further description see the U. S. P. X.

The constituents are resin, an acrid principle (possibly an alkaloid), a resinous amorphous body, starch, tannin, gum, etc.

U. S. P. Preparation—Fluidextractum Cimicifugæ.

N. F. Preparations—Elixir Sodii Salicylatis Compositum (from Fluidextract); Elixir Tongæ et Salicylatum; Tinctura Cimicifugæ.

Uses—It is used as a sedative and alterative in chronic rheumatism and chorea. Dose, fifteen grains (1 Gm.).

APOCYNUM. N.F. Apocynum

[**Apocyn.**—Canadian Hemp]

Apocynum consists of the dried rhizome and roots of *Apocynum cannabinum* Linné (Fam. *Apocynaceæ*).

Apocynum contains not more than 5 per cent of its stems or other foreign organic matter.

Description—Cylindrical, somewhat branched, of varying length from 3 to 10 mm. in thickness; externally reddish-brown to grayish-brown, longitudinally wrinkled and occasionally with transverse fissures having vertical sides extending through the bark; fracture short; internally bark light brown, from 1.5 to 3 mm. in thickness, wood faintly radiate, and with large tracheæ, a small pith occurring in pieces of the rhizome. Almost inodorous; taste starchy, afterwards becoming bitter and somewhat acrid.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Apocyni.

Apocynum contains a volatile oil and a resin, but the chief constituents are *cynotoxin*, a crystalline substance, and the bitter glucosides, *apocynin*, *apocynein*, also bitter extractive, tannin, etc.

Uses—It is used in heart diseases and dropsies. Dose, five to twenty grains (0.3 to 1.3 Gm.).

Caution—It has been stated that the absorption of Apocynum in the gastro-intestinal tract is uncertain and irregular. To avoid an accumulation of the drug or toxic action, the physician should carefully guard the dosage and determine in each case the tolerance of the patient.

ARNICA. N.F. Arnica

(U. S. P. IX)

[**Arnic.**—Arnica Flowers, Leopardsbane]

Arnica is the dried flower head of *Arnica montana* Linné (Fam. *Compositæ*).

Arnica contains not more than 3 per cent of foreign organic matter. Arnica flowers contain a trace of volatile oil, and a bitter principle, *arnicin*, with resin, coloring matter, etc. Alcohol and water extract their virtues.

Description—Heads about 3 cm. broad, depressed-roundish, consisting of scaly involucre in two rows, bearing about sixteen yellow, strap-shaped, ten-nerved ray-florets, and numerous yellow, five-toothed, tubular disk-florets, having slender, spindle-shaped achenes, crowned by a hairy pappus. Odor feeble, aromatic; taste, bitter and acrid.
For a further description see the N. F. V.

N. F. Preparations—Fluidextractum Arnicæ; Tinctura Arnicæ.

Uses—It is rarely used internally, but the tincture is employed as an embrocation. Dose of the flowers fifteen grains (1 Gm.).

ASCLEPIAS. N. F. Asclepias

[**Asclep.**—Pleurisy Root, Butterfly Weed Root]

Asclepias is the dried roots of *Asclepias tuberosa* Linné (Fam. *Asclepiadaceæ*).
Asclepias contains not more than 5 per cent of foreign organic matter.

Description—Usually cut or broken pieces, of variable size, of an irregularly fusiform root which, when entire, is from 10 to 20 cm. in length and from 0.5 to 5 cm. in thickness; occasionally branched; externally pale orange-brown, becoming grayish-brown, annulate above, the surface roughened by numerous fine intersecting grooves; bark thin, fracture tough, the broken surface granular and white, with inconspicuous pale yellow wood bundles, and large white medullary rays. Odor slight; taste bitterish and disagreeable, somewhat acrid.
For further description see the N. F. V.

N. F. Preparation—Fluidextractum Asclepiadis.

It contains a principle *asclepiadin*, an amorphous lucoside, also *asclepin*, and a volatile oil.

Uses—It is used as a diaphoretic, emetic, and cathartic. Dose, thirty grains (2 Gm.).

CALENDULA. N. F. Calendula

[**Calend.**—Marigold, Hollygold, Marybud]

Calendula consists of the dried ligulate florets of *Calendula officinalis* Linné (Fam. *Compositæ*).
Calendula contains not more than 2 per cent of foreign organic matter.

Description—Florets from 15 to 25 mm. in length, yellow- or orange-colored, one- or three-toothed, four- or five-veined, margin nearly entire, the short hairy tube occasionally enclosing the remnants of a filiform style and bifid stigma. Odor slight, somewhat heavy; taste slightly bitter, faintly saline.
For further description see the N. F. V.

N. F. Preparations—Fluidextractum Calendulæ; Tinctura Calendulæ.

Calendula contains a small quantity of a volatile oil, a bitter principle, gum, sugar, etc. *Calendulin* is not the active principle, having very little taste.

Uses—Chiefly in domestic practice as a mild aromatic and diaphoretic. Dose, fifteen grains (1 Gm.).

CYPRIPEDIUM. N. F. Cypripedium

[**Cypriped.**—Ladyslipper Root]

Cypripedium consists of the dried rhizome and roots of *Cypripedium bulbosum* Miller, *Cypripedium pubescens* Willdenow, or of *Cypripedium parviflorum* Salisbury (Fam. *Orchidaceæ*).
Cypripedium contains not more than 3 per cent of other parts of the same plant or other foreign organic matter and yields not more than 6 per cent of acid-insoluble ash.

Description—Rhizome of horizontal growth, curved, from 3 to 10 cm. in length, and from 2 to 6 mm. in thickness, orange-brown to dark-brown, the upper side showing numerous circular, cup-shaped scars, closely covered below with simple wiry roots, varying from 3 to 15 cm. in length; fracture of rhizome, short, white, that of roots somewhat fibrous. Odor distinct, heavy; taste sweetish, bitter, and somewhat pungent.
For further description see the N. F. V.

N. F. Preparation—Fluidextractum Cypripedii.

This rhizome contains resins, an acid principle, volatile oil, tannin, starch, etc. Diluted alcohol extracts its virtues.

Uses—It is used as a nerve sedative. Dose, fifteen grains (1 Gm.).

DAMIANA. N. F. Damiana

[Turnera]

Damiana is the dried leaf of *Turnera diffusa* Willdenow ex. Schultes or of *Turnera Aphrodisiaca* Ward (Fam. *Turneraceæ*).

Damiana contains not more than 15 per cent of its stems, not more than 3 per cent of other foreign organic matter, and yields not more than 4 per cent of acid-insoluble ash.

It contains a volatile oil, an amorphous principle *damianin*, tannin, soft resin, etc.

Description—Obovate to lanceolate from 10 to 25 mm. in length and from 4 to 10 mm. in width, shortly petiolate, obtuse or acute at the apex, and with a short, cuneate base; sharply two- to ten-toothed on each side; the veins ascending, generally strong, straight and simple and running to the sinuses of the teeth, but sometimes branched and sending the branches into the teeth; the upper surface smooth and pale green, the lower glabrous or with a few hairs on the ribs (*Turnera aphrodisiaca*) or densely tomentose over the entire surface (*Turnera diffusa*). Intermixed with the leaves are frequently found some reddish twigs, the young tips and buds of which are grayish with appressed pubescence (*Turnera aphrodisiaca*) or white floccose (*Turnera diffusa*), also flower buds, yellowish flowers, and globose pods. Odor aromatic, taste characteristic, aromatic, and resinous.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Damianæ.

Uses—It has been recommended as an aphrodisiac. The dose is thirty grains (2 Gm.

EUPATORIUM. N. F. Eupatorium

[**Eupator.**—Thoroughwort, Boneset]

Eupatorium consists of the dried leaf and flowering tops of *Eupatorium perfoliatum* Linné (Fam. *Compositæ*).

Eupatorium contains not more than 10 per cent of its stems and not more than 2 per cent of foreign organic matter.

Description—Usually more or less broken; leaves opposite, the pair united at the base, from 8 to 20 cm. in length and from 1.5 to 5 cm. in breadth, tapering regularly from near the base to an acute summit, crenate-serrate, rugosely veined, rough and bright green above, yellowish-gray-green, tomentose, and resinous-dotted beneath; flower-heads small, numerous, corymbed, with a campanulate involucre of lance-linear, imbricated scales and with from ten to fifteen tubular, yellowish-white florets having a bristly pappus in a single row. Odor faintly aromatic; taste strongly bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Eupatorii.

This plant contains a volatile oil and resin, *eupatorin*, gum, tannin, sugar, etc. Alcohol, diluted alcohol, and water extract its virtues.

Uses—It is used as a diaphoretic and mild laxative. Dose, thirty grains (2 Gm.).

GRINDELIA. N. F. Grindelia

(U. S. P. IX)

[**Grindel.**—Grin Plant]

Grindelia consists of the dried leaves and flowering tops of *Grindelia camporum* Greene or *Grindelia cuneifolia* Nuttall, or *Grindelia squarrosa* (Pursh) Dunal (Fam. *Compositæ*).

Grindelia contains not more than 10 per cent of stems over 2 mm. in diameter, or more than 2 per cent of other foreign organic matter.

Description—Leaves about 5 cm. or less long, varying from broadly spatulate or oblong to lanceolate, sessile, or clasping, obtuse, more or less sharply serrate, often spinosely toothed, or even lacinate-pinnatifid, pale green, smooth, finely dotted, thickish, brittle; heads many-flowered, sub-globular or somewhat conical; the involucre hemispherical, about 10 mm. broad, composed of numerous imbricated, squarrosely-tipped or spreading scales; ray-florets yellow, ligulate, pistillate; disk-florets yellow, tubular, perfect; pappus consisting of two or three awns of the length of the disk-florets; odor balsamic; taste pungently aromatic and bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Grindeliæ.

Grindelia contains a volatile oil and a bitter and resinous principle.

Uses—A mild expectorant. The fluidextract is largely used in lotions mixed with water (1 to 10), for the treatment of ivy or rhus poisoning. Dose, thirty grains (2 Gm.).

INULA. N. F. Inula

[Elecampane, Horsehead]

Inula consists of the dried rhizome and roots of *Inula Helenium* Linné (Fam. *Compositæ*).

Inula contains not more than 5 per cent of its stem bases or other foreign organic matter.

It contains a volatile oil, a soft acrid resin, and a number of other constituents have been separated.

Description—Rhizome usually split into longitudinal or more or less oblique pieces to which may be attached one or more of the roots; up to 8 cm. in length and 4 cm. in diameter; externally grayish-brown to dark brown, longitudinally wrinkled with occasional buds or stem scars and surmounted at the crown by a portion of the over-ground stem; inner or cut surface somewhat concave, the edges incurved with the over-lapping bark; yellowish-brown to grayish-brown, longitudinally striate and more or less fibrous near the cambium zone; fracture short and horny; inner surface light brown and marked by numerous circular or elliptical oleoresinous canals; roots cylindrical and tapering, frequently curved or irregularly curled; up to 13 cm. in length and 1.5 cm. in diameter. Odor aromatic; taste acrid, bitter and pungent.

For further description see the N. F. V.

N. F. Preparations—Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe.

Uses—Inula was formerly employed in amenorrhea, diphtheria, and tuberculosis but is probably of no value. Dose, ten to thirty grains (0.6 to 2 Gm.). Externally it has been used as a rubefacient.

IRIS VERSICOLOR. N. F. Blue Flag

[**Iris Vers.**—Fleur de Lys]

Blue Flag is the dried rhizome of *Iris versicolor* Linné or of *Iris Caroliniana* Watson (Fam. *Iridaceæ*).

Blue Flag contains not more than 5 per cent of its roots and leaf bases or other foreign organic matter.

It contains volatile oil, an acrid resin, tannin, and possibly an alkaloid.

Description—Rhizome frequently branched, up to 10 cm. in length and 2 cm. in thickness, usually cut into longitudinal pieces; outer surface grayish-brown to purplish-brown, somewhat annulate, the upper surface with markings of leaf bases, the lower with numerous root scars and remnants; fracture short, the broken surface pale purplish-brown and exhibiting a central stele with whitish fibro-vascular bundles distributed throughout, a distinct endodermis and cortex. Odor slight, not distinctive; taste acrid, nauseous.

For further description see the N. F. V.

N. F. Preparations—Elixir Corydalis Compositum (from Fluidextract); Fluidextractum Iridis Versicoloris; Fluidextractum Stillingiæ Compositum; Syrupus Stillingiæ Compositum (from Compound Fluidextract).

Uses—It is used as an emetic and cathartic, sometimes used as a hepatic stimulant.

MATRICARIA. N. F. Matricaria

(U. S. P. IX)

[**Matricar.**—German Chamomile, Wild Chamomile]

Matricaria is the dried flower-head of *Matricaria Chamomilla* Linné (Fam. *Compositæ*).

Matricaria contains not more than 5 per cent of stems or foreign organic matter and yields not more than 4 per cent of acid-insoluble ash.

Description—About 15 to 20 mm. broad, composed of a flattish, imbricate involucre, a conical, hollow, naked receptacle, which is about 5 mm. high, about fifteen, white, ligulate, reflexed ray-florets, and numerous yellow, tubular, perfect disk-florets without pappus; strongly aromatic and bitter.

The similar flower-heads of *Anthemis arvensis* Linné and *Maruta Cotula* De Candolle (Fam. *Compositæ*) have conical, solid, and chaffy receptacles.

For further description see the N. F. V.

N. F. Preparation—Species Emollientes.

Matricaria contains a dark blue volatile oil, which is soluble in alcohol; the bitter-principle is termed *anthemic acid*.

Uses—It is used chiefly in domestic practice as a mild aromatic and diaphoretic. Dose, four drachms (15 Gm.).

PULSATILLA. N. F. Pulsatilla

[Pulsatil.—Pasque Flower, Wind Flower, Prairie Anemone]

Pulsatilla is the dried herb of *Pulsatilla vulgaris* (Linné) Miller, *Anemone pratensis* (Linné) Miller, or *Pulsatilla patens* (Linné) Miller (Fam. *Ranunculaceæ*).

Pulsatilla contains not more than 5 per cent of foreign organic matter.

It contains tannin, and an acrid volatile oil of which the chief constituent is a camphor which is quickly decomposed, in the presence of water, into *anemonin*, $C_{10}H_8O_4$, and *isoanemonic acid*, $C_{15}H_{14}O_7$. These are both crystalline.

Description—Leaves and flowering scapes matted, silky-villous; basal leaves with petioles up to 30 cm. in length, the latter hollow, often purplish in color, the blades twice or thrice deeply three- or four-parted or pinnately cleft, the lobes linear and acute, the base of the petiole more hairy than above and frequently attached to the short root-stock; flowering scapes up to 30 cm. in length, solid in the lower portion and hollow in the upper part, with sessile, involucral dissected leaves near the flower, occasionally with remains of the dull purple hairy sepals and the dense-woolly, plumose-tailed achenes. Nearly odorless; taste very acrid.

For further description see the N. F. V.

N. F. Preparation—Tinctura Pulsatillæ.

Uses—It has been used in ovarian and uterine diseases. In overdose it is an active irritant causing vomiting and purging. It is said to be a diuretic, diaphoretic, expectorant, and sedative. Dose, five grains (0.3 Gm).

SABAL. N. F. Sabal

(U. S. P. IX)

[Saw Palmetto Berries]

Sabal is the partially dried, ripe fruit of *Serenoa serrulata* (Michaux) Hooker filius (Fam. *Palmæ*).

Sabal contains not more than 1 per cent of foreign organic matter. Sabal should contain from 10 to 15 per cent of its natural moisture when used for the manufacture of pharmaceutical preparations.

Sabal contains a volatile oil, fixed oil, resin, and an alkaloidal principle.

Description—Ellipsoidal or ovoid, occasionally compressed, from 1.5 to 3. cm. in length and from 1 to 1.5 cm. in diameter; externally brownish-black to bluish-black, smooth and somewhat oily, with a few large, more or less angular depressions due to the contraction of the inner layer on drying, summit marked by a scar of the style, and the base either with a short stalk or stem-scar; epicarp and sarcocarp together forming a thin coriaceous shell enclosing a hard but thin endocarp, which is externally reddish-brown and somewhat fibrous, as is also the inner layer of the sarcocarp; inner layer of endocarp smooth, enclosing a hard, ellipsoidal or ovoid, somewhat flattened, reddish-brown seed. Odor pronounced, aromatic; taste sweetish, aromatic, slightly acrid.

For further description see the N. F. V.

N. F. Preparations—Elixir Sabal et Santali; Fluidextractum Sabal; Tinctura Sabal et Santali.

Uses—It is used in genito-urinary diseases. Dose, fifteen to thirty grains (1 to 2 Gm.).

SENECIO. N. F. Senecio

[Life Root Plant, Golden Ragroot]

Senecio is the dried plant of *Senecio aureus* Linné (Fam. *Compositæ*).

Senecio contains not more than 10 per cent of foreign organic matter.

It contains a volatile oil, and a small amount of a bitter principle. The constituents have not been thoroughly investigated.

Description—Stems from 3 to 6 dm. in length, if entire bearing a basal rosette of leaves; sparingly clothed with successively smaller leaves and bearing at the summit several yellow heads in a loose corymb, white floccose when young, but mostly glabrous when expanded, radical leaves on long, slender petioles, mostly of rounded form from 5 to 7 cm. in breadth, the base often cordate, the summit rounded, the margin crenate-dentate; stem-leaves gradually changing from the shape of the radical leaves to lyrately-pinnate, then pinnatified and sessile, and at length clasping, oblong and incised; heads slender peduncled, from 12 to 25 mm. in breadth, the lance-linear involucral scales in about two series, closely appressed, rays about ten, bright-yellow, disk flowers very numerous, small, bearing a glabrous akene and a white pappus. Odor characteristically aromatic; taste bitter, slightly astringent and distinctly acrid, and pungent.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Senecionis.

Uses—It is used as an emmenagogue; dose, one drachm (4 Gm.).

STILLINGIA. N. F. Stillingia

(U. S. P. IX)

[**Stilling.**—Queen's Root, Queen's Delight]

Stillingia is the dried root of *Stillingia sylvatica* Linné (Fam. *Euphorbiaceæ*).

Stillingia contains not more than 3 per cent of foreign organic matter. Stillingia which has been stored for more than two years must not be used.

Description—About 30 cm. long, and nearly 5 cm. thick, subcylindrical, slightly branched, compact, wrinkled, tough, grayish-brown, breaking with a fibrous fracture, showing a thick bark and porous wood, the inner bark and medullary rays having numerous yellowish-brown resin-cells; odor peculiar, unpleasant; taste bitter, acrid, and pungent.

For further description see the N. F. V.

N. F. Preparations—Elixir Corydalis Compositum (from Fluidextract); Fluidextractum Stillingiæ; Fluidextractum Stillingiæ Compositum; Fluidextractum Trifolii Compositum.

Stillingia contains an acrid resin called *sylvacrol*, starch, a volatile oil, a fixed oil, etc.

Uses—It is used as an alterative, in doses of thirty grains (2 Gm.).

VIBURNUM OPULUS. N. F. Viburnum Opulus

[**Viburn. Op.**—High Bush Cranberry Bark, Cramp Bark]

Viburnum opulus is the dried bark of *Viburnum Opulus* Linné var. *americanum* (Miller) Aiton (Fam. *Caprifoliaceæ*).

Viburnum Opulus contains not more than 5 per cent of adhering wood or other foreign organic matter.

Its constituents are similar to those found in *Viburnum Prunifolium*. This bark is similar in appearance to the *mountain maple* (*Acer spicatum* Lam.) and for many years this bark was substituted for it.

Description—In strips, or occasionally in quills or chip-like fragments, the bark attaining a thickness of 3 mm.; outer surface of the thinner pieces of a light gray color with crooked, longitudinal, purplish-brown stripes and very small brown lenticels, the thicker pieces purplish-red or occasionally blackish, except when very young and more or less finely fissured or thinly scaly; inner surface varying in color from yellowish to rusty-brown, with very short oblique striæ, except where the outer wood layer adheres; fracture short and weak, the fractured surface mostly whitish, varying to pale brown in the inner layer, rusty brown in the outer layer, covering the green tangential layers of phelloderm. Odor strong and characteristic; taste mildly astringent and decidedly bitter.

For further description see the N. F. V.

N. F. Preparation—Elixir Viburni Opuli Compositum (from Fluidextract); Tinctura Viburni Opuli Composita.

Uses—It is used as an antispasmodic and in the treatment of dysmenorrhea. The dose is twenty to sixty grains (1.3 to 4 Gm.).

VIBURNUM PRUNIFOLIUM. N. F. Viburnum Prunifolium

(U. S. P. IX)

[**Viburn. Prun.**—Black Haw, Viburnum]

Viburnum Prunifolium is the dried root bark of *Viburnum prunifolium* Linné (Fam. *Caprifoliaceæ*).

Virburnum Prunifolium contains not more than 7 per cent of wood or other foreign organic matter and yields not more than 3 per cent of acid-insoluble ash.

Description—In irregular, transversely curved or quilled pieces, from 1.5 to 6 cm. in length and from 0.5 to 1.5 mm. in thickness; outer surface grayish-brown, or, where the outer cork has scaled off, brownish-red, longitudinally wrinkled; inner surface reddish-brown, longitudinally striated; fracture short but uneven, showing in bark which is young or of medium thickness, a dark brown cork, a brownish-red outer cortex, and a whitish inner cortex in which are numerous light yellow groups of sclerenchymatous tissues.

Odor and Taste—Odor slight; taste distinctly bitter and somewhat astringent.

For further description see the N. F. V.

N. F. Preparations—Elixir Viburni Prunifolii (from Fluidextract); Fluidextractum Viburni Prunifolii.

Viburnum contains valeric acid, a bitter, resinous principle, *viburnin*, tannin, etc. Alcohol is the best solvent for its active principles.

Uses—It is used in menstrual disorders. Dose, thirty grains (2 Gm.).

TRILLIUM. N. F. Trillium

[Trill.—Beth Root, Wake Robin]

Trillium consists of the dried rhizome of *Trillium erectum* Linné and other species of *Trillium* (Fam. *Liliaceæ*).

Trillium contains not more than 2 per cent of foreign organic matter. It contains a small amount of volatile oil, tannin, and a principle similar to saponin.

Description—Rhizome oblique, globular, oblong or obconical, truncate below, terminated by a small bud surrounded by a sheath of scarious leaf bases, annulated by leaf scars and fissured by stem scars; from 0.6 to 5 cm. in length and from 0.6 to 2.5 cm. in width, more or less compressed laterally, rootlet scars in several concentric rows on the under side in the upper portions; externally yellowish to reddish-brown; internally of a pale yellow; fracture somewhat uneven with a more or less spongy appearance. Odor distinct; taste bitter and acrid with a sensation of warmth in the throat, and when chewed causing an increased flow of saliva.

For further description see the N. F. V.

N. F. Preparations—Elixir Viburni Opuli Compositum (from Fluidextract); Fluidextractum Trillii.

Uses—It is used as an emmenagogue. Dose, thirty grains (2 Gm.).

XANTHOXYLUM. N. F. Xanthoxylum

(U. S. P. IX)

[Xanthox.—Prickly Ash Bark, Pepperwood, Toothache Tree]

Xanthoxylum is the dried bark of *Xanthoxylum americanum* Miller, known in commerce as Northern Prickly Ash Bark, or *Xanthoxylum Clava-Herculis* Linné, known in commerce as Southern Prickly Ash Bark (Fam. *Rutaceæ*).

Xanthoxylum contains not more than 2 per cent of foreign matter.

Description—*Xanthoxylum americanum* (Northern Prickly Ash) is in curved or quilled fragments, about 1 mm. thick; outer surface brownish-gray, with whitish patches, and minute, black dots, faintly furrowed, with some brown, glossy, straight, two-edged spines, linear at the base, and about 5 mm. long; inner surface whitish, smooth; fracture short, non-fibrous, green in the outer and yellowish in the inner layer; inodorous; taste bitterish, very pungent.

Xanthoxylum Clava-Herculis (Southern Prickly Ash) resembles the preceding, but is about 2 mm. thick, and is marked by many conical, corky projections, sometimes 2 cm. high, and by stout, brown spines, rising from a corky base.

Xanthoxylum should not be confounded with the bark of *aralia spinosa* Linné (Fam. *Araliaceæ*), which is nearly smooth externally, and beset with slender prickles in transverse rows.

For further description see the N. F. V.

N. F. Preparations—Elixir Corydalis Compositum (from Fluidextract); Fluidextractum Trifolii Compositum; Fluidextractum Xanthoxyli.

Xanthoxylum owes its virtues to a soft resin, a crystalline resin, a bitter principle, and an acrid green oil. There are also present sugar, tannin, gum, etc.

Uses—It is used as an alterative. Dose, thirty grains (2 Gm.).

XANTHOXYLI FRUCTUS. N. F. Prickly Ash Berrys

[Xanthox. Fruct.]

Prickly Ash Berrys are the dried fully grown fruit of *Xanthoxylum americanum* Miller (Northern Prickly Ash) or *Xanthoxylum Clava-Herculis* Linné (Southern Prickly Ash) (Fam. *Rutaceæ*).

Prickly Ash Berrys contain not more than 2.5 per cent of foreign organic matter. The constituents are similar to those found in the bark (see above).

Official Description—Capsules with short stalks (*X. americanum*) or without stalk (*X. Clava-Herculis*); when fresh, ellipsoidal, fleshy, gray-brown, when dry, dehiscent; carpels two, convex, summit short pointed; seeds one or two, oblong, black, shining, and wrinkled from drying. The carpels have a pungent, warm, aromatic taste and on chewing leave a tingling sensation on the tongue; when breathed upon they emit a faintly aromatic odor resembling that of citral.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Stillingiæ Compositum; Syrupus Stillingiæ Compositus (from Compound Fluidextract).

Uses—It is supposed to possess alterative virtues. Dose, fifteen grains (1 Gm.).

ZEA. N. F. Zea

[Corn Silk]

Zea consists of the fresh styles and stigmas of *Zea Mays* Linné (Fam. *Gramineæ*). Zea should be collected when the ears are in milk and used in the green condition for the manufacture of pharmaceutical preparations.

It contains a small amount of volatile oil, also a fixed oil, resin, and *maizenic acid*, with sugar and gum.

Description—In slender filaments from 10 to 20 cm. in length, and about 0.4 mm. in diameter; of a light green, purplish-red, yellow or light brown color; stigmas bifid, the segments very slender, frequently unequal and from 0.4 to 3 mm. in length.

Under the microscope, the styles are seen to consist for the most part of parenchyma and two parallel, vascular bundles with narrow, spiral or annular tracheæ; the epidermal cells are rectangular, many of these being extended into multicellular hairs, the latter being from 0.2 to 0.8 mm. in length, the basal portion consisting of two to five united cells, the upper portions being usually unicellular; the cells of the hairs are rich in cytoplasm and usually contain a small, spherical nucleus; the purplish-red styles contain a purplish-red cell cap.

N. F. Preparations—Elixir Sabal et Santali compositum; Fluidextractum Zeæ.

Uses—It is used in inflammation of the bladder. Preparations of the fresh drug are more active than those made from the dry drug, as the volatile principles are retained. Dose, one to two drachms (4 to 8 Gm.).

Unofficial Volatile Oils and Drugs Containing Volatile Oil, Bitter Principle, or Extractive

Absinthium Wormwood (N. F. IV)	The dried leaves and flowering tops of *Artemisia Absinthium* Linné (Fam. *Compositæ*). It contains 1 per cent or more of a volatile oil, bitter and disagreeable in taste, containing *thujone*, $C_{10}H_{16}O$, phellandrene, and small amounts of other constituents. The drug also contains a glucoside, *absinthin*, $C_{15}H_{20}O_4$. Formerly used as an anthelmintic. A narcotic poison in overdoses. Dose, thirty grains (2 Gm.)
Achillea Yarrow	A perennial herb of the Family *Compositæ*, *Achillea millefolium*, growing in America and Europe. It contains *achilleine*
Oleum Achilleæ Oil of Yarrow	A blue or dark green volatile oil. The yield is about $\frac{1}{10}$ per cent.
Anthemis (U. S. P. VIII)	The dried flower heads of *Anthemis nobilis* Linné (Fam. *Compositæ*), collected from cultivated plants. It contains a volatile oil and a bitter principle called *anthemic acid*. It is used as a tonic. Dose, thirty grains (2 Gm.)
Arnicæ Radix Arnica Root (U. S. P. 1890)	The rhizome and roots of *Arnica montana* Linné (Fam. *Compositæ*). It contains 1 per cent of volatile oil, a bitter principle *arnicin*, acrid resin, etc.
Angustura Angustura Bark	The bark of *Galipea cusparia*, from the mountains near the Orinoco River
Oil of Angustura, $C_{13}H_{24}O$	The yield of oil is about $\frac{1}{2}$ per cent.
Apocynum Androsæmifolium Dogsbane	A root which grows in New England and Canada
Artemisia Mugwort	From *Artemisia vulgaris*. It contains volatile oil, bitter principle, etc.
Bela Bael	From *Ægle marmelos*, grown in the Himalaya Mountains. It contains tannin, bitter principle, and volatile oil
Carthamus American Saffron, Safflower	See the chapter on coloring, page 845
Chekan Cheken	The leaves of *Eugenia chekan*, grown in Chili. It contains volatile oil, bitter principle, chekenon, chekenin, chekenetin, and cheken-bitter. Dose of the fluidextract, one to three fluidrachms (4 to 12 cc.)
Clematis Virgin's Bower	The herb from different species of *Clematis*
Erigeron Erigeron	The leaves and tops of *Erigeron canadensis*. Diuretic, tonic, astringent. Dose, in substance, one drachm (4 Gm.)
Oil of Erigeron (Oil of Fleabane) (U. S. P. VIII)	From the fresh flowering herb *Erigeron canadensis* Linné (Fam. *Compositæ*). It consists chiefly of *d-limonene* and it also contains an oxygenated portion. Used as an hæmostatic in uterine hemorrhage in a fifteen minim (1 cc.) dose
Euphrasia Eyebright	*Euphrasia officinalis*, indigenous to Europe
Genista Dyers' Broom	The young branches of *Genista tinctoria*, indigenous to Asia and Europe. It contains a yellowish-green volatile oil
Geum Water Avens	The rhizome of *Geum rivale*, grown in America and Europe. It contains volatile oil and bitter principle
Gnaphalium Life-Everlasting	From different species of *Gnaphalium*, grown in North America. It contains volatile oil and bitter principle
Helianthemum Frost Weed Rock-rose	The dried herb of *Helianthemum canadense* (Linné) Michaux (Fam. *Cistaceæ*). It contains a volatile oil, a fixed oil, tannin, and an alkaloidal principle. Dose, one drachm (4 Gm.). It is supposed to possess alterative properties
Hypericum St. John's-wort	From *Hypericum perforatum*, grown in Europe. It contains hypericum red, volatile oil, etc.

Unofficial Volatile Oils and Drugs Containing Volatile Oil, Bitter Principle, or Extractive—*Continued*

Lactucarium (U. S. P. IX)	The dried milk-juice of *Lactuca virosa* (Fam. *Compositæ*). Lactucarium is a complex substance. It contains a bitter resinous principle, *lactucin*, $C_{11}H_{12}O_3$ H_2O, *lactucic acid* (bitter and crystalline), *lactucopicrin* (bitter and amorphous), *lactucerin* or *lactucon* in large quantity, nearly 60 per cent (this principle is inert and crystallizable), caoutchouc, resin, asparagin, volatile oil, mucilage, etc. It is used as a sedative but has little if any action aside from its paste. Contrary to the popular opinion it bears no relationship to opium and contains no narcotic principle of importance or value. Dose, fifteen grains (1 Gm.)
Paracoto (N. F. IV)	The dried bark of an unidentified tree indigenous to Northern Bolivia. It contains a volatile oil, a volatile alkaloid, *propylamine*, *phenylcoumarin*, *piperonylic acid* and *cotoin*, $C_{14}H_{12}O_4$. Cotoin is obtained by extraction with ether and purified. *Dicotoin* is an impure mixture. An intestinal stimulant used in diarrhea. Dose, five grains (0.32 Gm.)
Parthenium Feverfew	The flowering herb of *Pyrethrum parthenium*, growing in waste places in Europe. It contains volatile oil and bitter principle
Phytolaccæ Fructus Poke Berries (U. S. P. 1890)	The fruit of *Phytolacca decandra* Linné (Fam. *Phytolaccaceæ*). It contains coloring matter, sugar, gum, etc. Used as an alterative
Primula Primrose	From *Primula officinalis*, indigenous to Europe and Asia. It contains a volatile oil and primulin
Pyrethrum Pellitory Root (U. S. P. IX)	The dried root of *Anacyclus* (Linné) De Candolle (Fam. *Compositæ*). This root contains an acrid, brown resin, containing *pelletorin*, the alkaloid *pyrethrine*, and a volatile and a fixed oil, inulin, mucilage, etc. It is used as a sialagogue and stimulant, in doses of fifteen to forty grains (1 to 2.6 Gm.)
Ranunculus Crowfoot	From *Ranunculus bulbosus*, found in North America. It contains a golden yellow volatile oil and a bitter principle
Tanacetum Tansy (U. S. P. 1890)	The leaves and tops of *Tanacetum vulgare* Linné (Fam. *Compositæ*). The bitter principle is *tanacetin*
Teucrium Germander	From *Teucrium Marum*, indigenous to Europe. It contains volatile oil and bitter principle
Tilia Linden Flowers	From *Tilia americana*. It contains volatile oil, bitter principle, etc.

CHAPTER LXX

RESINS, OLEORESINS, GUM RESINS, AND BALSAMS

Resins are natural or induced solid or semi-solid exudations from plants, characterized by being insoluble in water, mostly soluble in alcohol or ether, often uncrystallizable, and softening or melting at a moderate heat. They are usually the *oxidized terpenes* of the volatile oils of plants, and, owing to their insolubility in water, have little taste; they show no uniformity of chemical composition; some of them are acids, and combine with alkalies, forming soaps, as in the case of common rosin.

Resins, when pure, are usually transparent; when they contain water, they are opaque, and no longer hard and brittle.

A clear distinction must be made between natural resins and prepared resins. A natural resin is one which occurs as an exudation. Of this class Mastic is an official example; being in the N. F. A prepared resin may be made by exhausting a drug, which owes its activity to resinous constituents, with alcohol, pouring the concentrated alcoholic percolate into an excess of water, collecting, washing and drying the precipitate. The resins of podophyllum, jalap, etc. (see Resinæ, Part III), are examples of this class. A prepared resin may also be derived from a natural oleoresin by driving off the volatile oil by heat. Resina is an example of this class.

Natural oleoresins are mixtures of volatile oils and resin, generally obtained by incising the trunks of the trees in which they are found, as turpentine, copaiba, etc.

A distinction must be made also between the natural and prepared oleoresins. The prepared oleoresins are a class of powerful liquid preparations made by percolating drugs, naturally containing both volatile oil and resin, with an appropriate solvent, *i.e.*, acetone, ether or alcohol, and concentrating the percolate until the solvent has been dissipated. Examples of oleoresin are aspidium, capsicum, etc., see Oleoresinæ, Part III.

Gum resins are natural mixtures of gum and resin, usually obtained as exudations from plants, as myrrh, asafetida, etc.

Balsams are resinous substances which contain benzoic, or cinnamic acids or their esters, as balsam of tolu, balsam of Peru, etc.

Much faulty nomenclature occurs in the ordinary trade designations for many of these drugs. The word "*gum*" is frequently the one most misapplied as in *gum thus* for oleoresin of turpentine, *gum guaiac* for resin of Guaiac, *gum asafetida* for gum resin of asafetida (see also Gums, page 885). The word *balsam* is also wrongly applied to certain oleoresins as copaiba and Canada turpentine, neither of which contains any of the constituents characteristic of balsams.

The official resins, oleoresins, gum resins, and balsams will now be considered.

OLEUM TEREBINTHINÆ. U. S. Oil of Turpentine

[Ol. Tereb.—Turpentine Oil, "Spirits of Turpentine"]

The volatile oil distilled from the oleoresin obtained from *Pinus palustris*, Miller and other species of *Pinus* (Fam. *Pinaceæ*) which yield exclusively terpene oils.

This important oil has the composition $C_{10}H_{16}$, and, as has been already stated, is the type of the terpenes. It is used as a solvent in pharmacy.

Description and Physical Properties—A colorless liquid, having a characteristic odor and taste, both of which become stronger and less pleasant on aging or exposure to air.

Tests for Identity and Purity—The Oil is soluble in 5 volumes of alcohol.

Specific gravity: 0.854 to 0.868 at 25° C.

Optical rotation: active, but variable, page 1524.

Refractive index: 1.4680 to 1.4780 at 20° C., page 1525.

An alcoholic solution of the recently distilled Oil (1 in 5) is neutral or only slightly acid to moistened litmus paper.

Evaporate 5 cc. of the Oil in a small tared dish on a bath of boiling water: the weight of the residue does not exceed 0.1 Gm. (*petroleum, paraffin, or rosin oils*).

Three drops of the Oil placed on white unsized paper and exposed to the air, evaporate without leaving a permanent stain (*fixed oils*).

A 5 cc. portion of the Oil shaken with an equal volume of potassium hydroxide T.S. does not become darker than a light straw-yellow after standing twenty-four hours.

A 5 cc. portion of the Oil shaken vigorously with an equal volume of hydrochloric acid in a glass-stoppered cylinder and allowed to stand for five minutes does not develop a color darker than a light straw yellow in either the acid or the oil layer.

Place 100 cc. of Oil of Turpentine in a standard 100 cc. Engler flask, having the side tube 8 cm. above the top of the bulb, and distil the Oil at the rate of 2 drops per second: 90 per cent of the Oil distils between 154° and 170° C., the temperature being read with the bulb of the thermometer opposite the side tube of the flask, and the top of the mercury column of the thermometer remaining within the neck of the flask.

Place 20 cc. of fuming sulphuric acid (page 1543) in a graduated narrow-necked Babcock bottle, stopper, and place in an ice bath to cool, and then add slowly, drop by drop, from a pipette, 5 cc. of the Oil of Turpentine. Mix the acid and Oil, as added, by gently shaking or rotating the bottle, keeping the temperature at about 60° to 65° C. by continued immersion in the ice bath. When the mixture no longer becomes warm on shaking, agitate thoroughly by vigorously shaking for about one-half minute. Place the bottle in a water bath and heat at 60° to 65° C. for ten minutes, keeping the contents of the bottle thoroughly mixed by frequent vigorous shaking, not less than six times during the heating period.

(*If the shaking at first is too prolonged and vigorous, there is danger of the escaping SO_2 forcing some of the mixture out of the neck of the bottle.*)

Cool to room temperature and fill the bottle with sulphuric acid (specific gravity about 1.83) until the oily layer rises into the graduated neck. Centrifuge for five minutes at 1200 revolutions per minute, or for fifteen minutes at 900 revolutions per minute, or allow to stand, lightly-stoppered, for twelve hours. The reddish or straw-colored viscous layer which separates on top of the dark acid does not exceed 1 per cent (0.05 cc.) of the volume of Oil taken (*mineral oil*).

Caution—The addition of Oil of Turpentine to the fuming sulphuric acid, must be made only drop by drop because of the violence of the reaction.

Preserve in well-stoppered containers, in a cool place.

U. S. P. Preparations—Ceratum Cantharidis; Oleum Terebinthinæ Rectificatum.

N. F. Preparations—Linimentum Opii Compositum; Linimentum Terebinthinæ; Linimentum Terebinthinæ Aceticum; Petroxolinum Sulphuratum Compositum.

Uses—Paint store "turpentine" or "turps" frequently consists of a mixture of turpentine and a petroleum distillate. Wood turpentine made by distilling old stumps, etc., with steam, also constitutes much of the cheap turpentine of the market. This variety although closely resembling genuine oil of turpentine in its physical properties, is considered unsuitable for medicinal use.

Oil of turpentine when old becomes ozonized and produces a characteristic bleaching action upon the cork stopper of the bottle containing it. Upon long exposure it ultimately thickens and partly resinifies by oxidation.

Oil of turpentine is applied externally in liniments as a stimulant and counterirritant. The rectified oil of turpentine should be used internally.

OLEUM TEREBINTHINÆ RECTIFICATUM. U.S. Rectified Oil of Turpentine

[Ol. Tereb. Rect.—Rectified Turpentine Oil]

Oil of Turpentine, a convenient quantity.
Solution of Sodium Hydroxide, an equal quantity.

Mix the two liquids thoroughly in a suitable still provided with a well-cooled condenser. Recover about three-fourths of the Oil by distillation, and

separate the clear oil from the water. Dry the Oil by shaking with anhydrous calcium chloride or anhydrous sodium sulphate, and filter.

NOTE—Rectified Oil of Turpentine is to be dispensed when Oil of Turpentine is required for internal use. Oil that has become turbid should not be dispensed.

Description and Physical Properties—A colorless liquid which conforms to the properties and tests under *Oleum Terebinthinæ*, specific gravity and non-volatile residue excepted.

Specific gravity: 0.853 to 0.862 at 25° C.

Evaporate 5 cc. of Rectified Oil of Turpentine rapidly in a tared dish on a bath of boiling water: the weight of the residue does not exceed 0.015 Gm.

Preserve in well-stoppered, amber-colored bottles in a cool place, protected from light.

U. S. P. Preparation—Emulsum Olei Terebinthinæ.

Uses—It is used as a stimulant diuretic, carminative, and expectorant and may be given in the dose of five minims (0.3 cc.). The purpose of this preparation is merely to provide a purer form of oil for internal use.

As this oil deteriorates upon keeping, by ozonizing and finally resinifying, it should not be kept on hand for too long a time before using.

TEREBENUM. U. S. Terebene

[Tereben.]

Terebene is a mixture of terpene hydrocarbons, chiefly dipentene and terpene, obtained from oil of turpentine.

Description and Physical Properties—A colorless, thin liquid. It has a rather agreeable, thyme-like odor, and a somewhat terebinthinate taste.

On exposure to light and air, Terebene gradually becomes resinified and acquires an acid reaction.

It is practically insoluble in water, but miscible with chloroform, ether, and dehydrated alcohol. One cc. is soluble in 3 cc. of alcohol at 25° C.

Tests for Identity and Purity—Specific gravity: 0.860 to 0.865 at 25° C.

It boils between 160° and 172° C.

Terebene does not redden blue litmus paper which has been moistened with alcohol.

Its optical rotation does not exceed + 0.3° in a 100 mm. tube at 25° C. (*unaltered oil of turpentine*).

After the determination of the boiling point, transfer the residue remaining in the distilling flask to a dish, by means of ether, and evaporate the liquid on a water bath; the residue remaining does not exceed 1 per cent of the original weight of Terebene taken (*rosin*).

Preserve in well-closed containers, protected from light.

Uses—Terebene is a valuable stimulating expectorant, given in capsules or in an emulsion in doses of four to sixty minims (0.25 to 4 cc.) during the day.

TERPINI HYDRAS. U. S. Terpin Hydrate

[Terpin. Hyd.]

A dihydric alcohol [$C_{10}H_{18}(OH)_2.H_2O$ = 190.23].

Terpin hydrate is made by acting on a mixture of oil of turpentine and alcohol with nitric acid; after standing three or four days the crystals which form are purified by recrystallization.

Description and Physical Properties—Colorless, lustrous crystals, or a white powder. It has a slight odor, and is efflorescent in dry air.

One Gm. of Terpin Hydrate is soluble in about 200 cc. of water, 13 cc. of alcohol, 135 cc. of chloroform, and in 140 cc. of ether, at 25° C. One Gm. is soluble in about 34 cc. of boiling water, in 3 cc. of boiling alcohol, and in about 1 cc. of boiling glacial acetic acid.

When slowly heated to about 100° C., Terpin Hydrate sublimes in fine needles. It loses its water of crystallization at 100° C. It is also slowly dehydrated by drying over sulphuric acid.

Tests for Identity—When quickly heated, Terpin Hydrate melts between 115° and 117° C. with the loss of water.

Add a few drops of sulphuric acid to a hot aqueous solution of Terpin Hydrate: the liquid becomes turbid and develops a strongly aromatic odor.

Test for Purity—Terpin Hydrate has no odor of turpentine and its hot aqueous solution (1 in 100) is not acid to litmus paper.
Ash: not more than 0.05 per cent.
Preserve in well-closed containers, in a cool place.

N. F. Preparations—Elixir Terpini Hydratis; Elixir Terpini Hydratis et Codeinæ; Elixir Terpini Hydratis et Creosoti Compositum.

Uses—Terpin hydrate is used in bronchitis, in doses of two to four grains (0.125 to 0.25 Gm.).

Its slight solubility in water leads to dispensing difficulties. If the solvent is deficient in alcohol the terpin hydrate crystallizes out, if too high in alcohol sugar will crystallize out if present.

RESINA. U. S. Rosin

[**Resin.**—Colophony, Georgia Pine Rosin, Yellow Pine Rosin]

The residue left after distilling the volatile oil from the oleoresin obtained from *Pinus palustris* Miller and from other species of *Pinus* (Fam. *Pinaceæ*).

Description and Physical Properties—Sharply angular, translucent, amber-colored fragments, frequently covered with a yellow dust, fracture brittle at ordinary temperature, shiny and shallow-conchoidal. The odor and taste are slightly terebinthinate.
Rosin is freely soluble in alcohol, ether, benzene, glacial acetic acid, and in fixed or volatile oils. It is also soluble in dilute solutions of the fixed alkali hydroxides.
Tests for Identity and Purity—Its alcoholic solution is acid to litmus paper.
Specific gravity: 1.07 to 1.09 at 25° C.
Rosin is easily fusible and burns with a dense yellowish smoke.
Ash: not more than 0.05 per cent.
Acid number: not less than 150, page 1512.

U. S. P. Preparations—Ceratum Cantharidis; Ceratum Resinæ.
N. F. Preparations—Ceratum Resinæ Compositum; Linimentum Terebinthinæ (from Rosin Cerate); Solutio Resinæ Chloroformica.

Uses—It is a component of plasters, cerates and ointments to which it adds adhesive qualities. Its principal industrial uses are in sizing, waterproofing, soap making, etc.

TEREBINTHINA. N. F. Turpentine

[**Terebinth**—Gum Thus]

Turpentine is a concrete oleoresin obtained from *Pinus palustris* Miller and from other species of *Pinus* (Fam. *Pinaceæ*).
Turpentine contains not more than 2 per cent of foreign matter.
White turpentine contains *abietic anhydride*, which may be converted into *abietic acid*, $C_{44}H_{64}O_5$, a bitter principle, and 25 per cent. of volatile oil.

Official Description—Turpentine occurs in yellowish, opaque masses, lighter internally, sticky and more or less glossy, brittle in the cold.
Odor, Taste, and Reaction—Odor and taste characteristic. Its alcoholic solution is acid to litmus.
Solubility—Freely soluble in alcohol, ether, chloroform, or glacial acetic acid.
For further description see the N. F. V.

N. F. Preparation—Ceratum Resinæ Compositum.

Uses—It is an ingredient in compound rosin cerate and in some unofficial plasters, and is sometimes administered in pill form. Dose, fifteen to thirty grains (1 to 2 Gm.).

OLEUM PINI PUMILIONIS. U. S. Oil of Dwarf Pine Needles

[**Ol. Pin. Pumil.**—Dwarf Pine Oil]

The volatile oil distilled from the fresh leaves of *Pinus montana* Miller (*Pinus Pumilio* Haenke) (Fam. *Pinaceæ*).

Oil of Dwarf Pine Needles yields not less than 5 per cent of esters, calculated as bornyl acetate [$C_{10}H_{17}.C_2H_3O_2$].

Description and Physical Properties—A colorless or faintly yellowish liquid, having a pleasant, aromatic odor, and a bitter, pungent taste.

Tests for Identity and Purity—The Oil is soluble in 10 volumes of 80 per cent alcohol, by volume.

Specific gravity: 0.853 to 0.869 at 25° C.

Optical rotation: varies from −4° 30′ to −9° in a 100 mm. tube at 25° C., page 1524.

Refractive index: 1.4750 to 1.4800 at 20° C., page 1525.

A solution of the recently distilled Oil in 80 per cent alcohol (1 in 10) is neutral or only slightly acid to moistened litmus paper.

Less than 1 per cent of the Oil distils below 165° C.

Assay—Proceed as directed for esters under *Oleum Menthæ Piperitæ*, page 1461, using 10 cc. of Oil of Dwarf Pine Needles. Multiply the number of cc. of half-normal alcoholic potassium hydroxide, consumed in the saponification, by 9.811, and divide the product by the weight of the Oil taken. The result shows the per cent of esters, calculated as bornyl acetate.

Preserve in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil is obtained from the Tyrolese Alps and contains *l-pinene*, *l-phellandrene*, *sylvestrene*, *bornyl acetate*, and *cadinene*.

Uses—Used locally and internally in chronic rheumatic affections, but chiefly as an inhalant in bronchial affections.

ASAFŒTIDA. U.S. Asafetida

[**Asafœt.**—Gum Asafetida, Fetty]

Asafetida is the gum-resin obtained by incising the living rhizomes and roots of *Ferula Asafœtida* Linné and *Ferula fœtida* Regal and of other species of *Ferula* (Fam. *Umbelliferæ*).

Asafetida yields not less than 50 per cent of alcoholic-soluble extractive, and not more than 15 per cent of acid-insoluble ash.

Description and Physical Properties—A soft mass, sometimes almost semi-liquid, or irregular more or less pliable masses composed of agglutinated tears imbedded in a yellowish-brown or dark brown matrix, or loose ovoid tears from 1 to 4 cm. in diameter, the surface sometimes containing streaks of violet, yellowish-red or brownish-red and with a few vegetable fragments; becoming hard and occasionally brittle on drying; surface of the freshly fractured tears milky-white and opaque, changing gradually on exposure to air or light to a pinkish or reddish-purple or even reddish-brown; on moistening with water the tears become milky-white; odor persistent, alliaceous; taste bitter, alliaceous and acrid.

Tests for Identity—Asafetida, triturated with water, yields a milk-white emulsion, which becomes yellowish on the addition of alkalies.

A reddish-brown solution is formed when a fragment of Asafetida is heated with sulphuric acid. Greatly dilute this solution with water, filter, and render alkaline; the solution acquires a blue fluorescence.

A few drops of phloroglucinol T.S. and of hydrochloric acid, added to 10 cc. of the alcoholic filtrate obtained in the assay, produces a cherry-red color.

Tests for Purity—A few drops of ferric chloride T.S., added to 5 cc. of the alcoholic filtrate obtained in the assay, produces an olive-green color (*most foreign resins*). Hydrochloric acid, added to 10 cc. of the alcoholic filtrate from the assay until a faint turbidity results, produces a bluish-green color which fades on standing (*galbanum*).

Asafetida does not show the presence of rosin, page 1519.

Mix 2 cc. of an emulsion, prepared as directed under *Emulsum Asafœtidæ*, with 5 cc. of water and add 5 cc. of sodium hypobromite T.S. to form a separate layer: a red color is not produced (*ammoniac*).

Assay—Place about 10 Gm. of Asafetida in a tared, 250 cc. Erlenmeyer flask, weigh accurately, add 100 cc. of alcohol, and having connected the flask with an upright condenser, boil the mixture in the flask during one hour or until the drug is completely disintegrated. Filter and wash the flask and filter with several small portions of boiling alcohol until the washings no longer produce a cloudiness when dropped into water. Collect the mixed alcoholic solutions, using an aliquot part (50 per cent) for the completion of the assay, and reserve the remainder for the tests given above. Evaporate the aliquot part in a suitable tared container and dry to constant weight. The anhydrous alcohol-soluble extractive of the aliquot portion equals not less than 25 per cent of the weight of Asafetida taken.

U. S. P. Preparations—Emulsum Asafœtidæ; Pilulæ Asafœtidæ; Tinctura Asafœtidæ.

N. F. Preparations—Mistura Magnesiæ, Asafœtidæ et Opii (from Tincture); Pilulæ Aloes et Asafœtidæ.

A volatile oil is found in this gum resin, containing sulphides, also about 20 per cent of gum, and not less than 60 per cent of resin. The gum is partially

soluble in water; the resin is soluble in alcohol, and yields resorcinol by treatment with potassium hydroxide, and umbelliferone by dry distillation. The asafetida which reached this country was grossly adulterated until the regulations of the Food and Drugs Act were enforced. It may now be obtained of good quality. The valuable principles in asafetida are soluble in alcohol; with water an emulsion may be formed, which possesses its virtues.

Uses—It is used as an antispasmodic. Dose, six grains (0.4 Gm.).

MYRRHA. U.S. Myrrh

[**Myrrh.**—Gum Myrrh]

Myrrh is a gum resin obtained from *Commiphora Myrrha* (Nees) Baillon or from other species of *Commiphora* (Fam. *Burseraceæ*).

Myrrh yields not less than 30 per cent of alcohol-soluble extractive and not more than 4 per cent of acid-insoluble ash.

Description—In roundish or irregular tears or masses, dusty, brownish-yellow or reddish-brown; fracture waxy, somewhat splintery, translucent on the edges, sometimes marked with whitish veins; odor balsamic; taste aromatic, bitter and acrid.

Assay—Proceed as directed under alcohol-soluble extractive, page 1523.

For further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Myrrhæ.

N. F. Preparations—Pilulæ Aloes; Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Pilulæ Rhei Compositæ; Tinctura Aloes et Myrrhæ; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe; Tinctura Capsici et Myrrhæ.

Myrrh is a gum resin, and contains 3 per cent of an oxygenated volatile oil, a bitter principle, about 30 per cent of gum, and 60 per cent of resin. Alcohol is the best solvent for the oil and resin which are its active principles. The gum left after macerating Myrrh in alcohol may be used for making a good mucilage.

Uses—It is used as a local stimulant in diseases of the mouth. Formerly it was also employed in amenorrhea. Dose, eight grains (0.5 Gm.).

TOLU. U.S. Tolu

[Balsamum Tolutanum U. S. P. IX, Balsam of Tolu, Tolu]

Tolu is a balsam obtained from *Toluifera Balsamum* Linné (Fam. *Leguminosæ*).

Description and Physical Properties—A brown or yellowish-brown, plastic solid, transparent in thin layers and brittle when old, dried, or exposed to cold. It has a pleasant, aromatic odor resembling that of vanilla, and a mild, aromatic taste.

Tolu is nearly insoluble in water and in petroleum benzin. It is soluble in alcohol, chloroform, and ether. It dissolves in solutions of the fixed alkalies, usually leaving an insoluble residue.

Tests for Identity and Purity—An alcoholic solution of Tolu (1 in 20) is acid to litmus paper.

Shake about 1 Gm. of Tolu with 25 cc. of carbon disulphide, allow it to stand for thirty minutes, filter the liquid, and evaporate 15 cc. of the filtrate to dryness. The residue thus obtained when dissolved in glacial acetic acid, does not show a green color on the addition of a few drops of sulphuric acid (*rosin*). The remaining portion of the filtrate, when shaken with an equal volume of an aqueous solution of copper acetate (1 in 1000), does not acquire a green color (*rosin or copaiba*).

Dissolve about 1 Gm. of Tolu, accurately weighed, in 50 cc. of neutral alcohol, add 1 cc. of phenolphthalein T.S., and titrate the solution with half-normal alcoholic potassium hydroxide. The acid number thus obtained is not less than 112 and not more than 168, page 1512.

Add sufficient half-normal alcoholic potassium hydroxide to the neutralized liquid obtained in the preceding test to make the total volume of the volumetric alkali solution exactly 20 cc., heat the liquid on a water bath for half an hour under a reflux condenser, and cool. Mix the liquid with 200 cc. of distilled water, or more if necessary, and titrate the excess of potassium hydroxide with half-normal sulphuric acid. The total volume of half-normal potassium hydroxide corresponds to a saponification value of not less than 154 and not more than 220, page 1519.

Tolu contains *cinnamic* and *benzoic acids*, resins, a volatile oil called *benzyl benzoate*, $C_7H_5(C_7H_7)O_2$, *benzyl cinnamate*, *a terpene*, $C_{10}H_{16}$, termed *tolene*, and other constituents of less importance.

U. S. P. Preparations—Syrupus Tolu (from Tincture); Tinctura Benzoini Composita; Tinctura Tolu. It is also used as a pill coating for the following: Pilulæ Ferri Iodidi; Pilulæ Phosphori.

Uses—It is used as a stimulant expectorant in doses of fifteen grains (1 Gm.); also as a pill coating to prevent oxidation.

BALSAMUM PERUVIANUM. U. S. Balsam of Peru

[Bals. Peruv.—Peru Balsam, Indian Balsam]

Balsam of Peru is obtained from *Toluifera Pereiræ* (Royle), Baillon (Fam. *Leguminosæ*).

Description and Physical Properties—A dark brown, viscid liquid, transparent, and appearing reddish-brown in thin layers. It has an agreeable, vanilla-like odor, and a bitter, acrid taste with a persistent after-taste, and is free from stringiness or stickiness. It does not harden on exposure to air.

The Balsam is nearly insoluble in water, but is soluble in alcohol, chloroform, and glacial acetic acid, with not more than an opalescence. It is only partly soluble in ether and in petroleum benzin.

Tests for Identity and Purity—Specific gravity: 1.130 to 1.160 at 25° C.

Water becomes acid to litmus paper when agitated with the Balsam.

One Gm. of the Balsam forms a clear solution when shaken with a solution of 3 Gm. of chloral hydrate in 2 cc. of distilled water (*fixed oils*).

Shake about 1 Gm. of the Balsam with 5 cc. of purified petroleum benzin, and warm the mixture on a water bath for ten minutes, adding a sufficient quantity of the solvent to replace the loss by evaporation. On evaporating 2 cc. of the benzin solution, no odor of oil of turpentine is noticeable (*turpentine*).

Balsam of Peru does not show the presence of *rosin*, page 1519.

Dissolve about 1 Gm. of the Balsam, accurately weighed, in 100 cc. of neutral alcohol, add 1 cc. of phenolphthalein T.S., and titrate the solution with half-normal sodium hydroxide: the acid number thus obtained is not less than 56 and not more than 84, page 1512.

Mix about 3 Gm. of the Balsam, accurately weighed, with 30 cc. of sodium hydroxide T.S. in a separator, shake the mixture for a few minutes with 60 cc. of ether, and allow to stand until complete separation into two layers has taken place. Draw off the lower, aqueous layer and quickly filter the ethereal layer into a flask. Transfer 50 cc. of the ether filtrate (representing five-sixths of the weight of the Balsam taken) to a tared, conical flask, evaporate the ether, and dry the residue at 100° C. for thirty minutes. The weight of the residue of cinnamein so obtained corresponds to not less than 50 per cent and not more than 60 per cent of the weight of the Balsam represented by the 50 cc. of ethereal solution taken. Dissolve this residue in 25 cc. of alcohol, add 25 cc. of half-normal alcoholic potassium hydroxide, and heat the mixture carefully on a water bath for one-half hour, in a flask provided with a reflux condenser. Then add 1 cc. of phenolphthalein T.S., and titrate the excess of alkali with half-normal hydrochloric acid. The amount of half-normal alcoholic potassium hydroxide consumed corresponds to a saponification value for the cinnamein of not less than 235 and not more than 238, page 1519.

N. F. Preparations—Mistura Oleo-Balsamica; Solutio Mastiches Chloroformica Compositum.

Balsam of Peru contains *cinnamic* and *benzoic acids*, *benzyl cinnamate*, $C_9H_7(C_7H_7)O_2$, resin, *benzyl benzoate*, stilbene, etc.

Uses—Balsam of Peru is frequently adulterated, market products having been found which closely resembled the natural drug but which were wholly factitious.

It is chiefly employed externally in sluggish ulcers and in skin diseases. It is also used as a preservative for fats, ointments, etc.; internally, it acts like tolu but is not so pleasant. Dose, fifteen grains (1 Gm.).

BENZOINUM. U. S. Benzoin

[Benzoin.—Gum Benjamin]

Benzoin is the balsamic resin obtained from *Styrax Benzoin* Dryander, known in commerce as Sumatra Benzoin, or from other species of *Styrax*, known in commerce as Siam Benzoin (Fam. *Styraceæ*).

Sumatra Benzoin yields not less than 75 per cent of alcohol-soluble extractive and not more than 1 per cent of acid-insoluble ash. Siam Benzoin contains not more than 1 per cent of foreign organic matter, yields not less than 90 per cent of alcohol-soluble extractive, and not more than 0.5 per cent of acid-insoluble ash.

Description and Physical Properties—

Unground Sumatra Benzoin—Blocks or lumps of varying size, made up of tears, compacted together with a reddish-brown, reddish-gray, or grayish-brown resinous mass; tears externally yellowish or rusty-brown, milky-white on fresh fracture; hard and brittle at ordinary temperatures, but softened by heat and becoming gritty on chewing; odor aromatic. When digested with boiling water the odor suggests cinnamic acid or storax. Taste aromatic and slightly acrid.

Unground Siam Benzoin—Pebble-like tears of variable size, compressed, yellowish-brown to rusty-brown externally, milky-white on fracture, separate or very slightly agglutinated, hard and brittle at ordinary temperatures but softened by heat and becoming plastic on chewing; odor agreeable, balsamic, vanilla-like; taste aromatic and slightly acrid.

Tests for Identity—The solution of Benzoin in alcohol becomes milky upon the addition of water and is acid to litmus paper.

Heat a few fragments of Benzoin in a test tube: Sumatra Benzoin evolves a sublimate, consisting of plates and small, rod-like crystals that strongly polarize light. Siam Benzoin evolves a sublimate directly above the melted mass consisting of numerous long, rod-shaped crystals, which do not strongly polarize light.

Treat about 0.25 Gm. of Benzoin with 5 cc. of ether, decant about 1 cc. of the ethereal solution into a porcelain dish, and add to it 2 or 3 drops of sulphuric acid: the solution of Sumatra Benzoin produces a deep red-brown coloration of the sulphuric acid and the solution of Siam Benzoin produces a deep purplish-red coloration.

Heat about 0.5 Gm. of Benzoin in a test tube with 10 cc. of potassium permanganate T.S.: only the Sumatra variety develops an odor of benzaldehyde.

Treat about 1 Gm. of powdered Benzoin with 15 cc. of warm carbon disulphide, filter, wash the filter with an additional 5 cc. of carbon disulphide, and allow the filtrate to evaporate spontaneously: the residue is not less than 12.5 per cent. This residue responds to the tests for identity under *Acidum Benzoicum*.

Tests for Purity—Benzoin does not show the presence of *rosin*, page 1519.

Assay—Proceed as directed under alcohol-soluble extractive (page 1523).

U. S. P. Preparations—(From Siam Benzoin) Adeps Benzoinatus. (From any official Benzoin) Tinctura Benzoini; Tinctura Benzoini Composita.

N. F. Preparations—Sevum Benzoinatum; Unguentum Picis Compositum (from Tincture).

Benzoin contains *benzoic acid*, *cinnamic acid* ($C_9H_8O_2$), a fragrant volatile oil, and resins. In some varieties *vanillin* is found. Alcohol is the best solvent for its active principles.

Uses—It is employed chiefly as a local remedy for irritations of the skin. It was formerly used externally as an expectorant. Dose, fifteen grains (1Gm.).

STYRAX. U.S. Storax

[Liquid Storax]

Storax is a balsam obtained from the trunk of *Liquidambar orientalis*, Miller, known in commerce as Levant Storax, or of *Liquidambar styraciflua* Linné, known in commerce as American Storax (Fam. *Hamamelidaceæ*.).

Description and Physical Properties—A semi-liquid, grayish to grayish-brown, sticky, opaque mass, depositing on standing a heavy, dark brown layer (Levant Storax); or a semi-solid, sometimes a solid mass, softened by gently warming (American Storax). Storax is transparent in thin layers, has a characteristic odor and taste, and is heavier than water.

Storax is insoluble in water, but is soluble, usually incompletely, in an equal weight of warm alcohol. It is also soluble in acetone, carbon disulphide, and ether, some insoluble residue usually remaining.

Tests for Identity and Purity—To about 0.05 Gm. of the cinnamic acid obtained in the assay add 5 cc. of diluted sulphuric acid, heat, and add potassium permanganate T.S.: the odor of benzaldehyde is evolved. A portion of the acid recrystallized from hot water melts between 134° and 135° C.

Dry about 2 Gm. of well-mixed Storax, accurately weighed, for two hours at 100° C.; the loss in weight does not exceed 20 per cent.

Dissolve about 10 Gm. of well-mixed Storax, accurately weighed, in 40 cc. of hot alcohol, filter through counterbalanced filters or a Gooch crucible, and wash the residue with small por-

tions of hot alcohol until the washings are colorless or very nearly so: the residue after drying at 100° C. does not exceed 5 per cent. Evaporate the combined alcoholic filtrate and washings at a temperature not exceeding 60° C., and dry the residue for one hour at 100° C.: a yellow to brown residue of purified Storax remains, corresponding to not less than 70 per cent of the weight of the Storax taken. The purified Storax thus obtained complies with the following tests:

Dissolve about 1 Gm. of the purified Storax, accurately weighed, in 50 cc. of neutralized alcohol, add 0.5 cc. of phenolphthalein T.S., and titrate with half-normal sodium hydroxide: the acid number is from 56 to 85 for Levant Storax and from 38 to 85 for American Storax, page 1512.

Place about 2 Gm. of the purified Storax, accurately weighed, in a 250 cc. flask, mix with 50 cc. of purified petroleum benzin, add 25 cc. of half-normal alcoholic potassium hydroxide, and allow the mixture to stand twenty-four hours with frequent agitation. Then add 0.5 cc. of phenolphthalein T.S. and titrate the excess of alkali with half-normal hydrochloric acid. The saponification value thus obtained is not less than 160 and not more than 200, page 1519.

Boil about 2 Gm. of the purified Storax, accurately weighed, with 25 cc. of half-normal alcoholic potassium hydroxide for one hour under a reflux condenser. Neutralize with half-normal sulphuric acid, using 5 drops of phenolphthalein T.S. as indicator, and evaporate the alcohol on a water bath. Dissolve the residue in 50 cc. of distilled water and shake the solution with 20 cc. of ether. Shake the separated ether with 5 cc. of distilled water, add the washings to the aqueous solution, and reject the ether-extract. Add to the aqueous solution 10 cc. of diluted sulphuric acid and shake with four successive portions of 20 cc. each of ether. Wash the combined extract with 5 cc. of distilled water, rejecting the water washings, transfer to a flask and distil off the ether. Add to the residue 100 cc. of distilled water, and boil vigorously for fifteen minutes under a reflux condenser. Filter while hot and allow the filtrate to cool to about 25° C: white crystals of cinnamic acid separate. Filter the cinnamic acid on a Gooch crucible, applying a vacuum towards the end to drain the crystals completely. Repeat the extraction of the residue twice by boiling each time under a reflux condenser, as before described, with the filtrate from the preceding crystallization, and collect the additional cinnamic acid in the same crucible. Finally wash the cinnamic acid with two 10 cc. portions of ice cold water, dry at 80° C., and weigh. The weight of the cinnamic acid thus obtained corresponds to not less than 25 per cent of the purified Storax taken.

U. S. P. Preparation—Tinctura Benzoini Composita.

Storax contains cinnamic acid, benzoic acid, *styracin*, $C_9H_7(C_9H_9)O_2$, *storesin*, $C_{36}H_{57}O_3$, *ethyl cinnamate*, $C_9H_7(C_2H_5)O_2$, *phenyl-propyl cinnamate*, $C_9H_7(C_9H_{17})O_2$, *styrol*, C_8H_8, a fragrant hydrocarbon, and a resinous substance not yet investigated. A large quantity of water is usually present.

Uses—It is an expectorant but is used chiefly as a local remedy, especially in combination with benzoin. It may be used, like benzoin, to protect fatty substances from rancidity. Dose, fifteen grains (1 Gm.).

ACIDUM BENZOICUM. U. S. Benzoic Acid

Benzoic acid and its compounds which are largely prepared synthetically will be found on pages 832 to 839.

AGARICUS. N. F. Agaric

[White Agaric, Larch Agaric]

Agaric is the dried fruit of *Polyporus officinalis* Fries (Fam. *Polyporaceæ*) deprived of its outer rind.

Agaric contains not more than 5 per cent of foreign organic matter. It yields to boiling alcohol not less than 50 per cent of a non-volatile resinous extract.

It contains an active principle known as *agaracin*, also resin.

Description—Light, fibrous, somewhat spongy pieces of irregular shape; grayish-white to pale brown externally; yellowish and resinous internally; fracture tough, fibrous; friable but difficult to powder. Odor faint; taste sweetish, acrid, and bitter.

For further description see the N. F. V.

N. F. Preparations—Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe.

Uses—Used to control the night sweats of phthisis, in doses of five to ten grains (0.3 to 0.6 Gm.).

EUCALYPTI GUMMI. N. F. Eucalyptus Gum

[Eucalypt. Gum.—Red Gum]

Eucalyptus Gum is a dried gummy exudation from *Eucalyptus rostrata* Schlecht, and other species of *Eucalyptus* (Fam. *Myrtaceæ*).

Description—In dark reddish-brown grains or angular masses which in thin layers are of a transparent ruby-red color; brittle, the older surfaces sometimes dusty; forming a plastic mass and adhering to the teeth when chewed, coloring the saliva red; odor slight; taste very astringent. For further description and tests see the N. F. V.

Preparation—Trochisci Eucalypti Gummi.

Uses—A mild astringent in diarrhea but most frequently employed in lozenges and gargles to relieve a relaxed condition of the pharynx.

Dose, 10 grains (0.6 Gm.).

GUAIACUM. N. F. Guaiac
(U. S. P. IX)

[**Guaiac.**—Guaiac Resin]

Guaiac is the resin of the wood of *Guaiacum officinale* Linné, or of *Guaiacum sanctum* Linné (Fam. *Zygophyllaceæ*).

Guaiac yields not more than 15 per cent of residue insoluble in alcohol.

Description—In irregular fragments or in large, nearly homogeneous masses, occasionally in more or less rounded or ovoid tears, enclosing fragments of vegetable tissues; externally brown, becoming greenish-gray-brown on exposure, the fractured surface having a glassy luster, the thin pieces being translucent and varying in color from reddish to yellowish-brown. Odor balsamic; taste slightly acrid.

For further description see the N. F. V.

N. F. Preparations—Gargarisma Guaiaci Composita (from Ammoniated Tincture); Tinctura Guaiaci; Tinctura Guaiaci Ammoniata; Tinctura Guaiaci Composita.

This resin is usually prepared by boiling guaiac chips in salt water; the resinous scum is collected, melted, and strained. It consists of *guaiacic acid* ($C_{12}H_{16}O_6$), *guaiaconic acid* ($C_{19}H_{20}O_5$), *guaiaretic acid* ($C_{20}H_{26}O_4$), beta resin, gum, etc. Alcohol and alkaline solutions are the best solvents for guaiac. A solution of guaiac resin is colored blue by oxidizing agents, due to the presence of guaiaconic acid.

History—This drug came into use in the early part of the sixteenth century in the treatment of syphilis. It was so highly extolled that it sold for a price equivalent to $25 a pound.

Uses—Guaiac is used as a remedy in rheumatism in doses of fifteen grains (1 Gm.). It is a valuable reagent in one of the tests for occult blood.

DIOSCOREA. N. F. Dioscorea

[**Diosc.**—Wild Yam Root]

Dioscorea is the dried rhizome of *Dioscorea villosa* Linné (Fam. *Dioscoreaceæ*).

Dioscorea contains not more than 2 per cent of foreign organic matter.

Description—Knotted and woody, elongated, from 6 to 12 mm. in thickness, often compressed, bent and branched, bearing scattered nodular projections at the sides, slender tough roots underneath and stem-scars on the upper surface; externally pale brown, surface more or less scaly from the partly detached, thin outer layer; fracture short but tough, the fractured surface whitish or pale-brown, with numerous small, scattered, yellowish wood bundles. Odorless, taste starchy, insipid, afterwards acrid.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Dioscoreæ; Tinctura Viburni Opuli Composita.

Uses—It has been used in hepatic disorders and also in rheumatism. Dose, one drachm (4 Gm.).

DROSERA. N. F. Drosera

[**Droser.**—Sundew]

Drosera is the air-dried flowering plant of *Drosera rotundifolia* Linné, frequently mixed with the closely allied species *Drosera anglica* Hudson and *Drosera longifolia* Linné, or at times wholly replaced by these (Fam. *Droseraceæ*).

Drosera contains not more than 5 per cent of foreign organic matter and yields not more than 10 per cent of acid-insoluble ash.

It contains an acrid resin, citric and malic acids and a ferment.

Description—A delicate plant of a reddish color throughout, with a few fibrous, blackish rootlets; leaves all in a basal rosette, blade orbicular, about 15 mm. in diameter, abruptly contracted into a slender, pubescent petiole, upper surface covered with prominent glandular hairs; scape filiform, smooth, from 10 to 20 cm. in length, bearing a few, five-parted, small, white fugacious flowers in a curved, one-sided raceme.

Drosera intermedia is identified by its spatulate leaves with blades two or three times as long as they are wide and glabrous petioles. *Drosera longifolia* is identified by its elongated spatulate obovate leaves with blades six or eight times as long as they are wide, and its slender smooth petioles and scape, declinate at base. Odorless; taste faintly bitter and acidulous.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Droseræ.

Uses—It is used in chronic bronchitis, whooping-cough, and tuberculosis, but is apparently of little value. Dose, one drachm (4 Gm.).

ECHINACEA. N.F. Echinacea

[Echin.]

Echinacea consists of the dried rhizome and roots of *Brauneria pallida* (Nuttall) Britton or *Brauneria angustifolia* (De Candolle) Heller (Fam. *Compositæ*).

Echinacea contains not more than 3 per cent of foreign organic matter. Echinacea must not be used after it has lost its characteristic odor and taste.

It contains an acrid resin, and a minute amount of an alkaloid.

Description—Nearly entire, cylindrical, very slightly tapering and sometimes slightly spirally twisted, from 10 to 20 cm. in length and from 4 to 13 mm. in diameter, externally grayish-brown, light brown or purplish-brown, slightly annulate in the upper portion, with occasional V-shaped stem scars, somewhat longitudinally wrinkled or furrowed; fracture short, fibrous, bark less than 1 mm. in thickness, wood thick and composed of alternate light yellowish and black wedges; the rhizome with a circular pith. Odor faint, aromatic; taste sweetish, followed by a tingling sensation suggesting aconite, but lacking the persistent and benumbing effect produced by that drug.

For further description see the N. F. V.

N.F. Preparation—Fluidextractum Echinaceæ.

Uses—It is used as an alterative, and as a diaphoretic; also used in eczema. Dose, fifteen grains (1 Gm.).

EUPHORBIA. N.F. Euphorbia

[Euphorb.—Euphorbia Pilulifera—Pill Bearing Spurge]

Euphorbia is the dried herb of *Euphorbia herta* Linné (Fam. *Euphorbiaceæ*).

Euphorbia contains not more than 5 per cent of foreign organic matter and yields not more than 3 per cent of acid-insoluble ash.

It contains an acrid resin.

Description—Roots usually present, small, branched, and reddish; stems slender, cylindrical, obliquely erect, dichotomously branched from near the base, branches recurved at apices; branches and stem only sparsely leafed at base, pale greenish-brown, rough or hairy; stems coarsely pilose with yellow hairs which are rather dense on the upper parts but sparse on the lower; pubescence consisting of short, nearly straight unicellular hairs, becoming almost hispid at the flowering tops; leaves opposite, obliquely oblong, acute, serrulate, rusty pale green, pubescent especially on the prominent veins on the lower surface, becoming brittle on drying and usually much broken in the drug; flowers small, numerous, in short peduncled axillary clusters; fruits about 1 mm. in diameter, three-celled capsules, seeds about 0.9 mm. in diameter, triangular ovoid, pale brown. Odor aromatic, and characteristic; taste faintly bitter, aromatic, and acrid.

For further description see the N. F. V.

N.F. Preparation—Fluidextractum Euphorbiæ Piluliferæ.

Uses—It is used as an expectorant. Dose, thirty grains (2 Gm.).

KAVA. N.F. Kava

[Kav.—Methysticum—Kava Kava]

Kava is the dried rhizome and roots of *Piper methysticum* Forster (Fam. *Piperaceæ*).

Kava contains not more than 1 per cent of foreign organic matter.

Its chief constituent is a resin present to the extent of about 5 per cent. Small amounts of other principles, glucosidal and alkaloidal in character, are said to be present.

Description—It consists of a large, irregular knotty crown, often 12 cm. or more in diameter, from which proceed numerous, long, cylindrical, tough, nearly simple roots, which tend to fray out into bare, separated fibro-vascular bundles; the crown soft, light, spongy and granular and very starchy; externally dark-brown or blackish, the crown frequently partly scraped and light brown to light gray; internally white. Odor faint but characteristic; taste aromatic and pungent slightly bitter, more or less local anesthesia resulting.

For further description see the N. F. V.

N.F. Preparation—Fluidextractum Kavæ.

Uses—A stimulant diuretic. The dose is fifteen grains (1 Gm.).

MASTICHE. N.F. Mastic

(U.S.P. VIII)

Mastic is a concrete resinous exudation from *Pistacia lentiscus* Linné (Fam. *Anacardiaceæ*).

Mastic contains not more than 1 per cent of foreign organic matter.

Mastic contains a resin (mastichic acid, $C_{20}H_{32}O_2$), which is soluble in strong alcohol; also masticin, a resinous principle which is insoluble in alcohol; a small quantity of volatile oil is likewise present.

Description—In sub-globular, lenticular, elongated or pear-shaped tears, about 3 mm. in diameter, pale yellow or greenish-yellow, transparent, having a glass-like luster, the surface sometimes very slightly dusty; brittle, becoming plastic when chewed. Odor slight, balsamic; taste mild, terebinthinate.

For further description see the N. F. V.

N. F. Preparations—Pilulæ Aloes et Mastiches; Solutio Mastiches Chloroformica Compositum.

Uses—It is used in pills of aloes and mastic to modify the action of the aloes; in the arts and in dentistry it is employed to form a varnish. Dose, thirty grains (2 Gm.).

MITCHELLA. N. F. Mitchella

[**Mitchel.**—Squaw Vine]

Mitchella is the dried plant of *Mitchella repens* Linné (Fam. *Rubiaceæ*).

Mitchella contains not more than 5 per cent of foreign organic matter.

Description and Tests—(See the N. F. V.)

It contains resin, wax, and mucilage, and a saponin-like principle.

Preparations—Elixir Aletridis Compositum, Elixir Heloniadis Compositum, Fluidextractum Mitchellæ.

Uses—A diuretic, tonic, and astringent. *Dose*, 30 grains (2 Gm.).

PINUS ALBA. N. F. White Pine Bark

[**Pin Alb.**]

White Pine Bark is the dried inner bark of *Pinus Strobus* Linné (Fam. *Pinaceæ*).

White Pine Bark contains not more than 2 per cent of outer bark and not more than 2 per cent of foreign organic matter.

It contains tannin, gum, resin, and a peculiar body known as *coniferin*, ($C_{16}H_{22}O_8.H_2O$). This substance yields vanillin upon oxidation.

Description—In flat pieces of variable size and from 1 to 3 mm. in thickness; outer surface varying from a pale pinkish-white when fresh, to a light or rather deep-yellowish brown on keeping, occasionally with small patches of the gray-brown periderm adhering; more or less cottony, and often showing small scattered pits; inner surface either lighter or darker than the outer, finely striate; fracture tough, fibrous; transverse section showing an outer yellowish and an inner whitish band. Odor slight, terebinthinate; taste slightly mucilaginous, bitter, sweet, and astringent.

For further description see the N. F. V.

N. F. Preparations—Syrupus Pini Albæ Compositus; Syrupus Pini Albæ Compositus cum Morphina.

Uses—It is used as an expectorant in doses of thirty grains (2 Gm.).

Unofficial Products from Oils and Substances Containing Resins

Ammoniacum Ammoniac. (U. S. P. 1890)	A gum-resin obtained from *Dorema Ammoniacum* Don (Fam. *Umbelliferæ*). It contains 25 per cent gum, 70 per cent resin, and about 3 per cent volatile oil. It is expectorant and stimulant. Dose, fifteen grains (1 Gm.)
Bdellium Bdellium	From *Balsamodendron Mukul*, grown in India. It contains volatile oil and resin
Benzoyl Glycocoll, $CH_2 \begin{matrix} NH.C_7H_5O \\ COOH \end{matrix}$	The dose of benzoyl glycocoll, or *sodium hippurate*, is ten grains (0.65 Gm.) three times a day
Copal	A resinous substance, brought principally from the East Indies. Used for making varnish
Doundaké	An astringent and tonic febrifuge
Elastica, Rubber (India Rubber U. S. P. VIII)	The prepared milk-juice of several species of *Vebea* Aublet (Fam. *Euphorbiaceæ*), known in commerce as Para Rubber. It is used as the base for machine-made plasters
Elemi Elemi	From *Cannarium commune*, grown in the Philippine Islands. It contains 10 per cent of volatile oil, $C_{10}H_{16}$, and 25 per cent of resin
Euphorbium Euphorbium	From *Euphorbium resinifera*, found in Morocco. It contains 18 per cent of gum and 38 per cent of resin, etc.
Galbanum Galbanum	From *Ferula galbaniflua*. It contains 8 per cent of volatile oil and 85 per cent of resin. Dose, fifteen grains (1 Gm.)
Guaiac Wood Lignum Vitæ (N. F. IV)	The heart-wood of *Guaiacum officinale* Linné or of *Guaiacum sanctum* Linné (Fam. *Zygophyllaceæ*). The chief constituent is the resin which is official in the N. F. Used as a remedy in rheumatism in doses of one drachm (4 Gm.)
Gurjun Wood Oil	From *Dipterocarpus turbinatus*. It contains about 40 per cent of volatile oil and resin
Gutta Percha (N. F. IV)	The purified, coagulated, milky exudate of various trees of the genus *Palaquium* Blanco (Fam. *Sapotaceæ*). An adhesive, used for the preparation of Gutta Percha solution
Gutta Percha Solution (N. F. IV)	Prepared by dissolving 15 Gm. of gutta percha in 75 cc. of chloroform, adding 17 Gm. of lead carbonate previously mixed with 25 cc. of chloroform. Shake the mixture thoroughly and set it aside to clarify by subsidence.
Hippuric Acid, ($C_9H_9NO_3$)	Suggested as a remedy in the uric acid diathesis
Labdanum Labdanum	A stimulant expectorant. At present used only in plasters
Lac Lacca	A reddish-brown resin. Formerly used in medicine, but at present chiefly for making varnish; also in making sealing wax

Unofficial Products from Oils and Substances Containing Resins—*Continued*

Olibanum Frankincense	From several species of *Boswellia*, found in Africa. It contains 6 per cent of volatile oil and 56 per cent of resin
Pix Burgundica Burgundy Pitch (U. S. P. 1890)	The prepared resinous exudation of *Abies excelsa* Poiret (Fam. *Coniferæ*). Used in making plasters
Pix Canadensis Canada Pitch	From *Abies canadensis*. Used in making plasters
Resina Draconis Dragon's Blood	The resin from the fruit of *Calamus Draco*. It contains a peculiar resin, $C_{20}H_{20}O_2$, etc.
Retinol	A yellowish oil, boiling at 280° C. (536° F.) Mildly antiseptic. Good solvent of phosphorus
Sagapenum	Stimulant, antispasmodic. Dose, ten to thirty grains (0.65 to 2 Gm.). Used also externally in plasters as a discutient
Sandarach Gum Juniper	Used chiefly as a varnish and as incense. Formerly given internally, and used in ointments and plasters
Succinum Amber	Contains succinic acid, and a volatile oil which is stimulant and antispasmodic, or rubefacient when applied externally
Terebinthina Canadensis Canada Turpentine (Balsam of Fir Canada Balsam U. S. P. VIII)	A liquid oleoresin obtained from *Abies balsamea* (Linné) Miller (Fam. *Coniferæ*) (see Reagents, Part IX). Used externally but chiefly for mounting microscopic objects
Terpinol, $(C_{10}H_{16})_2 + H_2O$	Derivative of oil of turpentine. In colorless crystals. Dose, three to four grains (0.2 to 0.25 Gm.)
Venice Turpentine Larch Turpentine (N. F. IV)	A viscid oleoresin obtained from *Larix europæa* De Candolle (Fam. *Pinaceæ*). A nearly transparent, yellowish or yellowish-green, thick liquid, heavier than water. It is used as a stimulant diaphoretic and diuretic
Viscum Album Mistletoe	Oxytocic. Dose, one fluidrachm (4 cc.) of the fluidextract

Eclectic Resinoids

Prof. John Uri Lloyd has supplied the following statement concerning these products:

"Following the discovery of resin of podophyllum, made by Dr. John King and announced to the medical and pharmaceutical professions nearly one hundred years ago (1835), Wm. S. Merrill, a manufacturing pharmacist of Cincinnati, Ohio, introduced the preparation commercially. Came then an idealistic view of similar possibilities with other drugs of the American materia medica.

Soon afterward Doctor King introduced resin of cimicifuga (macrotys) known as *macrotin*, which was the second authentic "Eclectic Resinoid".

The service of resin of podophyllum, which rapidly grew into use, was of exceptional importance. It practically displaced scammony and resin of jalap. Thus, as an example, the term "Compound Cathartic Pills Improved" resulted.

Manufacturers were led illogically to attempt to parallel these resins with products from other plants. As a distinguishing feature the commercial term "*in*" affixed to the word was employed, thus King's resin of podophyllum was commercially changed to *podophyllin*, the same rule being applied elsewhere.

Doctor King did not utilize this commercial termination, *in*, stating—"as to the nomenclature given to these resins and dried extracts, it did not originate with me."

Within a reasonable time the commercial market was weighted with dried extracts and heterogeneous materials listed as "Eclectic resinoids, alkaloids, and concentrations". Few had originated with physicians of the Eclectic school.

Finally aroused by the frauds, the illogical and unfounded claims made by affixing the word "Eclectic" to this large class of heterogeneous preparations, it became necessary to deal a death blow to the products and their connection with the school. This was accomplished so far as the Eclectic School of Medicine was concerned by Doctor King. In the Worcester Journal of Medicine, 1855, he wrote as follows:

'I now wish to call the attention of all classes of physicians to a most stupendous fraud which is being perpetrated upon them in relation to concentrated preparations, in which oils, oleo-resins, fluidextracts, etc., are triturated with finely powdered green leaves, or roots, or barks, perhaps of the crude articles of which they purport to be concentrations, as well as with rosin, carbonate of magnesia, etc. The resin of jalap which can be obtained for two dollars a pound, is triturated with some inert agent, and sold for Jalapin at one dollar an ounce; and similar impositions.

I regret that I am compelled to thus definitely allude to these matters, but there is no help for it—the cause of Eclecticism, of truth, of justice, demands it. Already are the old school physicians manifesting an interest in our concentrated remedies, and if we permit such trash to be foisted on them as pure agents, they will believe that Eclecticism is indeed quackery and humbug, and it will require years to overcome the effects of such a disgraceful blow. We have sufficient to do in contending for the truth and justice of our cause, without warring against the imposition of those who either directly or indirectly claim to be with us.

I am sorry to say some individuals have been found so far regardless of the good of the cause, and of their own honor, as to have made strenuous efforts to introduce these agents to the profession by all the means in their power.

I shall make no comments on the subject; it speaks for itself with the voice of a stentor, and every honorable man, every true Eclectic, can not but feel its voice enkindling within his whole soul the strongest feelings of censure and indignation toward those who would thus deceive the profession in a matter so intimately connected with the health and lives of their fellow creatures.—John King.

In 1870, fortifying the foregoing, Dr. John M. Scudder struck another blow, the two together practically ending the use of these compounds with the exception of the Resin of Podophyllum, Macrotys and a few legitimates used by physicians of the Eclectic school.

Dr. Scudder wrote: In 1855 much of Eclectic medicine was an unmitigated humbug. That was the day of the so-called *concentrated medicines*, and anything having a termination in *"in"* was lauded to the skies. It was claimed that these resinoids were the active principles of the plants, and as they would replace the old drugging with crude remedies and teas, they must prove a great boon. But they did not give success, and finally, after trying them for awhile, the practitioner would go back to the crude articles and old syrups and teas with success, or he would settle down to podophyllin catharsis and quinine.'

Yet the term Eclectic resinoids, alkaloids and concentrations, affixed to a class of preparations that Eclecticism never fathered, never commended and in no wise originated, continued to be applied in print as their introduction.

To the foregoing it should be added that the alkaloidal products of certain alkaloid-yielding plants, such as sanguinaria and hydrastis, have been and are yet standard remedial agents in the Eclectic medical fraternity. They have been accepted the world over as strictly scientific.

At the risk of being considered an unwanted personal intrusion, the following from my pen, printed in 1909 in a treatise on the subject, is quoted:

'*The Lesson*—Comes now the lesson taught by near a century of turmoil in and among alkaloids, resins, resinoids, and oleo-resins. Shattered ambitions, blasted hopes, disappointments generally, have their uses. The resinoid craze is not an exception, for it has already served several purposes, one being the establishing of the fact that in only a few North American drugs are found alkaloids or resins of great individual merit, another being the dispelling of the illusion that a fragment can parallel the whole, if the whole be intelligently comprehended. Eclectic physicians learned from an experience not easily forgotten the lesson that dried fragments of drugs are not representatives of drugs'".

CHAPTER LXXI

FIXED OILS, FATS, SOAPS, AND PETROLEUM PRODUCTS

FIXED oils and fats are, with few exceptions, esters of the higher members of the paraffin series of fatty acids with the radical glyceryl, and are sometimes called glycerides of the fatty acids. The difference between fixed and volatile oils therefore is a very vital difference. The volatile oils have no uniformity or similarity in their general composition, their volatility being their common distinguishing character. The fixed oils, besides the similarity of their composition, are non-volatile, except when heated to the point of decomposition.

The difference between fixed oils and fats is one of consistence, the fats being harder, owing to variations in the proportions of certain constituents common to both. Waxes resemble both fats and fixed oils in that they are esters of fatty acids, but they differ in that instead of being esters of glyceryl, they are esters of higher alcohols (see Cera Flava, page 1191). Fats and oils are sometimes referred to as *lipoids* or *lipides*.

Fixed oils and fats are distinctive in their physical properties. They are greasy to the touch and leave a permanent oily stain upon filter paper. They are all lighter than water and insoluble therein, but are soluble in ether, chloroform, and other immiscible solvents. A few of them are soluble in alcohol.

When purified, they are nearly colorless and of a bland odor and taste, with very little distinctiveness.

When heated moderately, fats liquefy and oils become thinner. When heated strongly, they undergo decomposition with the production of acrid, inflammable vapors and when ignited, burn with a sooty flame. The acridity of an overheated fixed oil or fat is due to the liberation of *acrolein* (*acrylic aldehyde*).

Upon exposure to air and moisture, a peculiarly disagreeable quality is developed which is known as *rancidity* and which is usually accompanied by the liberation or formation of lower members of the series of fatty acids, known as volatile fatty acids. Rancidity may be retarded by keeping fixed oils and fats in a cool, dry place in well-filled dry containers, protected from light. When rancidity has occurred, it may sometimes be removed by careful treatment of the oil with weak alkalies and subsequent additional purification.

Most of the fixed oils and fats are obtained by expression from the plant or animal tissues in which they occur. Generally the material is prepared by grinding and is subsequently submitted to hydraulic pressure.

The oils as obtained by the first expression usually are of the highest commercial value, as in olive oil where the first pressings are called "virgin" olive oil, but sometimes the expressed oil from plant tissues is crude in its character and requires subsequent treatment and purification, as in the case of cottonseed oil. Fixed oils and fats are frequently bleached by treatment with fuller's earth or similar clays, and subsequent filtration.

Some few oils for technical purposes are not obtained by expression but are extracted from the plant tissues by means of volatile solvents which are later recovered. Animal fats and oils are usually separated by the process known as "rendering" which consists in melting the tissues until the fat separates mechanically.

There are several proximate constituents which are common to many fixed oils. They are *olein*, *palmitin*, and *stearin*.

A fat or oil containing all three of these constituents might be called an *oleo-palmito-stearate of glyceryl.*

Olein is *glyceryl trioleate* [$C_3H_5(C_{18}H_{33}O_2)_3$]. It is liquid at ordinary temperatures. It predominates in expressed oil of almond and in lard oil.

It is the predominating constituent in the more fluid oils of animal and vegetable origin and is separated and purified by cold expression, the other constituents being retained by their lack of fluidity at low temperatures. It is insoluble in water but soluble in alcohol and in ether.

Palmitin is *glyceryl tripalmitate* [$C_3H_5(C_{16}H_{31}O_2)_3$]. It is semi-solid at ordinary temperatures. It predominates in palm oil, coconut oil, and in some waxes.

Stearin is *glyceryl tristearate* [$C_3H_5(C_{18}H_{35}O_2)_3$]. It is solid at ordinary temperatures. It predominates in solid fats and is separated by cold expression, which removes the olein and palmitin.

A constituent called *margarin* was at one time believed to exist in fats but this was later discovered to consist of a mixture of palmitin and stearin.

A glance at the chemical formulas of olein and stearin will show their close similarity, stearin containing two more atoms of hydrogen in each molecule. Olein is now capable of being converted into stearin by a process known as *hydrogenation* which consists in the action upon olein, of nascent hydrogen in the presence of a catalyst, such as finely divided nickel. Liquid oils are now commercially transformed into solid fats which are much more valuable. *"Crisco"*, the proprietary cooking fat, is an example of a hydrogenated fat; it is made from cottonseed oil.

Oils and fats, when subjected to pressure at certain temperatures, can be fractionated into the foregoing constituents: olein, palmitin, and stearin. In the natural change which takes place in most fluid oils upon standing, the stearin has a tendency to precipitate and make the oil unsightly and less valuable.

In the days before artificial refrigeration the oils expressed in the summer (at a higher temperature), when the stearin would be kept in solution to a greater extent, were found to deposit the stearin much more readily than those pressed in the winter (at a lower temperature), and *"summer pressed"* and *"winter pressed"* were commercial designations which still obtain, although at the present time it is a matter of temperature control at the time of pressing, irrespective of the season.

Fixed oils are classified into drying and non-drying oils. The former when exposed to the air undergo oxidation with the formation of a tough hard film. Linseed oil is an example of the class of drying oils which find their greatest use in the manufacture of paints and varnishes. The non-drying oils when exposed to the air remain sticky to the touch for an indefinite period and therefore cannot be used in paints and varnishes. Olive oil and the expressed oil of almond are examples of non-drying oils. The drying or non-drying quality is caused by the presence, in the former class, of unsaturated fatty acids of a distinctive character.

The analytical factors of importance in identifying fixed oils and in judging of their quality, are the iodine number, acid number, saponification number, and refractive index. The specific gravity, color, odor, and congealing point are of little or no value. Some oils, such as cottonseed oil and sesame oil, are identifiable by specific tests, but the identification of a fixed oil is only inferentially possible as a rule, after taking all physical and chemical factors into account.

The common property of all fats and oils is that of undergoing saponification when treated with alkalies. (See under Glycerin, Lead Plaster, Soap, Soft Soap, etc.)

OLEUM AMYGDALÆ EXPRESSUM. U. S. Expressed Oil of Almond

[Ol. Amygd. Exp.—Oil of Sweet Almond]

The fixed oil obtained from the kernels of varieties of *Amygdalus communis* Linné (Fam. *Rosaceæ*).

Preparation—This oil is obtained equally pure from sweet and bitter almonds. The almonds, having been deprived of a reddish-brown powder adhering to their surface, by being rubbed together in a piece of coarse linen, are ground in a mill, and then pressed in canvas sacks between plates of steel slightly heated. The oil, which is at first turbid, is clarified by rest and filtration. Sweet almond yields about 40 per cent and bitter almond 35 per cent of fixed oil.

A colorless oil may be obtained by expressing almonds which have been *blanched—i.e.*, deprived of their testa by soaking them in hot water and slightly pressing them, and afterwards drying in a stove to evaporate the water. The fixed oil from peach or apricot kernels is frequently sold for expressed oil of almond; it is commercially known as *Oleum persica*. While a useful product, it is not intended by the U. S. P. that it should be substituted for oil of sweet almond (see official test below).

The *sweet almond, Amygdala dulcis*, was official in the U. S. P. IX. It contains about 40 per cent of fixed oil, protein substances (*conglutin* and *amandin*), sugar and mucilage.

The integument must be removed by placing the seeds in boiling water for a moment before preparing the emulsion (see page 290).

Description and Physical Properties—A clear, pale straw-colored or colorless, oily liquid. It is almost odorless, and has a bland taste.

It is slightly soluble in alcohol, but is miscible with ether, chloroform, benzene, and with petroleum benzin.

Tests for Identity and Purity—Specific gravity: 0.910 to 0.915 at 25° C.

The Oil remains clear at −10° C., and does not congeal until cooled to nearly −20° C. (*olive or lard oil*).

Shake vigorously, for five minutes, 2 cc. of the Oil with a mixture of 1 cc. of fuming nitric acid and 1 cc. of distilled water: the mixture is not more than slightly colored. (*Oil of peach kernels and oil of apricot kernels* yield a red color, and *sesame oil and cottonseed oil* yield a brown color.)

Heat 10 cc. of the Oil with 15 cc. of an aqueous solution of sodium hydroxide (1 in 6) and 30 cc. of alcohol on a water bath in a flask, having a small funnel inserted in the neck, and occasionally agitate the mixture until it becomes clear. Transfer the solution to a shallow dish, and evaporate the alcohol on a water bath: the residue, when mixed with 100 cc. of distilled water, produces a clear solution (*paraffin oil*). Add an excess of hydrochloric acid to this solution: a layer of oleic acid rises to the surface which, when separated, washed with warm water, clarified by heating on a water bath, and cooled to 15° C. remains clear for thirty minutes (*various foreign oils*).

One volume of the oleic acid obtained in the preceding test, when mixed with an equal volume of alcohol, yields a clear solution, which, at 15° C., does not deposit any fatty acids, or become turbid upon the further addition of 1 volume of alcohol (*difference from olive, peanut, cottonseed, sesame, and other fixed oils*).

Saponification value: not less than 191 and not more than 200, page 1519.

Iodine value: not less than 93 and not more than 100, page 1519.

Preserve in well-closed containers.

U. S. P. Preparation—Unguentum Aquæ Rosæ.

N. F. Preparations—Emulsum Petrolati; Oleum Phosphoratum; Unguentum Veratrinæ.

The press cake obtained as a by-product in the manufacture of expressed oil of almond is sometimes recommended as a food product for use by diabetics on account of its high protein and low carbohydrate content. The pharmacist must exercise care in selling almond meal for this purpose that bitter almond

meal which is poisonous is not supplied. Under the name of almond meal a spurious article consisting of corn meal, soap, etc., is marketed for detergent and cosmetic purposes.

Uses—Expressed oil of almond is used as an emollient and is an ingredient in several of official preparations (see page 1034).

OLEUM CHAULMOOGRÆ. U.S. Chaulmoogra Oil
[Ol. Chaulmoog.]

The fixed oil expressed from the seeds of *Taraktogenos Kurzii* King (Fam. *Flacourtiaceæ*). The fixed oil from the seeds of certain species of *Hydnocarpus*, when designated as such and when agreeing in physical and chemical characters with Chaulmoogra Oil, may be used in its place.

In addition to small quantities of the glycerides of the fatty acids commonly found in vegetable fats, chaulmoogra oil contains the glycerides of a series of highly unsaturated fatty acids, chiefly chaulmoogric acid, $C_{18}H_{32}O_2$, and hydnocarpic acid, $C_{16}H_{28}O_2$. This series of fatty acids differs from other ordinary fatty acids in being optically active and in possessing, as part of the molecular structure, a ring of carbon atoms. The therapeutic properties of chaulmoogra oil appear to be due to these optically active unsaturated fatty acids of the chaulmoogric series.

The sodium salts of the fatty acids of chaulmoogra oil and the ethyl esters prepared from these fatty acids have been introduced for hypodermic use in the treatment of leprosy with the claim that they are better tolerated than the oil. The ethyl esters prepared from the fatty acids of the oil have been used for a number of years.

Description and Physical Properties—A yellow or brownish-yellow liquid, or, at temperatures below about 25° C., a whitish, soft solid. It has a characteristic odor, and a somewhat acrid taste.

Chaulmoogra Oil is sparingly soluble in alcohol; soluble in benzene, chloroform, ether, and in petroleum benzin.

Tests for Identity—Specific gravity: about 0.950 at 25° C.

The specific rotation $[\alpha]_D$ of Chaulmoogra Oil determined at 25° C. in chloroform, containing about 10 Gm. of the Oil in each 100 cc. of the solution, and using a 100 mm. tube, is not less than +48° and not more than +60°, page 1524.

Tests for Purity—Dissolve 1 Gm. of the Oil in 15 cc. of a mixture of equal volumes of alcohol and ether, previously neutralized with tenth-normal sodium hydroxide, using 5 drops of phenolphthalein T.S. as indicator, and titrate the solution with tenth-normal sodium hydroxide to the production of a pink color which persists for fifteen seconds: not less than 1.8 cc. and not more than 5 cc. of tenth-normal sodium hydroxide is required (*free acid*).

Saponification value: not less than 196 and not more than 213, page 1519.

Iodine value: not less than 98 and not more than 104, page 1519.

Preserve in well-closed containers, in a cool place, protected from light.

Uses—Chaulmoogra oil has been used in the treatment of leprosy for many years, much of the evidence indicating that it is of value, though not having specific, curative properties. The fatty acids of chaulmoogra oil, which are official under the title Æthylis Chaulmoogras, page 921, have a destructive action on acid-fast bacilli, such as the bacillus of leprosy, and it is to this property that the beneficial effects of chaulmoogra oil derivatives in leprosy are probably due. Chaulmoogra oil is given by mouth or by hypodermic injection, although the latter procedure is not devoid of disadvantages (abscesses).

Dose—By mouth, 0.3 cc. (5 drops) in capsules thrice daily, increasing to the point of tolerance. By hypodermic injection it has been used mixed with olive oil, the following being a typical formula: chaulmoogra oil, 500 cc.; olive oil, 500 cc.; camphor, 5 Gm.; guaiacol, 10 Gm.

Such mixtures are given by intramuscular injection in doses of from 2 to 10 cc. once a week.

OLEUM OLIVÆ. U.S. Olive Oil

[Ol. Oliv.]

The fixed oil obtained from the ripe fruit of *Olea europœa* Linné (Fam. *Oleaceæ*).

Preparation—It is obtained by crushing the recently collected ripe olives in a mill without breaking the putamen, then moderately pressing the pulpy mass. This produces the highest grade oil, known as *virgin oil.* The mass in the press is then mixed with water and again expressed with greater pressure, an oil of second quality resulting. Any oil remaining in the press cake is finally extracted with carbon disulphide, or the mass is thrown into large cisterns, mixed with water, and the oil allowed to separate. A few years ago it was difficult to obtain pure olive oil, but since the passage of the Food and Drugs Act it is unusual to find original packages labeled "olive oil" which do not contain genuine olive oil. When bought in bulk or from unlabeled containers, cottonseed oil or other bland oils are not uncommonly found as adulterants. Large quantities of olive oil are imported from Italy and other countries bordering the Mediterranean, and it is produced to a limited extent in the Southern United States, chiefly in California.

Description and Physical Properties—A pale yellow, or light greenish-yellow, oily liquid, having a slight, peculiar odor and taste, with a faintly acrid after-taste.

Olive Oil is slightly soluble in alcohol, but is miscible with ether, chloroform, and carbon disulphide.

Tests for Identity and Purity—Specific gravity: 0.910 to 0.915 at 25° C.

When cooled to from 10° to 8° C., the Oil becomes somewhat cloudy from the separation of crystalline particles, and at 0° C. it usually forms a whitish, granular mass.

Mix 5 cc. of the Oil in a test tube with 5 cc. of a mixture of equal volumes of amyl alcohol and carbon disulphide, the latter containing 1 per cent of precipitated sulphur in solution, and immerse the test tube to one-third of its depth in boiling, saturated aqueous solution of sodium chloride: no reddish color develops in fifteen minutes (*cottonseed oil*).

Mix 2 cc. of the Oil with 1 cc. of hydrochloric acid containing 1 per cent of sucrose, shake the mixture for half a minute, and allow it to stand for five minutes: on adding 3 cc. of distilled water to the mixture and shaking it, the acid layer shows no pink color (*sesame oil*).

Saponify 10 Gm. of Olive Oil by heating it under a reflux condenser with a solution of 4 Gm. of potassium hydroxide in 80 cc. of alcohol for one hour. Neutralize exactly with diluted acetic acid, using phenolphthalein T.S. as indicator, and wash into 120 cc. of boiling lead acetate T.S. Boil the mixture for one minute, and cool by immersing the flask in cold water, occasionally rotating the contents to cause the precipitate to adhere to the sides of the flask. Decant the liquid, wash the precipitate with cold water to remove excess of lead acetate, then wash with 90 per cent alcohol (by volume). Add 100 cc. of ether, cork well, and allow to stand until the precipitate is disintegrated. Connect with a reflux condenser, boil for five minutes, cool to about 15° C., and allow to stand overnight. Filter, and thoroughly wash the precipitate of lead soaps with ether. Wash the precipitate into a 500 cc. separator by means of a jet of ether, alternating with diluted hydrochloric acid at the end if a little of the precipitate adheres to the filter paper. Add enough diluted hydrochloric acid to make the total acid layer about 100 cc., and enough ether to make the total ether layer about 100 cc., and shake vigorously for several minutes. Allow the layers to separate, draw off the acid layer, and wash the ether once by shaking with 50 cc. of diluted hydrochloric acid and then with several portions of water until the water washings are no longer acid to methyl orange T.S. Transfer the ether solution to a dry flask, evaporate the ether, add a little dehydrated alcohol and evaporate on a steam bath. Dissolve the dry fatty acids by warming with 50 cc. of 90 per cent alcohol (by volume), slowly cool the solution to 15° C., shaking frequently to aid crystallization, and allow the mixture to stand at 15° C. for thirty minutes. No crystals separate (*peanut oil*).

Saponification value: not less than 190 and not more than 195, page 1519.

Iodine value: not less than 79 and not more than 90, page 1519.

Preserve in well-closed containers, in a cool place.

U.S.P. Preparation—Emplastrum Plumbi Oleatis.

N.F. Preparations—Curatio Paraffini; Emplastrum Fuscum Camphoratum; Linimentum Calaminæ; Oleatum Veratrinæ; Oleum Phenolatum; Unguentum Fuscum.

Uses—Olive oil is used in making cerates, ointments, liniments, and plasters. It is a bland, agreeable oil, well suited for emollient purposes and for food.

Average dose—1 fluidounce (30 cc.).

OLEUM GOSSYPII SEMINIS. U.S. Cottonseed Oil

[Ol. Gossyp. Sem.—Cotton Seed Oil]

The refined, fixed oil obtained from the seeds of cultivated varieties of *Gossypium herbaceum*, Linné or of other species of *Gossypium* (Fam. *Malvaceæ*).

Preparation—This oil is made commercially in the southern part of the United States upon a very large scale. The seeds contain about 15 per cent of oil.

The testa of the seeds is first separated, and the kernels are exposed to powerful expression in hydraulic presses. The crude oil thus obtained requires purification before it is suitable for medicinal or food purposes.

Description and Physical Properties—A pale yellow, oily liquid. It is odorless or nearly odorless, and has a bland taste.

Cottonseed Oil is slightly soluble in alcohol, but is miscible with ether, chloroform, petroleum benzin, and with carbon disulphide.

Tests for Identity and Purity—Specific gravity: 0.915 to 0.921 at 25° C.

At a temperature below 12° C. particles of solid fat separate from the Oil, and at about 0° to −5° it becomes solid or nearly so.

Dilute cottonseed Oil with an equal volume of carbon disulphide, and add sulphuric acid (specific gravity 1.6 to 1.7): a reddish-brown color is rapidly produced.

Mix 2 cc. of the Oil in a test tube with 2 cc. of a mixture of equal volumes of amyl alcohol and a 1 per cent solution of precipitated sulphur in carbon disulphide, and immerse the test tube to one-third of its depth in a boiling, saturated aqueous solution of sodium chloride: a red color develops in from ten to fifteen minutes.

Saponification value: not less than 190 and not more than 198, page 1519.

Iodine value: not less than 105 and not more than 114, page 1519.

Preserve in well-closed containers.

U.S.P. Preparation—Linimentum Camphoræ.

N.F. Preparations—Ampullæ Camphoræ; Unguentum Picis Compositum.

Uses—The official preparations are given above. It is sometimes given internally in the dose of four fluidrachms (16 cc.).

OLEUM LINI. U.S. Linseed Oil

[Ol. Lini—Oil of Flaxseed, Raw Linseed Oil]

The fixed oil obtained from linseed. Linseed Oil which has been "boiled" must not be used or dispensed.

Preparation—The Pharmacopœia excludes oil which has been boiled, the objection to this arising from the fact that *"boiled oil"* is intended for use in paints and varnishes, and compounds of lead or manganese are usually added to increase the drying property. The presence of any foreign substance renders the oil unfit for medicinal use. "Raw oil" should be ordered.

Linseed oil is a drying oil, and consists mainly of *linolein*, which, by exposure, becomes *linoxyn*, $C_{32}H_{54}O_{11}$; *myristin* and *palmitin* are also present.

Description and Physical Properties—A yellow, oily liquid, having a peculiar odor, and a bland taste. When exposed to the air, it gradually thickens, darkens in color, and acquires a more pronounced odor and taste.

Linseed Oil is slightly soluble in alcohol, but is miscible with ether, chloroform, petroleum benzin, carbon disulphide, and with oil of turpentine.

Tests for Identity and Purity—Specific gravity: 0.925 to 0.935 at 25° C.

Linseed Oil, when spread in a thin layer on a glass plate and allowed to stand in a warm place, is gradually converted into a hard, transparent film (*non-drying oils*).

Dissolve 2 Gm. of Linseed Oil in 20 cc. of a mixture of equal volumes of alcohol and ether, which has previously been neutralized with tenth-normal sodium hydroxide, using 5 drops of phenolphthalein T.S. as indicator, and titrate with tenth-normal sodium hydroxide to the production of a pink color, which persists for fifteen seconds: not more than 1.5 cc. of tenth-normal sodium hydroxide is required (*free acid*).

To 10 cc. of the Oil, add 3 Gm. of potassium hydroxide, 10 cc. of alcohol, and 10 cc. of distilled water, and heat the mixture on a water bath with frequent agitation until a clear solution results: the addition of 100 cc. of distilled water to this solution yields a clear liquid, free from oily drops (*mineral or rosin oils*).

Warm 2 cc. of the Oil with an equal volume of glacial acetic acid in a test tube, agitating frequently, and after cooling add to the mixture 1 drop of sulphuric acid: a greenish color is produced (a violet color under these circumstances indicates the presence of *rosin or rosin oils*).

Unsaponifiable matter: not more than 1.5 per cent, page 1520.

Saponification value: not less than 187 and not more than 195, page 1519.

Iodine value: not less than 170, page 1519.

Preserve in well-stoppered containers.

U. S. P. Preparations—Linimentum Calcis; Liquor Cresolis Compositus; Sapo Mollis.

N. F. Preparations—Ceratum Resinæ Compositum; Pasta Zinci Mollis; Petroxolinum Sulphuratum; Petroxolinum Sulphuratum Compositum.

Uses—Linseed oil is occasionally used as a laxative, in doses of one to two fluidounces (30 to 60 cc.), and in the official preparations named above.

PEPO. U. S. Pepo

[Pumpkin Seed]

Pepo is the dried ripe seed of cultivated varieties of *Cucurbita Pepo* Linné (Fam. *Cucurbitaceæ*).

Pepo contains not more than 5 per cent of broken or defective seed or other foreign organic matter.

Description—Broadly-ovate, flat; from 15 to 23 mm. in length and from 2 to 3 mm. in thickness; white or whitish, nearly smooth, with a shallow groove parallel to the edge; containing a short, conical radicle and two flat cotyledons; inodorous; taste bland and oily.

For further description see the U. S. P. X.

Uses—This seed contains about 40 per cent of fixed oil, starch, protein compounds, a little acrid resin, sugar, etc. Pumpkin seed is used as a tænifuge in the form of an *emulsion*. This may be prepared by blanching 2 oz. (av.) of the seeds, by soaking them in hot water, then beating them to a mass with 240 grains of sugar and 60 grains of acacia, and gradually adding 4 fluidounces of water. A better method, however, is to emulsify the fixed oil, which is now an article of commerce, and made by percolating the ground seeds with ether. Dose, of the seed, one ounce (30 Gm.).

OLEUM MORRHUÆ. U. S. Cod Liver Oil

For description, tests and assay see page 1187.

OLEUM RICINI. U. S. Castor Oil

[Ol. Ricin.]

The fixed oil obtained from the seeds of *Ricinus communis* Linné (Fam. *Euphorbiaceæ*).

Preparation—Castor oil is prepared by cold expression and subsequent clarification of the oil by heat. It contains *ricinolein* and palmitin. The purgative action is supposed to be due to the presence of two principles *ricin*, an unorganized ferment related to the toxalbumins and *ricinine*, $C_8H_8N_2O_2$, a poisonous base, precipitated from solution by mercuric chloride solution and Wagner's reagent. Other alkaloidal reagents do not affect it. A given weight of the seeds is more active than the same quantity of oil.

Description and Physical Properties—A pale yellowish or almost colorless, transparent, viscid liquid. It has a faint, mild odor, and a bland, afterwards slightly acrid and usually nauseating taste.

Castor Oil is miscible with dehydrated alcohol and with glacial acetic acid.

Tests for Identity and Purity—Specific gravity: 0.945 to 0.965 at 25°C.

Castor Oil is only partly soluble in petroleum benzin (*difference from most other fixed oils*), but it yields a clear liquid with an equal volume of alcohol (*foreign fixed oils*).

Dissolve 2 Gm. of Castor Oil in 20 cc. of alcohol, which previously has been neutralized with tenth-normal sodium hydroxide, using 5 drops of phenolphthalein T.S. as indicator, and titrate

with tenth-normal sodium hydroxide to the production of a pink color which persists for fifteen seconds: not more than 1.5 cc. of tenth-normal sodium hydroxide is required (*free acid*).

Saponification value: not less than 179 and not more than 185, page 1519.

Iodine value: not less than 83 and not more than 88, page 1519.

Preserve in well-closed containers.

U. S. P. Preparation—Collodium Flexile.

N. F. Preparations—Emulsum Olei Ricini; Oleum Ricini Aromaticum.

History—The *Palma Christi* tree as the castor oil plant was called has been identified as Jonah's Gourd. It is certain that the seeds of this plant and the oil pressed therefrom were used by the ancient Egyptians and are referred to in the Ebers Papyrus.

The name *Ricinus* was the Latin name of the dog-tick and was applied to these seeds on account of their resemblance in appearance to the insect. In Greek the same insect was known as *Kroton*. The name castor oil was derived through an erroneous belief during the sixteenth and seventeenth centuries that the plant which yielded the seeds was *Agnus Castus*.

Uses—Castor oil is used as a purgative, in doses of one-half to one fluid-ounce (15 to 30 cc.).

The administration of castor oil is greatly facilitated by adding the dose, extemporaneously, to a small amount of "soda water" flavored with "sarsaparilla" syrup, as much foam being developed as possible by using a fine stream. The glass should be well wetted with water and the oil carefully poured into the center of the glass without touching the side

It may also be administered in capsules or by mixing it with an equal bulk of aromatic syrup of rhubarb and shaking thoroughly before administering.

It is also administered to children in the form of a jelly, made by adding 3 per cent of spermaceti and a suitable flavor, such as oil of peppermint or made up by the following formula:

Castor Oil Jelly

Castor Oil	3 fl. oz., 21	min.
Stearic Acid	38	gr.
Sodium Hydroxide (U. S. P.)	9	gr.
Saccharin	1½	gr.
Oil of Peppermint	3	min.
Alcohol	81	min.

Dissolve the sodium hydroxide in the alcohol, add the castor oil and stearic acid, heat until combined, add the other ingredients and then cool.

OLEUM TIGLII. U. S. Croton Oil

[Ol. Tiglii]

The fixed oil expressed from the seeds of *Croton Tiglium* Linné (Fam. *Euphorbiaceæ*).

Caution—Croton Oil must be handled with caution as it causes pustular eruptions when applied to the skin. It should never be sold except on a physician's order.

Preparation—Croton oil is prepared by expression or by percolating the ground seeds with carbon disulphide and distilling the percolate. Neither the purgative principle nor the vesicating principle has been isolated; by the decomposition of the fatty substances present, tiglinic, valeric, formic, acetic, myristic, stearic, isobutyric, lauric, and palmitic acids have been detected; *croton-resin*, $C_{13}H_{18}O_4$, is said to be present.

Description and Physical Properties—A pale yellow or brownish-yellow, somewhat viscid and slightly fluorescent liquid, having a slight, characteristic odor.

Croton Oil is slightly soluble in alcohol, the solubility increasing with age; freely soluble in ether, chloroform, and in fixed or volatile oils.

Tests for Identity and Purity—When gently heated with twice its volume of dehydrated alcohol, it forms a clear solution from which the Croton Oil separates, either partially or completely, on cooling.

It is acid to litmus paper, previously moistened with alcohol.

Specific gravity: 0.935 to 0.950 at 25° C.

Add 1 cc. of fuming nitric acid and 1 cc. of distilled water to 2 cc. of the Oil and shake the mixture vigorously for a few minutes: it does not solidify either completely or partially after standing for twenty-four hours (*foreign oils*).

Saponification value: not less than 200 and not more than 215, page 1519.

Iodine value: not less than 104 and not more than 110, page 1519.

Preserve in small, well-stoppered bottles, protected from light.

Uses—Internally in doses of one minim (0.06 cc.), croton oil is a powerful purgative; externally, when applied to the skin, it is rubefacient and vesicant.

The collodion and liniment of croton oil of the N. F. IV have been omitted (see pages 344 and 350).

OLEUM THEOBROMATIS. U. S. Oil of Theobroma

[Ol. Theobrom.—Cacao Butter, Cocoa Butter]

The fat obtained from the roasted seeds of *Theobroma Cacao* Linné (Fam. *Sterculiaceæ*).

Preparation—This is made by grinding the kernels of the "chocolate bean" and expressing in powerful, horizontal hydraulic presses. The yield is about 40 per cent. It has also been prepared by dissolving the oil from the unroasted beans by the use of a volatile solvent. This oil, however, is not official in the U. S. P.

Chemically it is a mixture of stearin, palmitin, olein, arachin, and laurin, and, owing to its low fusing point, and its property of becoming solid at a temperature just below the fusing point, it is valuable in pharmacy for making suppositories. (See Suppositoria.)

Description and Physical Properties—A yellowish-white solid, having a faint, agreeable odor, and a bland, chocolate-like taste.

It is usually brittle at temperatures below 25° C.

Oil of Theobroma is slightly soluble in alcohol; soluble in boiling dehydrated alcohol; freely soluble in ether, chloroform, petroleum benzin, and in benzene.

Tests for Identity and Purity—Specific gravity: about 0.973 at 25° C.

It melts between 30° and 35° C.

Refractive index: 1.4537 to 1.4578 at 40° C., page 1525.

Dissolve 1 Gm. of Oil of Theobroma in 3 cc. of ether in a test tube at a temperature of 17° C., and immerse the tube in water having the temperature of melting ice: the liquid does not become turbid or deposit white flakes in less than three minutes. After congealing, raise the temperature to 15° C.: a clear liquid is gradually formed (*wax, stearin, or tallow*).

Saponification value: not less than 188 and not more than 195, page 1519.

Iodine value: not less than 33 and not more than 38, page 1519.

Uses—In addition to its use as a vehicle for suppositories cacao butter is an excellent emollient application to the skin when inflamed; it also is used in various skin creams especially the so-called "*skin foods*". It is also used in massage.

ADEPS. U. S. Lard

The purified internal fat of the abdomen of the hog *Sus scrofa* var. *domesticus* Gray (Fam. *Suidæ*).

Preparation—The adipose matter adhering to the kidneys, mesentery, and omentum of the hog is the usual source of the best lard. This, after careful removal of the membranes and adhering flesh, should be cut into small pieces, malaxated with successive portions of cold water until this remains clear, and then heated moderately, in a tinned iron or copper vessel, over a slow fire, until the melted fat becomes perfectly clear and anhydrous. This operation is known as *rendering*. Lastly, it is to be strained into earthen pots,

being occasionally stirred as it cools; the pots should be securely covered with waxed or varnished paper, or the lard protected from the air by pouring over it a thin layer of melted paraffin, and kept in a cool, dry cellar.

Description and Physical Properties—A soft, white, unctuous mass, having a faint odor, and a bland taste. It is free from rancidity.

Lard is insoluble in water; very slightly soluble in alcohol; readily soluble in ether, chloroform, carbon disulphide, and in petroleum benzin.

Tests for Purity—Lard melts between 36° and 42° C., forming a clear liquid from which no aqueous layer separates.

Distilled water boiled with lard shows no alkaline reaction to litmus paper (*alkalies*).

Dissolve 10 Gm. of Lard in 30 cc. of chloroform, mix the solution with 10 cc. of neutralized alcohol, and add one drop of phenolphthalein T.S.: not more than 2 cc. of tenth-normal sodium hydroxide is required to produce a pink tint when shaken vigorously (*free fatty acids*).

Boil 1 Gm. of Lard with 20 cc. of alcohol under a reflux condenser for ten minutes, cool, filter, and add to the filtrate 5 drops of an alcoholic solution of silver nitrate (1 in 50): the turbidity, if any, is not greater than that produced by the same quantity of the silver nitrate solution in a mixture of the same volume of alcohol and 0.5 cc. of fiftieth-normal hydrochloric acid (*chloride*).

Agitate in a test tube 5 cc. of melted and filtered Lard, while warm, with 5 cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 cc. of alcohol, and adding 2 drops of nitric acid), and heat this mixture for five minutes on a water bath: the liquid fat acquires no reddish or brown color, nor is any dark color produced at the line of contact of the hot liquids (*cottonseed fats*).

Dissolve 5 Gm. of Lard in 20 cc. of ether, in a test tube, close the tube loosely with purified cotton, and allow it to stand for about eighteen hours at a temperature of about 20° C. Collect some of the crystals which have separated at the bottom of the test tube, mount them either in alcohol or in a fixed oil, and examine under a microscope having a magnifying power of about two hundred diameters; lard stearin crystallizes in the form of flat, rhomboidal plates, cut off obliquely at one end and grouped irregularly. (Beef stearin crystallizes in the form of cylindrical rods or needles with sharp ends and grouped in fan-shaped clusters.)

Saponification value: not less than 195 and not more than 203, page 1519.

Iodine value: not less than 46 and not more than 70, page 1519.

Preserve in a cool place, in well-closed containers which are impervious to fat.

U. S. P. Preparations—Adeps Benzoinatus; Ceratum Resinæ; Emplastrum Plumbi Oleatis.

N. F. Preparations—Unguentum Camphoræ; Unguentum Hydrargyri Nitratis; Unguentum Picis Compositum; Unguentum Sinapis; Unguentum Sulphuris Compositum.

Lard, like most animal fat and oils, consists of stearin, palmitin, and olein; its consistence, when pure, depending largely upon the relative proportion of these principles; olein, being the liquid principle, can readily be separated from the other two by subjecting lard in cold weather to strong pressure, when the lard oil, consisting principally of olein is pressed out; the solid residue mainly consisting of stearin being used for various purposes, particularly for the manufacture of soap.

Lard Oil is a fixed oil, consisting principally of olein and made by exposing lard to a low temperature and then pressing it powerfully in an hydraulic press. Lard oil was formerly used in the official process for citrine ointment. Its principal uses are as a lubricant, especially in the wool industry, and as an illuminant.

Uses—Lard is used in pharmacy principally as a vehicle for ointments but it needs protection from rancidity. (See Adeps Benzoinatus.)

ADEPS BENZOINATUS. U.S. Benzoinated Lard

[Adeps Benz.]

	Metric	Alternative
Lard	1000 Gm.	16 oz. av.
Siam Benzoin, in coarse powder	10 Gm.	70 gr.
To make about	1000 Gm.	16 oz. av.

Melt the lard on a water bath, add the benzoin, mix thoroughly, and continue the heat for two hours, covering the vessel and not allowing the

temperature to rise above 60° C. Strain the liquid through muslin, and stir it occasionally while it cools.

Preserve in a cool place, in well-closed containers which are impervious to fat.

NOTE—For use in southern latitudes and during the heated season in other localities, 50 Gm. of the lard (or more, if necessary) may be replaced by an equal weight of white wax.

U. S. P. Preparations—Ceratum; Ceratum Cantharidis; Unguentum; Unguentum Hydrargyri Fortior; Unguentum Sulphuris.

N. F. Preparations—Ceratum Camphoræ; Mulla Acidi Salicylici; Mulla Creosoti Salicylata; Mulla Hydrargyri Chloridi Corrosivi; Mulla Zinci; Pasta Zinci Sulphurata; Unguentum Plumbi Iodidi; Unguentum Potassii Iodidi; Unguentum Stramonii; Unguentum Sulphuris Alkalinum; Unguentum Veratrinæ.

Certain balsamic substances, when digested with lard or fats, have the property of preventing or retarding rancidity; benzoin is most frequently used for this purpose. The temperature at which it is digested should not exceed 60° C., or the agreeable vanilla-like odor of the benzoin will be dissipated. A specially selected benzoin, called Siam benzoin or vanilla-benzoin is preferably used, and is now officially directed by the Pharmacopœia. The method of incorporating tincture of benzoin with cold lard does not produce a good product, for it is darker in color, less fragrant, and sometimes acts as an irritant when applied in certain skin diseases.

ADEPS LANÆ. U. S. Wool Fat

[**Adeps Lan.**—ANHYDROUS LANOLIN, REFINED WOOL FAT]

The purified, anhydrous, fat-like substance from the wool of sheep, *Ovis aries* Linné (Fam. *Bovidæ*).

Preparation—This substance, to which the name of *anhydrous lanolin* is applied is prepared by purifying the fatty matter obtained from the wool of the sheep (*suint*). This natural wool fat contains about 30 per cent of free fat acids and fatty acid esters of *cholesterol* and other higher alcohols. The cholesterol compounds are the important constituents and, to secure these in a purified form, many processes have been devised. In one of these the crude wool fat is treated with weak alkali, the saponified fats and emulsion centrifuged to secure the aqueous soap solution, from which, on standing, a layer of partially purified wool fat separates. This product is further purified by treating it with calcium chloride and then dehydrating by fusion with unslaked lime. It is finally extracted with acetone and the solvent subsequently separated by distillation. *Wool fat* differs from *hydrous wool fat* in containing practically no water. Wool fat consists mainly of *cholesterol* $C_{26}H_{43}OH.H_2O$ and *isocholesterol*, but other alcohols are present, associated with esters.

Description and Physical Properties—A brownish-yellow, tenacious, unctuous mass, having not more than a slight odor.

Wool fat is insoluble in water, but mixes without separation with about twice its weight of water. It is sparingly soluble in cold alcohol, more soluble in hot alcohol, and freely soluble in ether and in chloroform.

Tests for Identity and Purity—Wool Fat melts between 38° and 42° C.

Dried to constant weight on a water bath with frequent stirring, Wool Fat loses not more than 0.5 per cent of its weight (*water*).

Ash: not more than 0.1 per cent.

Dissolve 2 Gm. of Wool Fat in 10 cc. of ether, and add 2 drops of phenolphthalein T.S.: the liquid is not colored red (*free alkalies*), but on the addition of 0.2 cc. of tenth-normal sodium hydroxide a deep red color is produced (*free fatty acids*).

Boil 1 Gm. of Wool Fat with 20 cc. of alcohol under a reflux condenser, cool, filter, and add to the filtrate 5 drops of an alcoholic solution of silver nitrate (1 in 50): the turbidity, if any, is not greater than that produced by the same quantity of the silver nitrate solution in a mixture of the same volume of alcohol and 0.5 cc. of fiftieth-normal hydrochloric acid (*chloride*).

Warm 10 Gm. of Wool Fat with 50 cc. of distilled water on a water bath, constantly stirring the mixture until the Wool Fat is melted; the fat separates completely on cooling, leaving the

aqueous layer nearly clear and neutral to litmus paper. A 10 cc. portion of the filtered aqueous layer leaves no sweet residue on evaporation (*glycerin*). Another 10 cc. portion of the filtrate emits no *ammonia* vapors when boiled with 1 cc. of sodium hydroxide T.S., and a further 10 cc. portion does not completely decolorize 0.05 cc. of tenth-normal potassium permanganate within ten minutes (*soluble oxidizable impurities*).

About 0.5 Gm. of Wool Fat dissolves completely in 40 cc. of boiling dehydrated alcohol (*petrolatum*).

Iodine value: not less than 18 and not more than 28, using 0.8 to 0.85 Gm. of Wool Fat. page 1519.

Preserve in a cool place in well-closed containers which are impervious to fat.

U. S. P. Preparations—Unguentum Belladonnæ; Unguentum Iodi; Unguentum Iodoformi.

N. F. Preparations—Ceratum Plumbi Subacetatis; Unguentum Resorcinolis Compositum.

A proprietary ointment vehicle is sold under the trade name *Eucerin*. It is said to consist of 3 per cent of the free alcohols from wool fat, incorporated with petrolatum. The claim is made that this vehicle will not reduce metallic oxides but is capable of suspending large proportions of water.

Uses—Wool fat is used as a vehicle for ointments, but the hydrous wool fat is more frequently employed.

ADEPS LANÆ HYDROSUS. U. S. Hydrous Wool Fat

[Adeps Lan. Hyd.—LANOLIN]

Hydrous Wool Fat consists of wool fat incorporated with not less than 25 per cent and not more than 30 per cent of water.

Preparation—Hydrous wool fat is made by incorporating about 30 per cent of water with anhydrous wool fat.

Description and Physical Properties—A yellowish-white, or nearly white, ointment-like mass, having not more than a slight odor.

Hydrous Wool Fat is insoluble in water.

Tests for Purity—With ether and with chloroform Hydrous Wool Fat yields turbid solutions which are neutral to moistened litmus paper.

Hydrous Wool Fat heated on a water bath separates into an upper oily and a lower aqueous layer. When the heating is continued with frequent stirring until it ceases to lose weight, not less than 70 per cent and not more than 75 per cent of residue remains, which, when melted, is transparent and when cold, is a yellowish, tenacious, unctuous mass completely soluble in ether or chloroform and only sparingly soluble in alcohol. Hydrous Wool Fat thus deprived of water meets the requirements of the test for *petrolatum* under *Adeps Lanæ*.

Hydrous Wool Fat complies with the tests for *free alkalies, free fatty acids, chloride, glycerin,* and *ammonia,* described under *Adeps Lanæ*, allowance being made for the proportion of water present.

Preserve in a cool place, in well-closed containers which are impervious to fat.

U. S. P. Preparations—Unguentum Chrysarobini; Unguentum Hydrargyri Ammoniati; Unguentum Hydrargyri Oxidi Flavi.

N. F. Preparations—Inunctum Mentholis; Inunctum Mentholis Compositum; Petroxolinum Hydrargyri; Unguentum Hydrargyri Oxidi Rubri; Unguentum Stramonii.

Uses—This substance is used largely as a vehicle for ointments, for which it is admirably adapted, on account of the facility with which it is absorbed by the skin.

SEVUM PRÆPARATUM. U. S. Prepared Suet

[Sev. Præp.—MUTTON SUET]

The internal fat of the abdomen of the sheep *Ovis aries* Linné (Fam. *Bovidæ*) purified by melting and straining.

Preparation—Prepared Suet is made by a process similar to that for lard. (See Adeps.)

Description and Physical Properties—A white, solid fat, having, when fresh, a slight characteristic odor and a bland taste. It becomes rancid on prolonged exposure to the air and must not then be used.

Prepared Suet is insoluble in water and in cold alcohol. It is soluble in 45 parts of boiling alcohol, in about 60 parts of ether, and slowly dissolves in 2 parts of purified petroleum benzin. From its solution in the latter, when allowed to stand in a stoppered flask, it slowly separates in a crystalline form.

Tests for Identity and Purity—Prepared Suet melts between 45° and 50° C. and congeals between 37° and 40° C.

Saponification value: not less than 193 and not more than 200, page 1519.

Iodine value: not less than 33 and not more than 48, page 1519.

One Gm. of Prepared Suet, dissolved in 50 cc. of hot neutralized alcohol, with a few drops of phenolphthalein T.S. added, requires not more than 0.6 cc. of tenth-normal sodium hydroxide to produce a pink color (*free acid*).

Preserve in well-closed containers impervious to fat.

U. S. P. Preparation—Unguentum Hydrargyri Fortius.

N. F. Preparations—Ceratum Resinæ Compositum; Sevum Benzoinatum; Unguentum Fuscum.

Uses—Prepared suet is used in ointments and cerates and is firmer than lard, owing to its containing a larger proportion of stearin.

SEVUM BENZOINATUM. N. F. Benzoinated Suet

[Sev. Benz.]

	Metric	Alternative
Benzoin in moderately coarse powder	**30 Gm.**	210 gr.
Prepared Suet	**1000 Gm.**	16 oz. av.
To make about	**1000 Gm.**	16 oz. av.

Mix the benzoin thoroughly with the suet and allow the mixture to stand at the room temperature for two hours, then melt it on a water bath and maintain a temperature not exceeding 50° C., during one hour, stirring frequently; finally strain, and stir the mixture until cold.

OLEUM SESAMI. N. F. Sesame Oil

(U. S. P. IX)

[Ol. Sesam.—Teel Oil, Benne Oil]

A fixed oil obtained from the seeds of one or more cultivated varieties of *Sesamum indicum* Linné (Fam. *Pedaliaceæ*).

Preparation—It is obtained by subjecting benne seeds to pressure, the yield being about 50 per cent. The best grade of oil is the cold pressed.

Official Description—A pale yellow, oily liquid.

Odor and Taste—Almost odorless and having a bland taste.

Solubility—Slightly soluble in alcohol, miscible with ether, chloroform, petroleum benzin, or carbon disulphide.

Specific gravity: 0.916 to 0.921 at 25° C. (77° F).

Tests for Identity and Purity—Shake 1 cc. of the Oil for half a minute with a solution of 0.1 Gm. of sugar in 10 cc. of hydrochloric acid; the acid layer becomes bright red and changes to dark red on standing.

Free Acid—Blue litmus paper previously moistened with alcohol is not more than slightly reddened by 2 cc. of the Oil.

Cottonseed Oil—Mix 5 cc. of the Oil in a test tube with 5 cc. of a mixture of equal volumes of amyl alcohol and a 1 per cent solution of sulphur in carbon disulphide and immerse the test tube to one-third of its depth in a boiling saturated aqueous solution of sodium chloride; no reddish color develops in fifteen minutes.

Saponification value: not less than 188 and not more than 193.

Iodine value: not less than 103 and not more than 112.

N. F. Preparations—Linimentum Ammoniæ; Olea Infusa.

Uses—Used much like olive oil both medicinally and for food. It replaced cottonseed oil in ammonia liniment in the U. S. P. IX as it saponifies more readily and produces a more permanent and less sticky emulsion.

CACAO PRÆPARATUM. N. F. Cocoa

[Cacao Præp.—Prepared Cacao, Powdered Cocoa, or Cocoa Powder]

Cocoa is a powder prepared from the roasted, cured kernels of the ripe seed of *Theobroma Cacao* Linné (Fam. *Sterculiaceæ*). Cocoa powder is a by-product in the manufacture of oil of theobroma.

Official Description—A brownish powder.

Odor and Taste—A chocolate-like odor and taste, free from sweetness.

Tests for Identity and Purity—Extracted with ether, Cocoa yields not less than 18 per cent, or more than 25 per cent, of fat, and the fatty residue does not have a spicy odor or taste.

The residue insoluble in ether shows not more than 3 per cent of Cocoa shells.

Cocoa yields not more than 6 per cent of crude fiber and not more than 15 per cent of starch.

N. F. Preparations—Syrupus Cacao Præparati; Tabellæ Phenolphthaleini; Tabellæ Santonini; Tabellæ Santonini Compositæ.

Uses—It is used as a food and pharmaceutically as a flavor in tablets, syrups, pill coating, troches, etc.

LYCOPODIUM. U. S. Lycopodium

[Lycopod.]

Lycopodium consists of the spores of *Lycopodium clavatum* Linné (Fam. *Lycopodiaceæ*).

Official Description—A light yellow, very mobile powder. It is not wetted by water but floats upon it; when boiled with water it sinks; when thrown into a flame it burns with a quick flash. Nearly inodorous and tasteless. The spores of Lycopodium are spherical tetrahedrons, from 0.025 to 0.04 mm. in diameter.

For further description see the U. S. P. X.

Uses—Lycopodium contains 47 per cent of fixed oil, with minute quantities of volatile bases. It is used as a dusting powder for suppositories, and to allay irritation of the skin and for similar purposes.

Unofficial Fixed Oils

Oil of Bassia	From *Bassia longifolia*. Fam. Sapotaceæ. A greenish oil is expressed from the seeds
Bayberry	From *Myrica cerifera*. Fam. Myricaceæ. Habitat, North America. The oil and wax are prepared by boiling the fruit with water until the oil collects on the surface. The yield of oil is about 30 per cent
Beech	From the fruit of *Fagus sylvatica*. Fam. Cupuliferæ. Habitat, Europe. It is of a yellow color and mild odor and taste. The yield of oil is about 20 per cent
Behen	From the fruit of *Moringa aptera*. Used in ointments and pomades
Ben	A fixed oil from the seeds of *Moringa pterygosperma*. Used for the same purposes as olive oil
Black Mustard	From the seed of *Brassica nigra* (Linné) Koch. Fam. Cruciferæ. Habitat, Europe. A yellow or brownish-yellow fixed oil. Sp. gr. 0.916. The yield of oil is about 20 per cent
Brazil Nut	From the seed of *Bertholletia excelsa*. Fam. Lecythidaceæ. Habitat, Brazil. It is a pale yellow, bland oil. The yield of oil is about 50 per cent
Candle Nut	From *Aleurites triloba*. Habitat, islands of the Pacific Ocean. The yield of oil is about 60 per cent
Cardamom	From the fruit of *Elettaria repens*. Fam. Zingiberaceæ. The yield of oil is about 10 per cent
Cocoanut	From *Cocus nucifera*. Fam. Palmæ. Habitat, tropical countries. Prepared by boiling the seeds with water and expressing. It is of a butyraceous consistence, white, and has a peculiar odor and a bland taste.
Crab	From *Carapa guianensis*. Prepared by expressing the seed
Cucumber Seed	From the seed of *Cucumis sativus*. Fam. Cucurbitaceæ. Habitat, Central Asia
Ergot	From *Claviceps purpurea*. The yield of oil is about 25 per cent
Groundnut	From the kernels of the fruit of *Arachis hypogæa*. Prepared by expression
Hazelnut	From *Corylus avellena*. Fam. Cupuliferæ. Habitat, Europe. The yield of oil is about 50 per cent
Hemp Seed	From the seed of *Cannabis sativa*. Fam. Urticaceæ. Habitat, Europe and North America. The yield of oil is about 30 per cent
Horsechestnut	From the kernels of the fruit of *Æsculus hippocastanum*. Fam. Sapindaceæ. The yield of oil is about $\frac{1}{10}$ per cent
Hydrastis	From *Hydrastis canadensis*. Fam. Ranunculaceæ. Habitat, United States
Hyoscyamus Seed	From the seed of *Hyoscyamus niger*. Fam. Solanaceæ. Habitat, Europe. The yield of oil is about 25 per cent
Juglans	From *Juglans cinera*. Fam. Juglandaceæ. Habitat, United States. The yield of oil is about 15 per cent
Oil of Kurung	From *Pongamia glabra*. Fam. Leguminosæ. Habitat, India. It is a thickish, yellow oil, of sp. gr. 0.945
Larkspur Seed	From the seed of *Delphinium Consolida*. Fam. Ranunculaceæ. Habitat, Central Europe
Laurel	From *Laurus nobilis*. Fam. Lauraceæ. Habitat, Europe. Prepared by steeping the fruit in hot water and expressing
Mace	From the arillus of the fruit of *Myristica fragrans*. Fam. Myristicaceæ. Habitat, Molucca Islands
Madia	From *Madia sativa*. Fam. Compositæ. Habitat, Europe. The yield of oil is about 40 per cent

Unofficial Fixed Oils—*Continued*

Oil of Mangosteen	From *Garcinia indica*. Fam. Guttiferæ. Habitat, India. The yield of oil is about 30 per cent
Melon Seed	From *Cucumis Melo*. Fam. Cucurbitaceæ. Habitat, Central Asia
Nicker Seed	From *Cæsalpinia Bunducella*. Fam. Leguminosæ
Nigella	From the seed of *Nigella sativa*. Fam. Ranunculaceæ. Habitat, Southern Europe. The yield of oil is about 35 per cent
Niger Seed	From *Guizotia oleifera*. Fam. Compositæ. Habitat, India. The yield of oil is about 40 per cent
Nutmeg	From the kernel of the seed of *Myristica fragrans*. Fam. Myristicaceæ. Habitat, Molucca Islands. The yield of oil is about 22 per cent
Palm	From the fruit of *Elæis guineensis*. Fam. Palmæ. Habitat, West Africa. Sp. gr. 0.945
Peach	From *Persica vulgaris*. Fam. Rosaceæ. The oil resembles expressed oil of almond
Poppy Seed	From the seed of *Papaver somniferum*. Fam. Papaveraceæ. Habitat, Asia and Europe. It is of a yellow color, bland, and limpid. The yield is about 45 to 50 per cent
Pumpkin Seed	From the seed of *Cucurbita Pepo*. Fam. Cucurbitaceæ. Habitat, Asia and Europe. The yield of oil is about 45 per cent
Purging Nut	From the seed of *Curcas purgans*. Fam. Euphorbiaceæ. Habitat, West Indies. The yield is about 35 per cent
Rape Seed	From *Brassica campestris*. A fixed oil is used for making green soft soap
Staphisagria	From the seed of *Delphinium Staphisagria*. Fam. Ranunculaceæ. Habitat, Europe. The yield of oil is about 30 per cent
Stramonium Seed	From the seed of *Datura Stramonium*. Fam. Solanaceæ. Habitat, United States. The yield of oil is about 25 per cent
Tonka	From the seed of *Dipterix odorata*. Fam. Leguminosæ. Habitat, Guiana. An odorous fixed oil. The beans contain coumarin. Used for flavoring. Narcotic. Used in whooping-cough, in doses of five to eight grains (0.3 to 0.5 Gm.), given in the form of fluidextract
Tucom	From the fruit of *Astrocaryum vulgare*. Habitat, South America. It has a bright red color and an agreeable odor
Watermelon Seed	From the seed of *Cucurbita Citrullus*. Fam. Cucurbitaceæ. Habitat, Southern Asia. The yield is about 30 per cent
White Mustard	From the seed of *Sinapis Alba*. Fam. Cruciferæ. Habitat, Asia. The yield of oil is about 20 per cent

ACIDUM OLEICUM. U.S. Oleic Acid

[Acid. Oleic.]

Oleic Acid is obtained from fats, and consists chiefly of $C_{17}H_{33}COOH$ (282.36).

Preparation—Oleic acid is generally obtained as a by-product in the manufacture of candles from fats, the solid stearic and palmitic acids being the fatty substances sought for by candle manufacturers. The crude oleic acid is known as "red oil", the stearic and palmitic acids being separated by cooling the mixture and filtering.

Description and Physical Properties—A pale yellow or brownish-yellow, oily liquid. It has a peculiar lard-like odor and taste, but is free from disagreeable odor. On exposure to air it absorbs oxygen and becomes darker.

Oleic Acid is almost insoluble in water, but is miscible with alcohol, chloroform, ether, benzene, petroleum benzin, and with fixed or volatile oils.

Specific gravity: about 0.895 at 25° C.

On heating strongly, Oleic Acid is decomposed with the formation of acrid vapors.

Tests for Identity and Purity—When cooled to about 4° C., it congeals to a whitish solid or nearly solid mass.

The ash from 5 cc. does not exceed 0.005 Gm.

When gradually cooled, Oleic Acid does not become cloudy above 10° C. (*stearic acid*).

Shake 5 cc. of Oleic Acid with an equal volume of distilled water, allow the liquids to separate, and filter through a paper filter moistened with water: the filtrate is not reddened by the addition of a drop of methyl orange T.S. (*mineral acids*).

Boil 1 cc. of Oleic Acid with about 0.5 Gm. of sodium carbonate, and 30 cc. of distilled water in a capacious flask; the resulting solution, while hot, is clear or at most opalescent (*neutral fat or mineral oils*).

Preserve in well-closed glass or stoneware containers, in a cool place.

U.S.P. Preparation—Oleatum Hydrargyri.

N.F. Preparations—Oleatum Quininæ; Oleatum Veratrinæ; Pasta Zinci Mollis; in all Petroxolins; Unguentum Iodi Denigrescens.

Uses—Oleic acid is used as the basis for the oleates, a number of which are official (see page 350). The oleates are very useful external remedies; they are used in various skin diseases, and also for communicating the constitutional effects of numerous remedies. Oleic acid is more readily absorbed by the skin than any other similar vehicle.

Unofficial Oleates

Oleate of Aconitine (N. F. IV)	Prepared by dissolving 2 Gm. of Aconitine in 5 Gm. of oleic acid and adding olive oil to make 100 Gm.
Oleate of Atropine (N. F. IV)	Triturate 2 Gm. of Atropine with 2 cc. of alcohol in a tared mortar, adding 2 cc. of oleic acid and warm until alcohol evaporates. Then add oleic acid to make 50 Gm. and triturate until dissolved. Finally, add olive oil to make 100 Gm.
Oleate of Cocaine (N. F. IV)	Triturate 5 Gm. of cocaine with 5 cc. of alcohol in a tared mortar, adding 2 cc. of oleic acid and warm until alcohol evaporates. Then add oleic acid to make 50 Gm. and triturate until dissolved. Finally add olive oil to make 100 Gm.
Aluminum Oleate, $Al(C_{18}H_{33}O_2)_3$	By decomposing sodium oleate with aluminum sulphate. It is a semi-solid, of a dark brown color, and has a decidedly astringent action. Used in treating burns, scalds, foul ulcers, etc.
Silver Oleate, $AgC_{18}H_{33}O_2$	By precipitating sodium oleate with a saturated solution of silver nitrate, washing the precipitate with boiling water, drying it, and reducing to a fine powder. It is of a brownish-yellow color. Used externally
Arsenic Oleate, $As(C_{18}H_{33}O_2)_3$	By first preparing arsenous chloride by treating metallic arsenic with hydrochloric acid, and then adding sodium oleate and collecting the precipitate. It is of a yellowish color and has the consistence of butter
Bismuth Oleate, $Bi(C_{18}H_{33}O_2)_3$	By dissolving *crystallized* bismuth nitrate in glycerin, then diluting sodium oleate with water and adding the bismuth solution to the sodium mixture, warming, rejecting the aqueous layer, and lastly, washing several times with warm water. It is of a white or a yellowish-white color, and has about the consistence of an ointment
Copper Oleate, $Cu(C_{18}H_{33}O_2)_2$	By adding sodium oleate to a saturated solution of copper sulphate, then washing the precipitate. It is a handsome, dark green, waxy solid. Used chiefly in the treatment for ringworm
Iron Oleate (Ferric), $Fe(C_{18}H_{33}O_2)_3$	By adding sodium oleate to a solution of ferrous sulphate and boiling. It is a dark red, soft, solid oleate. Used locally
Manganese Oleate	By adding to a solution of sodium oleate a solution of manganese sulphate, heating gently, and collecting the precipitate. It is of a light gray, slightly pinkish color, having a peculiar odor
Mercury and Morphine Oleate	By combining with a gentle heat 40 parts mercuric oleate, 3 parts morphine, and 13 parts oleic acid. It forms a very dark brown, soft solid
Nickel Oleate	By adding sodium oleate to a solution of nickel sulphate and collecting the precipitate. It is a green, amorphous, waxy substance. Used locally as an astringent
Sodium Oleate	By dissolving 1 part of pure Castile soap in 8 parts of hot water, cooling and filtering from deposited sodium palmitate. The filtrate contains sodium oleate
Sodium Oleate, Acid, $NaC_{18}H_{33}O_2$	Contains an excess of oleic acid. Yellow, fatty granules. Used in biliary lithiasis
Tin Oleate	By adding a solution of tin chloride to a solution of sodium oleate and collecting the precipitate. It has a grayish-yellow color, a soft consistence, and a decided metallic taste

ACIDUM STEARICUM. U.S. Stearic Acid

[Acid. Stear.]

Stearic Acid is obtained from tallow and other solid fats, and consists chiefly of $C_{17}H_{35}.COOH$ (284.38).

Preparation—It is usually prepared from tallow and similar fats by boiling them with soda lye, separating the glycerin and decomposing the resulting soap with sulphuric or hydrochloric acid. The stearic acid is subsequently separated from any oleic acid by cold expression. It is also prepared by the hydrogenation of olein (see page 1033). It may be purified by dissolving in hot alcohol when, upon cooling, the acid separates.

Description and Physical Properties—A hard, white or faintly-yellowish, somewhat glossy and crystalline solid. It is odorless, or has a slight, tallow-like odor, and is stable in the air.

Stearic Acid is almost insoluble in water. One Gm. dissolves in 21 cc. of alcohol, 2 cc. of chloroform, and in 3 cc. of ether, at 25° C. It is soluble in carbon disulphide and in carbon tetrachloride.

Tests for Purity—Melting point: not below 56° C.

Congealing point: not below 54° C.

Ash: not more than 0.1 per cent.

Boil 1 Gm. of Stearic Acid and 0.5 Gm. of sodium carbonate with 30 cc. of distilled water in a capacious flask: the resulting solution while hot is not more than opalescent (*neutral fat or paraffin*).

Shake melted Stearic Acid with an equal volume of hot distilled water, cool, and filter: the filtrate is not reddened by the addition of a drop of methyl orange T.S. (*mineral acids*).

U.S.P. Preparation—Suppositoria Glycerini.

N.F. Preparation—Linimentum Saponato-Camphoratum.

Uses—Its chief use in pharmacy is in the preparation of sodium stearate which is the solidifying agent for the official glycerin suppositories, and for many other commercial products, such as toilet creams, solidified alcohol (see page 95), solidified smelling salts, etc.

GLYCERINUM. U.S. Glycerin

[Glycerin.—Glycerol]

Glycerin contains not less than 95 per cent of $CH_2OH.CHOH.CH_2OH$ (92.08).

Preparation—This valuable liquid has been made in several ways: 1. Through the saponification of fats and oils in making soap or lead plaster. 2. By the decomposition of fats and oils through pressure and superheated steam. 3. It has also been prepared synthetically, one method being the heating of trichlorpropane with water, at a temperature of 180° C. During the World War vast quantities of glycerin were made in Germany by the fermentation of beet sugar molasses in the presence of large amounts of sodium sulphite. Under these conditions the following reaction takes place:

$$\underset{\text{glucose}}{C_6H_{12}O_6} = \underset{\text{glycerin}}{C_3H_5(OH)_3} + \underset{\text{acetaldehyde}}{CH_3CHO} + \underset{\text{carbon dioxide}}{CO_2}$$

Glycerin came into use in medicine and pharmacy about 1846, and it was first obtained on a commercial scale from the washings of lead plaster by Robert Shoemaker, of Philadelphia. In making the plaster, litharge, olive oil, and water are boiled together, when the olein of the oil is decomposed by the lead oxide, according to the following equation:

$$\underset{\text{glyceryl oleate (olive oil)}}{2C_3H_5(C_{18}H_{33}O_2)_3} + \underset{\text{lead oxide}}{3PbO} + \underset{\text{water}}{3H_2O} = \underset{\text{lead oleate (lead plaster)}}{3Pb(C_{18}H_{33}O_2)_2} + \underset{\text{glyceryl hydroxide (glycerin)}}{2C_3H_5(OH)_3}$$

The process most frequently used for making glycerin originated with R. A. Tilghman, of Philadelphia, and consists in subjecting fatty bodies to the action of water at a high temperature under pressure, whereby the fats, which are *glycerides* or esters of the fatty acids, are broken up into glycerin and fatty acids, the water supplying the elements of hydrogen and oxygen necessary to the change. The reaction is expressed as follows in the case of a fat like stearin:

$$\underset{\text{stearin}}{C_3H_5(C_{18}H_{35}O_2)_3} + \underset{\text{water}}{3H_2O} = \underset{\text{glycerin}}{C_3H_5(OH)_3} + \underset{\text{stearic acid}}{3HC_{18}H_{35}O_2}$$

Chemically, glycerin belongs to the class of alcohols, and is sometimes termed *glycerol*, or *glyceric alcohol*. It is the hydroxide of the radical glyceryl, C_3H_5, which is trihydric, and one, two, or three of the hydroxyl groups may be replaced by monad radicals.

Description and Physical Properties—A clear, colorless, syrupy liquid, having a sweet taste It has not more than a slight, characteristic odor, which is neither harsh nor disagreeable. When exposed to the air, it absorbs moisture.

Glycerin is miscible with water and with alcohol. It is insoluble in chloroform, ether, benzene, petroleum benzin, carbon disulphide, and in fixed or volatile oils.

Tests for Identity—Heat a few drops of Glycerin with about 0.5 Gm. of potassium bisulphate: pungent vapors of acrolein are evolved.

Tests for Purity—Glycerin is colorless when viewed transversely in a tube of colorless glass about 30 mm. in diameter, held in a vertical position.

Specific gravity: not below 1.249 at 25° C.

An aqueous solution of Glycerin (1 in 20) is neutral to litmus paper.

Heat 50 Gm. of Glycerin in an open, shallow, 100 cc. porcelain dish until it ignites, and allow it to burn without further application of heat in a place free from draught: not more than 0.015 per cent of carbonaceous and mineral residue remains. Ignite this residue at a low red heat, until combustion is complete: not more than 0.007 per cent of mineral residue remains.

Place 5 cc. of Glycerin in a 50 cc. glass-stoppered cylinder, add 5 cc. of sulphuric acid, and shake vigorously for one minute: the liquid does not become darker than yellow on standing for one hour (*readily carbonizable substances*).

Mix 50 Gm. of Glycerin with 50 cc. of freshly boiled distilled water and 5 cc. of half-normal sodium hydroxide, boil the mixture for five minutes, cool, and titrate the excess of alkali with

half-normal hydrochloric acid, using phenolphthalein T.S. as indicator: not less than 4 cc. of half-normal hydrochloric acid is required (*fatty acids and esters*).

Ten cc. portions of an aqueous solution of Glycerin (1 in 10) remain clear on the addition of 0.5 cc. of calcium chloride T.S. (*oxalate*), or of 0.5 cc. of silver nitrate T.S. (*chloride*), and no turbidity is produced in 10 cc. of the solution, previously treated with three drops of diluted hydrochloric acid, by the addition of five drops of barium chloride T.S. (*sulphate*).

An aqueous solution of Glycerin meets the requirements of the test for *heavy metals*, page 1519, and of the test for *arsenic*, page 1512.

A mixture of 5 cc. of Glycerin and 5 cc. of an aqueous solution of potassium hydroxide (1 in 10) does not become yellow when kept for five minutes at 60° C. (*acrolein, glucose*) or emit an odor of ammonia (*ammonium compounds*).

Preserve in well-closed containers.

U. S. P. Preparations—Gelatinum Glycerinatum; Glycerites; Fluidextracts; Liquor Ferri et Ammonii Acetatis; Massa Hydrargyri; Mistura Cretæ; Mistura Glycyrrhizæ Composita; Mucilago Tragacanthæ; Pilulæ Ferri Carbonatis; Pilulæ Phosphori; Sapo Mollis; Suppositoria Glycerini; Syrupus Ipecacuanhæ; Syrupus Pruni Virginianæ; Tinctures; Unguentum Acidi Tannici; Unguentum Iodi.

N. F. Preparations—Cataplasma Kaolini; Elixirs; Glycerites; Fluidextracts; Fluidglycerates; Mixtures; Liquors; Syrups; Tinctures, etc.; Lotio Calaminæ; Mel Rosæ et Sodii Boratis; Mel Sodii Boratis: Pasta Dextrinata; Suppositoria Boroglycerini; Unguentum Resorcinolis Compositum.

Uses—Glycerin is one of the most valuable products known to pharmacy. It is solvent and antiseptic, scarcely inferior to alcohol. Glycerin is useful in keeping substances moist, owing to its tendency to absorb water from the air. It is a valuable emollient in many skin diseases, and its agreeable taste and nonpoisonous properties adapt it for many purposes. Its varied pharmaceutical uses have been frequently referred to in the preceding pages.

When glycerin is acted on by nitric acid, nitroglycerin, a powerful explosive, is formed. This is used in the preparation of dynamite and other high explosives; it is sometimes called *glonoin* and *trinitrin*. A 1 per cent alcoholic solution is official (see Spiritus Glycerylis Nitratis, page 310).

Soaps

Soaps are salts of metals combined with fatty acids. Soaps may be divided into two classes, *soluble* and *insoluble*. The soluble soaps are the detergent or cleansing soaps and are compounds of the fatty acids with the alkali metals, sodium and potassium particularly. Sapo and sapo mollis are examples of soluble soaps. The insoluble soaps are salts of the fatty acids and metals of any other group. Lead oleate plaster is an example of an insoluble soap in the pure state, zinc stearate is another, while lime liniment owes its characteristic properties to a calcium soap of linseed oil.

Soaps may also be divided into hard and soft soaps. The hard soaps are those in which sodium is the base and the soft soaps are those in which potassium is used. The predominance of olein or stearin respectively has some influence upon the consistence of soaps.

Soap may be made in several ways as follows:

1. Saponification of fats or oils by alkalies, the resulting glycerin being removed from the soap and sold as a by-product.
2. Saponification of fats or oils by alkalies, the resulting glycerin being allowed to remain in the finished soap.
3. Direct neutralization of free fatty acids by alkali hydroxides or carbonates, no glycerin being produced.

The reaction involved in the first and second processes is illustrated by the following equation:

$$\underset{\substack{\text{fixed oil or fat}}}{C_3H_5(\text{oleo-palmito stearate})} + \underset{\text{caustic alkali}}{3NaOH} = \underset{\text{soap}}{3Na(\text{oleo-palmito stearate})} + \underset{\text{glycerin}}{C_3H_5(OH)_3}$$

The reaction occurring in the third process is shown by the following equation:

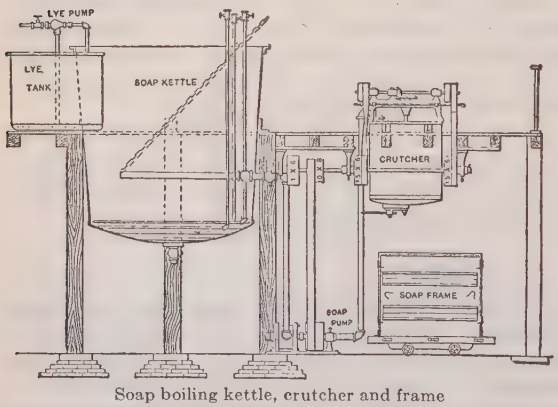
$$\underset{\text{stearic acid}}{HC_{18}H_{35}O_2} + \underset{\text{caustic alkali}}{NaOH} = \underset{\substack{\text{sodium stearate, a very}\\\text{hard variety of soap}}}{NaC_{18}H_{35}O_2} + \underset{\text{water}}{H_2O}$$

The quality of the soap in a measure depends upon the completeness of the saponification and the care taken to produce a neutral or almost neutral soap.

For certain purposes, such as for exceptional detergent or germicidal value, as in "soft soap", to be used for cleansing the hands of a surgeon and in preparing an area for a surgical operation, a slight excess of alkali is desirable, but for toilet purposes and for the laundry the neutrality of the soap is essential. A few soaps are superfatted, that is, they contain an excess of fat but they are only used for special purposes, such as to remove an excess of machine oil or some such form of dirt.

Another characteristic of the fatty acid influences the solubilities of soaps and thus has a bearing upon their adaptability. All soaps except those made from cocoanut oil are insoluble in salt (sodium chloride) solutions and therefore only cocoanut oil or chiefly cocoanut oil must form the basis for what is known as "marine soap" to be used with sea water. This quality of soaps is taken advantage of in their manufacture to separate the glycerin, salt being added to the saponified mixture, causing it to rise to the top of the soap-boiling kettles (see Fig. 437) in more or less granular form, leaving the glycerin, "spent lye", and salt solution at the bottom to be drawn off and treated for the glycerin. This stage of the process is known as "graining". When the glycerin has been removed, the separated soap is again heated and water is added to restore a uniform consistence. This warm mixture is then drawn off into mixers, known technically as "crutchers" (see Fig. 437), where, if the soap is a cheap laundry or washing soap, an inexpensive perfume may be incorporated, and a better consistence secured by actively stirring before the soap is run into "frames" to cool. If the soap is to be a "floating" soap, the "crutching" or beating is continued until sufficient air has been worked into the cooling mass to make the specific gravity less than that of water.

FIG. 437



Soap boiling kettle, crutcher and frame
(From "Modern Soaps, Candles, and Glycerin" by L. L. Lamborn)

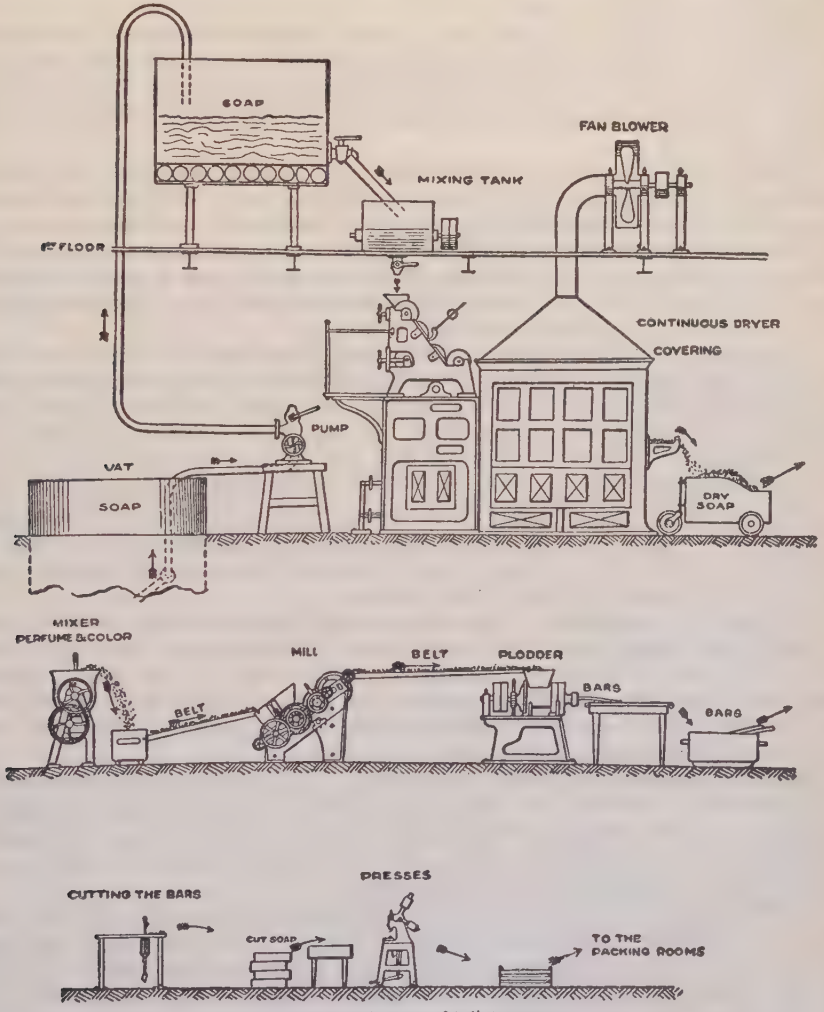
A "floating soap", therefore, means less soap for the size of the cake and thousands of minute air spaces throughout the cake, which tend to increase its solubility and wasting qualities.

The "frame" (see Fig. 437) into which the soap is run to cool usually consists of an iron or steel box about 4½ feet long, 15 inches wide, and 4 feet deep, mounted on wheels. The sides and ends are removable and each frame holds about 1000 pounds of soap. When the soap in the frame has cooled sufficiently, the sides are removed and in due time the mass of soap is cut into slabs by forcing it against piano wires fitted to a frame, and these slabs in turn are

cut in the same manner into bars weighing about three pounds each. In the cheaper laundry soaps these bars are further cut into cakes, and the cakes roughly stamped by a press, before being wrapped and boxed.

Much laundry soap is now being sold in powder and flake form. This not only enables the user to regulate the exact amount of soap used but also

FIG. 438



The manufacture of toilet soap
(From "Modern Soaps, Candles, and Glycerin" by L. L. Lamborn)

provides quick solution and is admirably adapted to the modern domestic or laundry washing machines. In the production of chip soap it is not necessary to run the warm fluid soaps into frames to cool as the crutched soap, while still fluid, is run between a series of cooled steel rollers and the thin film which dries on the rollers is mechanically scraped off at one stage of the process. It then drops to a movable belt and is carried into a warm closet, from which it emerges dry enough to market as "flake" or "chip" soap (see Fig. 438).

For the production of powdered soap, the flakes are more thoroughly dried and are then powdered in the usual manner.

It must be evident to all who know something of the nature of soap that an important factor in its actual value is the percentage of water it contains. Not only does this control the amount of soap available, but when a large amount of water is present a soap in cake form rapidly disintegrates when used and fails to give adequate service.

It may be startling information to some to know that often as much as 80 per cent of laundry soap in cakes is represented by water. In flakes the water must be greatly reduced and is not often above 5 per cent. This is another reason for the preference of chip or flake soap over other forms, for laundry purposes.

Washing powders, on the other hand, are usually mixtures, rarely containing more than 20 per cent of soap and often less. In addition to the soap they usually contain from 25 to 30 per cent of "soda ash" (sodium carbonate), the remainder being water. This combination of soap and "soda ash" is particularly efficient in the washing of clothes and, even if pure chip soap is used, the experts who conduct experiments in laundry methods advise the addition of soda ash to the first water.

To produce the higher grade toilet or medicinal soaps, the bars cut from the frames are reduced to chips by a chipping machine or scraped directly from the roller (see Fig. 438). These are further dried and then "milled" (see Fig. 438) by passing them repeatedly through heavy rollers without heat, until a uniform mass results. During this process the coloring matter, if any, is incorporated and also the desired perfume or medicating ingredients.

This soft mass is then forced under heavy pressure into bars of the shape and size best suited to form the desired cake, the machine being called a "plodder" (see Fig. 438). These bars, while yet soft from the milling, are then cut into cake size and stamped into tablets.

The raw fatty materials from which commercial soaps are made depend to some extent upon the market conditions. The cheapest form of olein or stearin obtainable is likely to be employed as the basis for the soap. Among these ingredients are bone fat, cocoanut oil, palm kernel oil, palm oil, olive oil, "olive oil foots", peanut oil, cottonseed oil, corn oil, soya bean oil, linseed oil, hydrogenated oils, rosin, tallow, and fatty acids.

Kinds of Commercial Soaps—*Curd Soap*—Curd soap is a soap separated by salt solution, reheated and mixed with sufficient water to form a smooth emulsion, run into frames, cooled, and cut into bars or cakes. It usually constitutes the bar laundry soap. It is frequently high in alkali and usually contains fillers, such as sodium silicate.

Mottled Soap—This is a form of curd soap, showing streaks of color irregularly running through the mass. Formerly it was caused by the addition of some metallic salt, as ferrous sulphate, manganese dioxide, or ultramarine. Originally such soaps were considered to be of superior quality, but the effects have been artificially produced, so that today mottled soap does not necessarily indicate a high grade soap, often containing as little as 20 per cent of actual fatty acid. The mottled soaps have nearly disappeared from the American market.

Milled Soap—When a high-grade soap stock has been made by the boiling or the cold process, and dried in the frames, it is then cut into slabs and bars and subsequently chipped. These chips in turn are milled between stone rollers until the soap has acquired a uniform consistence. Such soap is much more lasting when finally made into cakes and may be variously colored

or perfumed. It is possible, of course, to apply this general process to low-class soaps, but whatever the basic stock, a milled soap is much more serviceable and satisfactory than the same soap cut directly from the bars.

Soft Soap—This soap, made from potash, or mixtures of potash and soda, and usually a liquid fat, has already been referred to. It is chiefly used medicinally, either as a cleanser for the hands of the surgeon or for preparing an operating area or in the treatment of the skin or scalp. It is most frequently employed in alcoholic solution under the name "tincture of green soap".

Disinfectant Soap—If some form of disinfectant, such as cresol or phenol, is added to soap stock during the milling, the soap is known as a disinfectant soap, even though the amount of added substance is not sufficient to produce very effective germicidal action.

Marine Soap and Hard Water Soap—For use with sea water and also for use with water containing lime salts, known as "hard" water, ordinary soaps are very unsatisfactory, because such salts precipitate the soap. It is possible, however, to make a soap which is soluble and therefore usable in such water, by employing cocoanut oil as the fat and possibly introducing a small amount of palm kernel oil. It is this form of soap which is sold under the above names.

Transparent Soap—For many years there have been offered soaps which are known as "transparent" soaps. These were originally prepared chiefly from mixtures of cocoanut and castor oils and the resulting soap dissolved in alcohol. When the excess of alcohol is distilled off, the residue is transparent. It has been found possible in recent years to produce much cheaper and quite satisfactory transparent soaps from mixtures of cocoanut oil and castor oil by the simple addition of cane sugar syrup. Such soap has a tendency to "fig", that is, in time to separate crystalline salts of fatty acids.

Liquid Soap—A largely used form of soap, chiefly because of its economy and sanitary advantages, is known as "liquid soap". This is usually an aqueous solution of cocoanut oil-potash soap, suitably colored and perfumed. It is found in modern hotels and railroad trains and is used by means of a special apparatus which delivers a few drops of the soap without contaminating the remainder.

Floating Soap—Floating soap is made by beating the soap in a crutcher soon after running it from the boiling kettles. Air is thus beaten into the soap as it cools and the resulting production is thus made lighter than water. While this lessens the actual weight of soap in a cake it is justified by adding to the convenience in the use of the product.

Shaving Soap—Soaps for use in shaving are usually made from carefully selected stock and are carefully neutralized to avoid any caustic action when applied to the face. These soaps generally contain a large percentage of cocoanut oil. Tragacanth and milk sugar are added in small amounts to shaving creams to increase the permanence of the lather.

Grit Soap—For cleaning the hands, when especially soiled with grease or machine work, soaps are offered which contain powdered silica mixed with the soap. Such soaps are on the market in paste and cake form.

Dry-Cleaning Soap—Cleansers of this character usually consist of an ammonia or possibly a potash soap of oleic acid usually dissolved in a volatile solvent such as benzin. They are used to remove spots in clothing.

Scouring Powders—Substances of this character sold extensively in a box with a perforated top are not actually soaps. The makers usually claim freedom from alkali or caustic effect. They generally consist of powdered volcanic lava and serve in a purely mechanical function as a cleanser.

How Does Soap Clean?—Some believe that soap is used only as a lubricant. Through its use it becomes possible to easily rub the hands together or more readily scrub clothing or other surfaces and through its mechanical lubricant action the cleansing process is promoted. Another view of the reason why soap is efficacious is the fact that it usually hydrolizes when dissolved in water as may be readily shown by pouring an alcoholic solution of neutral soap into water. In a few moments the presence of free alkali due to hydrolysis becomes apparent if an indicator is added. Phenolphthalein will quickly turn pink, indicating free alkali. Many of the foreign substances on the hands and in clothing which are to be removed, are all of a fatty nature and it is argued that free alkali saponifies these and thus promotes cleanliness. But while these two explanations of the value of soap are doubtless true and they in part explain the value of soap, there is another quality which soap possesses, which is related to its colloidal character.

Soap possesses a quality which is known as "adsorption". When it comes in contact with foreign substances, it seems to possess the quality of combining and rendering soluble many otherwise insoluble materials. This quality may be very clearly illustrated by mixing lampblack with water and pouring the mixture on a filter. The water will pass through the filter leaving the black, greasy, lampblack on the interior surface. If some soap solution now is added to the mixture in the filter, the lampblack will be immediately carried through the filter, showing the peculiar effect of soap on otherwise insoluble substances. If salt is now added to the mixture in the filter, thus precipitating soap, the lampblack immediately regains its insoluble character and will not pass through the filter.

There are two kinds of soluble soaps official, *i. e.*, Olive Oil Castile Soap and Soft Soap. The official requirements are given below.

SAPO. U.S. Soap

[Olive Oil Castile Soap, White Castile Soap]

Soap prepared from olive oil and sodium hydroxide.

The official soap is commonly called Castile soap because it originally came from Castile, Spain. Much of the so-called Castile soap on the market is not pure olive oil soap but contains cocoanut oil soap to increase its lathering quality.

Description and Physical Properties—A white or whitish solid, in the form of bars, hard, yet easily cut when fresh, or a fine, yellowish-white powder. It has a faint, characteristic odor, free from rancidity, and a disagreeable, alkaline taste.

Soap is soluble in water and in alcohol, more readily, however, with the aid of heat.

An aqueous solution of Soap is alkaline to indicators.

Tests for Purity—Dissolve about 0.5 Gm. of Soap, accurately weighed, in 10 cc. of alcohol, evaporate the mixture to dryness in a tared beaker containing 1 Gm. of clean sand, which has been previously dried at 110° C., and dry the residue to constant weight at 100° C.: the loss does not exceed 36 per cent for unpowdered Soap or 10 per cent for powdered Soap (*water*).

A solution of a quantity of Soap corresponding to 0.64 Gm. of dried Soap in 25 cc. of hot alcohol does not gelatinize on cooling to 20° C. (*soap from animal fats*).

Ten cc. of an aqueous solution of Soap (1 in 20) remains unchanged in color upon the addition of ammonium sulphide T.S., and upon acidulating another portion of 10 cc. of the solution with hydrochloric acid and filtering, the filtrate remains unchanged in color when an equal volume of hydrogen sulphide T.S. is added and the mixture allowed to stand well-stoppered, in a warm place, for half an hour (*heavy metals*).

Dissolve about 10 Gm. of Soap, accurately weighed, in 100 cc. of neutralized alcohol, with the aid of heat. Transfer the undissolved residue, if any, to a tared filter which has been dried at 100° C., and wash it thoroughly with boiling neutralized alcohol. The weight of the residue after drying at 100° C. does not exceed 1 per cent of the weight of dry Soap taken (*sodium chloride, carbonate, silica, or other alcohol-insoluble substances*). This residue, thoroughly washed with distilled water and dried at 100° C., does not yield a residue exceeding 0.15 per cent of the weight of dry Soap taken (*silica or other water-insoluble substances*).

The alcoholic filtrate and washings from the preceding test are not reddened by 3 drops of phenolphthalein T.S. (*sodium hydroxide*).

Dissolve about 10 Gm. of Soap in 200 cc. of hot distilled water, add 2 drops of methyl orange T.S. and then diluted sulphuric acid with constant stirring until the aqueous layer becomes red. Boil the mixture until the supernatant layer of the fatty acids is clear and free from solid particles. Separate the aqueous layer with the aid of a siphon and wash the fatty acids by decantation with hot distilled water, until a 10 cc. portion of the washings, acidulated with a drop of hydrochloric acid, no longer gives a precipitate on the addition of barium chloride T.S. Place the dish containing the fatty acids on a water bath and heat until they are completely liquefied, filter the warm acids through a dry filter in a hot-water funnel into a flat dish, and dry over sulphuric acid. The iodine number of the acids thus obtained is not less than 84 and not more than 90, page 1519.

Preserve in well-closed containers.

U. S. P. Preparations—Extractum Colocynthidis Compositum; Linimentum Chloroformi (from Soap Liniment); Linimentum Saponis; Pilulæ Aloes; Pilulæ Asafœtidæ.

N. F. Preparations—Dentifricium; Emplastrum Saponis; Lavatio Ori, Pilulæ Aloes et Asafœtidæ; Pilulæ Rhei.

Uses—Soap is used in pill masses, in combination with resins, to render them soluble and to modify their harsh action. It is also used in liniments, plasters, cerates, etc.

SAPO MOLLIS. U. S. Soft Soap

[Sapo Moll.]

	Metric	Alternative
Linseed Oil	**400 Gm.**	14 oz. av. 48 gr.
Dekanormal Solution of Potassium Hydroxide	**29 cc.**	471 min.
Dekanormal Solution of Sodium Hydroxide	**110 cc.**	3 fl. oz. 345 min.
Glycerin	**50 cc.**	1 fl. oz. 332 min.
Water, a sufficient quantity, To make	**1000 Gm.**	35 oz. av. 120 gr.

Mix the dekanormal solutions, pages 1558 and 1561, with the oil and enough water to make the product weigh 925 Gm. [32 oz. av. 275 gr.]. Heat the mixture to boiling with frequent stirring, add the glycerin, and continue the boiling until the mixture becomes transparent and a portion dissolves completely in hot water, producing a clear solution. Then add sufficient hot water to make the Soap weigh 1000 Gm. [35 oz. av. 120 gr.] and allow to stand with little stirring until the water is absorbed.

NOTE—The 29 cc. [471 min.] of dekanormal solution of potassium hydroxide directed above may be replaced by 19.14 Gm. [295 gr.] of 85 per cent potassium hydroxide and the 110 cc. [3 fl. oz. 345 min.] of dekanormal solution of sodium hydroxide may be replaced by 48.89 Gm. [1 oz. av. 317 gr.] of 90 per cent sodium hydroxide, dissolving the hydroxides in 100 cc. (3 fl. oz. 183 min.) of water. If upon assay the potassium and the sodium hydroxides are found to be of any other strength, a proportionately larger or smaller quantity should be taken.

A variety of soft soap prepared from green colored oils, such as green olive oil, or artificially colored, is known as "Green Soap". The official soap is not green in color.

It has been demonstrated, moreover, that the green color adds nothing to the therapeutic value and cottonseed oil soap has long been used with satisfaction. On a large scale the soap may be prepared without the addition of alcohol or glycerin, heat and concentrated alkali producing saponification. "Green olive oil" has been used to make a green soap. It should contain a little free alkali, but an excess must be avoided; this is regulated by the U. S. P. test.

In the U. S. P. X linseed oil has again been introduced into soft soap because of its superior saponifying and detergent qualities. It has also been found possible to replace much of the potassium hydroxide by sodium hydroxide and still retain the soft character of the soap.

The dekanormal alkali solutions have been used in the official formula for the purpose of readily supplying a definite amount of alkali, the stick caustic being so deliquescent that the amount of water present is always indefinite. It is expected that the pharmacist will be able to buy these dekanormal solutions as he now buys strong acids. They have been shown to be relatively permanent if kept in stoppered bottles.

Description and Physical Properties—A soft, unctuous, yellowish-white to brownish-yellow mass, having a slight, characteristic odor and an alkaline taste.

An aqueous solution of Soft Soap is alkaline to litmus paper and phenolphthalein T.S.

Dissolve about 5 Gm. of Soft Soap, accurately weighed, in 100 cc. of hot neutralized alcohol, collect the residue, if any, on a filter, thoroughly wash it with hot neutralized alcohol, and dry it to constant weight at 100° C. The weight of the residue does not exceed 3 per cent of the weight of Soap taken. The combined filtrate and washings, on the addition of 0.5 cc. of phenolphthalein T.S. and titration with tenth-normal sulphuric acid, shows not less than 0.1 per cent and not more than 0.25 per cent of KOH. Each cc. of tenth-normal sulphuric acid corresponds to 0.00561 Gm. of KOH.

Tests for Purity—A solution of Soft Soap in hot distilled water (1 in 20) is nearly clear.

Soft Soap loses not more than 52 per cent in weight when tested for water as directed under *Sapo*.

U. S. P. Preparation—Linimentum Saponis Mollis.

N. F. Preparations—Linimentum Saponis Mollis Compositum; Pasta Betanaphtholis; Unguentum Sulphuris Compositum.

Uses—Green soap is used in skin diseases, chiefly in eczema, and largely as a detergent in surgery. It is also largely used in alcoholic solution, in the cleansing and treatment of the scalp.

Unsaponifiable Fats and Petroleum Products

Under this head will be found several official products which cannot be classed properly with either the fixed or the volatile oils, yet in some respects they partake of the properties of both. Petrolatum in its several forms, paraffin, and petroleum benzin, are products from petroleum, and are mixtures of hydrocarbons belonging to the methane series.

Crude Petroleum—Rock Oil

Petroleum has been known from the earliest historical period. Within the limits of the United States it has long been known to exist in a few localities. On the borders of Seneca Lake in the State of New York small quantities of it were collected, and to some extent used in medicine under the name of Seneca oil. In Western Pennsylvania, on Duck Creek in Ohio, near Scottsville in Kentucky, and on the Kanawha in Virginia, it attracted local attention, and a certain locality in Western Canada had acquired some notoriety by its burning spring. Little attention was paid to it until 1859, when, the preparation of oil for burning, distilled from bituminous shales, and called "coal oil", having proved profitable, and a strong resemblance having been shown to exist between this and petroleum, enterprise was directed towards some of the known resources of the latter liquid. The first oil well was sunk by Drake, in 1859, at Titusville, Pa., and from that arose an enormous industry. At first the most productive locality of petroleum was in Western Pennsylvania but it is now obtained in many States. After the Pennsylvania field, in order of development, is that of Ohio; but most of the oil produced in this state is from a different geological strata—*viz.*, the Trenton limestone—and contains a persistent sulphur impurity. This renders the Ohio oil (popularly known also as Lima oil, from the town of Lima, Ohio) more difficult and expensive to refine. It is hence very largely used in the crude state as fuel oil, and as such has been of the greatest industrial value, being shipped

by pipe line or tank cars to great distances. Within recent years large quantities of petroleum have been found in California, Texas, Louisiana, Kentucky, and Kansas, but in the main it is of a grade much inferior to that known as Pennsylvania oil, being largely used as fuel oil. Oil is also obtained from Mexico, and Russia, and is a big factor in international relations due to its great value.

Crude petroleum is occasionally almost colorless when taken from the earth, but is generally of a greenish color, appearing claret-red by transmitted light. The green color may, however, become so dark as to be almost black. In gravity, it varies from 0.865 to 0.777.

To purify petroleum the crude oil is run into large retorts of wrought iron and exposed to a heat rising gradually to between 315.5° C. whereby all the volatile ingredients are distilled, leaving from 5 to 10 per cent of solid residue, constituting a sort of coke. The liquids thus obtained are comparatively colorless, though still retaining the strong odor of the crude oil. The several fractions are collected separately, and show widely varying gravity and volatility, and are applied to different uses. An average result of a normal distillation may be stated as follows: Gasoline, 1½ per cent, refined naphtha 10 per cent, benzin 4 per cent, refined petroleum or kerosene (sometimes called coal oil) 55 per cent, lubricating oil 17½ per cent, paraffin 2 per cent, gas, and coke 10 per cent. As the greater demand for illuminating oil makes it desirable to get the maximum quantity of this fraction, the distillation is generally so conducted that by the process of "cracking" the yield of burning oil is increased at the expense of the lubricating oil and heavy naphtha. Many distilleries obtain, therefore, from 75 to 80 per cent of illuminating oil from the crude material.

Uses—Petroleum has been considered to be a stimulating antispasmodic, expectorant, and diaphoretic.¶ It was used as a folk remedy in the treatment of acute bronchitis, but probably with no beneficial action in this condition save by virtue of its nauseating effect. It is affirmed that many cases of asthma are much benefited by inhaling petroleum vapors. It is a minor ingredient in the popular remedy called British Oil. This is made as follows:

British Oil

Petroleum (Barbados)	1 fl. oz.
Petroleum (American)	1 fl. oz.
Oil of Turpentine	2 fl. oz.
Oil of Linseed	24 fl. oz.
Oil of Amber	8 fl. oz.
Oil of Juniper	2 fl. oz.

Mix them well together.

PETROLATUM LIQUIDUM. U. S. Liquid Petrolatum

[**Petrolat. Liq.**—Liquid Paraffin, White Mineral Oil, Paraffin Oil]

Liquid Petrolatum is a mixture of liquid hydrocarbons obtained from petroleum.

Preparation—After removing the lighter hydrocarbons from petroleum, by distillation, the residue is again subjected to distillation at a temperature between 330° and 390° C. and the distillate treated first with sulphuric acid, then with sodium hydroxide, and afterwards decolorized by filtering through bone black, animal charcoal, or fuller's earth. The purified product is again chilled, to remove paraffin, and redistilled at a temperature above 330° C. In some instances the sulphuric acid treatment is omitted.

Official Description—*Heavy Liquid Petrolatum*—Heavy liquid Petrolatum has a kinematic viscosity of not less than 0.381 at 37.8° C. (100° F), page 1526.

Light Liquid Petrolatum—Light Liquid Petrolatum has a kinematic viscosity of not more than 0.370 at 37.8° C. (100° F.), page 1526.

Each variety conforms to the following description and tests:

Description and Physical Properties—A colorless, transparent, oily liquid, free, or nearly free, from fluorescence.

It is insoluble in water and in alcohol; soluble in ether, chloroform, petroleum benzin, and in fixed or volatile oils. Camphor, menthol, thymol, and many similar substances are soluble in Liquid Petrolatum.

Tests for Purity—Specific gravity: 0.828 to 0.905 at 25° C.

Liquid Petrolatum is odorless and tasteless when cold, and develops not more than a faint petroleum odor when heated.

When cooled to 0° C., Liquid Petrolatum does not become more than opalescent (*solid paraffins*).

Boil 10 cc. of Liquid Petrolatum with an equal volume of alcohol: the alcohol remains neutral to moistened litmus paper (*acid or alkali*).

Pour 5 cc. of Liquid Petrolatum and 5 cc. of colorless sulphuric acid into a glass-stoppered cylinder, which has been previously rinsed with sulphuric acid, and heat in a water bath for ten minutes, shaking the mixture well at intervals of thirty seconds: the oil remains unchanged in color and the acid does not become darker than pale amber (*carbonizable substances*).

Prepare a saturated solution of lead monoxide in an aqueous solution of sodium hydroxide (1 in 5), and mix 2 drops of the clear solution with 4 cc. of Liquid Petrolatum and 2 cc. of dehydrated alcohol: the mixture does not darken after heating at 70° C. for ten minutes and cooling (*sulphur compounds*).

Preserve in well-closed containers, protected from light.

U. S. P. Preparations—Unguentum Hydrargyri Ammoniati; Unguentum Hydrargyri Oxidi Flavi.

N. F. Preparations—Nebula Aromatica; Nebula Eucalyptolis; Nebula Mentholis; Nebula Mentholis Composita; Nebula Thymolis; Pasta Resorcinolis Fortior; Pasta Resorcinolis Mitis; Petroxolins; Lubricant in Tabellæ.

Uses—Liquid Petrolatum is used as a basis for medicinal preparations, for spraying the nasal passages, and as a laxative, its efficiency being due to mechanical lubrication. For this latter purpose an oil of high viscosity, the so-called "heavy oil" is usually preferred as the lighter oils have a tendency to produce leakage. The lighter oils are used for spraying. Because of the widespread use of this oil as a laxative, it has been sold under many special names.

Average dose—4 fluidrachms (15 cc.).

A popular form of liquid petrolatum, for its laxative effect, is the *Agar emulsion.* Frequently the efficacy of this is increased by the addition of phenolphthalein, when it is called "*Compound Agar Emulsion of Petrolatum*".

This emulsion is usually prepared on the large scale in a special machine known as a homogenizer (see Emulsions), but it may be prepared by the pharmacist by the following formula, suggested by Ambrose Hunsberger:

Unofficial Agar Emulsion of Petrolatum (Plain)

Agar (pure granules or flakes)	68 gr.
Distilled Water	3½ pints

Boil this mixture for fifteen minutes, adding enough water to make up that lost by evaporation. Cool slightly, and strain if necessary. While still hot pour the above solution into a mixture of

Powdered Acacia	110 gr.
Powdered Tragacanth	110 gr.
Oil of Orange	3 fl. dr.
Liquid Petrolatum	4 pints

Shake the mixtures vigorously and repeat the shaking at frequent intervals until it becomes creamy and fully emulsified. Then cool and add the following solution:

Soluble Glucide	10 gr.
Compound Tincture of Vanilla	4 fl. dr.
Sodium Benzoate	2 dr.
Glycerin	4 fl. oz.
Water, sufficient to make 1 gallon.	

Shake well together or heat actively in an emulsion machine.

PETROLATUM. U.S. Petrolatum

[**Petrolat.**—Amber Petrolatum, Petroleum Jelly]

A purified, semi-solid mixture of hydrocarbons, obtained from petroleum.

Preparation—The "residuums", as they are termed technically, which are obtained by the distillation of petroleum, are purified by melting, usually

treating with sulphuric acid, and then percolating through recently burned bone black; this abstracts the odor and modifies the color.

Description and Physical Properties—An unctuous mass, varying in color from yellowish to light amber. It has not more than a slight fluorescence even after being melted, and is transparent in thin layers. It is free or nearly free from odor and taste.

Petrolatum is insoluble in water; almost insoluble in cold or hot alcohol, and in cold dehydrated alcohol. It is freely soluble in benzene, carbon disulphide, chloroform, and oil of turpentine. It is soluble in ether, petroleum benzin, and in most fixed or volatile oils, the degree of solubility in these solvents varying with the composition of the Petrolatum.

Tests for Identity and Purity—Specific gravity: 0.820 to 0.865 at 60° C.

It melts between 38° and 54° C.

Heat 2 Gm. of Petrolatum in an open porcelain or platinum dish over a Bunsen flame: it volatilizes without emitting an acrid odor, and on incineration leaves not more than 0.05 per cent of ash.

Shake melted Petrolatum with an equal volume of hot distilled water: the latter remains neutral to litmus paper (*acids or alkalies*).

Digest 10 Gm. of Petrolatum at 100° C., with 10 Gm. of sodium hydroxide and 50 cc. of distilled water for half an hour, then separate the aqueous layer, and supersaturate it with sulphuric acid: no oily or solid substance separates (*fixed oils, fats or rosin*).

U. S. P. Preparations—Unguentum Acidi Borici; Unguentum Belladonnæ; Unguentum Hydrargyri Mitis; Unguentum Hydrargyri Oxidi Flavi; Unguentum Iodoformi; Unguentum Phenolis; Unguentum Picis Pini.

N. F. Preparations—Emulsum Petrolati; Pasta Betanaphtholis; Pasta Zinci; Unguentum Hydrargyri Oxidi Rubri; Ointments.

Uses—Petrolatum is used as a basis for ointments, for which it is well adapted. It is, however, not so readily absorbed as are other unctuous bases. Special brands are known as *cosmoline*, *vascline*, *petrolina*, *deodorolina*, *albolene*, etc.

PETROLATUM ALBUM. U. S. White Petrolatum

[**Petrolat. Alb.**—White Petroleum Jelly]

Petrolatum wholly or nearly decolorized.

Preparation—It is prepared in the same manner as petrolatum, the charcoal treatment being continued until the product is practically free from yellow color. The product often sold for white petrolatum, made by mixing paraffin and liquid petrolatum, is not satisfactory for pharmaceutical purposes as it is granular and the liquid portion often separates. The U. S. P. test excludes this variety.

Description and Physical Properties—White Petrolatum is a white or faintly yellowish, unctuous mass, transparent in thin layers even after cooling to 0° C.

In other respects White Petrolatum has the characteristics of and responds to the tests for identity and purity under *Petrolatum*.

U. S. P. Preparations—Unguentum Hydrargyri Ammoniati; Unguentum Plumbi Oleatis; Unguentum Zinci Oxidi.

N. F. Preparations—Ceratum Camphoræ; Ceratum Plumbi Subacetatis; Curatio Paraffini; Unguentum Hydrargyri Chloridi Mitis; Unguentum Zinci Stearatis.

Uses—White petrolatum is employed as a basis for ointments and cerates.

PARAFFINUM. U. S. Paraffin

[**Paraff.**]

A purified mixture of solid hydrocarbons, obtained from petroleum.

Hard paraffin or *paraffin wax*, is a solid, white, diaphanous substance resembling white wax, which is made by distilling the residuum obtained from the refining of petroleum and collecting and purifying the distillate. It can be mixed in all proportions with wax, stearin, palmitin, and rosin, but it is difficult to prevent the mixtures from "granulating", even after prolonged stirring.

Description and Physical Properties—A colorless, or white, more or less translucent mass, frequently showing a crystalline structure. It is without odor or taste, and is slightly greasy to the touch.

Paraffin is insoluble in water and in alcohol; slightly soluble in dehydrated alcohol; freely soluble in chloroform ether, benzene, petroleum, benzin, carbon disulphide, volatile oils, and in most warm fixed oils.

Tests for Identity and Purity—Specific gravity: about 0.900 at 25° C.

It melts between 50° and 57° C.

For further tests see the U. S. P. X.

U. S. P. Preparations—Paraffinum Chlorinatum; Unguentum Zinci Oxidi.

N. F. Preparations—Curatio Paraffini; Unguentum Capsici; Unguentum Iodi Denigrescens.

Uses—It is used in denarcotizing tincture of opium, also as the basis for burn dressings (see Curatio Paraffini, below) and in addition it is used to increase the consistence of some ointments.

PARAFFINUM CHLORINATUM. U. S. Chlorinated Paraffin

[**Paraff. Chlorinat.**—Chlorcosane]

A chlorinated paraffin.

Description and Physical Properties—A light yellow to light amber, clear, thick, oily liquid. It is odorless and is stable in the air.

Chlorinated Paraffin is insoluble in water; slightly soluble in alcohol, but miscible with benzene, carbon tetrachloride, chloroform, and with ether.

Tests for Identity and Purity—See the U. S. P. X.

CURATIO PARAFFINI. N. F. Paraffin Dressing

[**Curat. Paraf.**]

A formula for the largely used paraffin dressing for burns has been made official in the N. F. V. Paraffin intended for application to burns, etc., should be solid at body temperature, but more ductile and pliable than the official paraffin. It should be liquid at or below 50° C. A thin film when prepared and tested as described below should be pliable at or below 28° C. and ductile at or below 31° C. At body temperature (38° C.) it should be pliable, and adhere to, but permit ready detachment from, the skin.

	Metric	Alternative
Resorcinol	**1 Gm.**	17½ gr.
Oil of Eucalyptus	**2 cc.**	35 min.
Olive Oil	**3 cc.**	52 min.
White Petrolatum	**12 Gm.**	210 gr.
Paraffin	**82 Gm.**	3 oz. av. 123 gr
To make	**100 Gm.**	4 oz. av.

Melt the paraffin, add the white petrolatum and olive oil, and stir, continuing the heat if necessary, until a uniform liquid is obtained. Dissolve the resorcinol in the oil of eucalyptus, add to the warm paraffin mixture and mix well. Stir the mixture frequently until it begins to congeal.

Uses—Paraffin for films acts mechanically. When applied to burns and denuded surfaces, it provides an air-excluding dressing which relieves pain, forming a soft, pliable splint-like covering to wounded surfaces, keeps the parts at a relatively uniform temperature, immobilizes the epidermal tissue, and may aid in the formation of new tissue by acting as a scaffolding for newly-formed cells.

Paraffin for films is used mainly in the treatment of burns. It is said to be useful in the treatment of frostbite and chilblains, and for covering denuded surfaces. It is also employed to prepare paraffin covered bandages and to seal gauze dressings.

In the paraffin treatment of burns, the wound, after preparatory treatment, is dried and a thin coating of the melted paraffin dressing (at a temperature of about 53° C.) is applied by means of an atomizer or brush. This is followed by the application of a thin layer of cotton and then another layer of the melted paraffin. The dressing is finished by covering with cotton and bandaging.

A simple and equally efficient method consists in cutting a thin sheet of cotton or similar absorbent to a size somewhat larger than the wound. This is dipped into the melted paraffin, applied snugly to the wound, and covered with a bandage.

Similar preparations have been sold under trade names such as *Ambrene* and *Parresine*.

BENZINUM PURIFICATUM. U. S. Purified Petroleum Benzin

[**Benzin. Purif.**—Petroleum Ether]

Purified Petroleum Benzin is a purified distillate from American petroleum, consisting of hydrocarbons, chiefly of the methane series.

The U. S. P. VIII method of purification was as follows:

	Metric	Alternative
Potassium Permanganate	10 Gm.	146 gr.
Sodium Hydroxide	2 Gm.	29 gr.
Sulphuric Acid	60 cc.	2 fl. oz.
Petroleum Benzin	1000 cc.	2 pints
Water, a sufficient quantity.		

Add the acid to 550 cc. [17½ fl. oz.] of water, and when the mixture has become cold, pour it into a bottle having a capacity of about two liters [4 pints]. Add 8 Gm. [117 gr.] of potassium permanganate and agitate until it is dissolved, then add the petroleum benzin, in four portions, shaking the liquor after each addition. Allow the liquids to remain in contact for 24 hours, shaking the bottle at frequent intervals; then decant the petroleum benzin into another bottle of the same capacity, and having dissolved 2 Gm. [29 gr.] of potassium permanganate in 240 cc. [8 fl. oz.] of water, in which the sodium hydroxide has previously been dissolved, mix the liquids and agitate the mixture frequently during several hours, then decant, repeat the washing with water, and again decant the purified petroleum benzin.

Description and Physical Properties—A clear, colorless, non-fluorescent, volatile liquid, having an ethereal or faint, petroleum-like odor, and a neutral reaction.

Caution—It is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently.

Purified Petroleum Benzin is practically insoluble in water. It is freely soluble in alcohol, and is miscible with ether, chloroform, benzene, and with fixed or volatile oils, with the exception of castor oil.

Tests for Identity and Purity—Specific gravity: 0.634 to 0.660 at 25° C.

Purified Petroleum Benzin distils completely between 35° and 80° C., when determined by Method II, page 121.

Pour 10 cc. of Purified Petroleum Benzin in portions upon clean, odorless filter paper laid on a warm glass plate. No disagreeable or notably sulphureted odor becomes apparent as the last portions disappear from the paper, and no greasy stain remains.

Not more than 0.001 Gm. of residue remains on evaporating 50 cc. of Purified Petroleum Benzin at a temperature not exceeding 40° C.

For further tests see the U. S. P. X.

Preserve in well-closed containers, in a cool place, remote from fire.

U. S. P. Preparations—Extractum Colchici; Extractum Nucis Vomicæ; Fluidextractum Colchici; Tinctura Digitalis; Tinctura Strophanthi.

Uses—Petroleum benzin is a useful solvent for fats, resins, oils, caoutchouc, and similar bodies. It is not identical with benzene, the product obtained in the destructive distillation of coal. The object of introducing purified petroleum benzin into the Pharmacopœia was to furnish a solvent which would not communicate a disagreeable odor to preparations, as is the case when commercial petroleum benzin is used.

Petroleum Benzin and similar solvents of like origin such as gasoline are frequently used in so-called "*dry cleaning*" which is a term used to describe cleaning garments etc., without the use of water. Their efficiency in this direction is due to the facility with which they remove grease spots, and with them the adherent dirt. The use of inflammable solvents for such purposes, either on the large or small scale is always attended with more or less danger. Carbon tetrachloride, which is a non-inflammable solvent used for similar purposes, may be used as an ingredient for mixing with petroleum distillates to reduce their inflammability and at the same time augment their grease dissolving powers. Seventy-five per cent of carbon tetrachloride and twenty-five per cent of petroleum benzin makes a non-inflammable mixture which is an excellent solvent for grease, and may be used with perfect safety.

Unoffiical Petroleum Products

Kerosene, Deodorized, N. N. R.	Kerosene treated to remove odorous constituents. Used, because of its solvent action on fats, as a pediculocide and as a means of removing dandruff and the detritus of wounds. Employed also as a vehicle in sprays and liniments

CHAPTER LXXII

DRUGS CONTAINING GLUCOSIDES OR NEUTRAL PRINCIPLES, WITH THEIR PREPARATIONS

THE glucosides are organic plant principles of complex constitution. Under the recent system of international chemical nomenclature they belong to the group which includes the carbohydrates proper and which general group is distinguished by the name *"glucides"*.

The distinguishing characteristic of the glucosides is the fact that upon decomposition they yield dextrose (formerly called glucose) with one or more substances, frequently of an aromatic nature.

They have been described as ester or ether-like compounds of carbohydrates with aromatic compounds. In the majority of cases the carbohydrate is dextrose, but it may be an isomeric hexose, as galactose, or a pentose such as rhamnose.

Examples of three types of glucosides are found in the following: *Salicin*, which upon decomposition yields *saligenin* and dextrose, as follows:

$$\underset{\text{salicin}}{C_{13}H_{18}O_7} + \underset{\text{water}}{H_2O} = \underset{\text{dextrose}}{C_6H_{12}O_6} + \underset{\text{saligenin}}{C_6H_4OHCH_2OH}$$

Digitonin which yields *digitogenin*, dextrose, and *galactose* as follows:

$$\underset{\text{digitonin}}{C_{54}H_{92}O_{28}} + \underset{\text{water}}{2H_2O} = \underset{\text{digitogenin}}{C_{30}H_{48}O_6} + \underset{\text{dextrose}}{2C_6H_{12}O_6} + \underset{\text{galactose}}{2C_6H_{12}O_6}$$

Quercitrin which yields *quercetin* and *rhamnose*, as indicated by the following equation:

$$\underset{\text{quercitrin}}{C_{21}H_{20}O_{11}} + \underset{\text{water}}{H_2O} = \underset{\text{quercetin}}{C_{15}H_{10}O_7} + \underset{\text{rhamnose}}{C_6H_{12}O_5}$$

The glucosides are devoid of nitrogen except in the case of a small group known as cyanogenetic glucosides, exemplified by amygdalin which splits up as follows:

$$\underset{\text{amygdalin}}{C_{20}H_{27}NO_{11}} + \underset{\text{water}}{2H_2O} = \underset{\text{dextrose}}{2C_6H_{12}O_6} + \underset{\text{benzaldehyde}}{C_6H_5CHO} + \underset{\text{hydrocyanic acid}}{HCN}$$

The reaction by which glucosides are split up into their constituent parts is a hydrolytic reaction. It may be brought about by boiling with dilute mineral acids or in some cases by alkalies. In the plants which contain glucosides the decomposition is effected by means of suitable ferments (such as *emulsin*, *myrosin*, etc.), which often exist in the same part of the plant, but usually in different cells from the glucosides.

Each glucoside may have an enzyme of a distinctive character associated with it, but the enzymes as a rule possess the power of splitting several glucosides.

There are no simple identifying tests for glucosides, except by the character of the cleavage products in some cases. Methods for the detection of glucosides and for their quantitative determination involve the estimation of reducing sugars before and after the solution is hydrolyzed by boiling with dilute acids, or by the action of emulsin.

The saponins are a group of glucosides, which are amorphous colloidal substances, readily soluble in water and producing a froth when the aqueous solution is agitated. They are excellent emulsifying agents and the aqueous solutions of some of them are used as detergents to replace soap (see quillaja).

Many of the saponins are markedly toxic in their physiological action. They usually possess a powerful solvent action on red blood corpuscles, a property known as hemolysis.

The saponins are widely distributed in the botanical kingdom.

Glucosides

Glucoside	Source	Derivatives
Adonidin	From *Adonis vernalis*	
Æsculin, $C_{15}H_{16}O_9$	From *Æsculus Hippocastanum*	Æsculetin
Amygdalin, $C_{20}NH_{27}O_{11}$	From *Prunus amygdalus*	Benzaldehyde and hydrocyanic acid
Arbutin, $C_{12}H_{16}O_7$, N. N. R.	From *Uva Ursi* and other Ericaceæ	Hydroquinone and methyl-hydroquinone
Bryonin, $C_{34}H_{48}O_9$	From *Bryonia alba* and *B. dioica*	Bryoretin and bryogenin
Colocynthin, $C_{56}H_{84}O_{23}$	From *Citrullus colocynthis*	Colocynthein
Coniferin, $C_{16}H_{22}O_8$	From *Coniferous woods*	Coniferyl alcohol
Convallamarin, $C_{23}H_{44}O_{12}$	From *Convallaria majalis*	Convallamaretin
Convallarin, $C_{34}H_{62}O_{11}$	From *Convallaria majalis*	Convallaretin
Convolvulin, $C_{31}H_{50}O_{16}$	From *Exogonium purga*	Convolvulinic acid and methyl-ethyl acetic acid
Crocin, $C_{44}H_{70}O_{28}$	From *Crocus sativus*	Crocetin
Daphnin, $C_{15}H_{16}O_9$	From *Daphne Mezereum*	Daphnetin
Datiscin, $C_{21}H_{22}O_{12}$	From *Datisca cannabina*	Datiscetin
Dhurrin, $C_{14}N_{17}NO_7$	From *Sorghum vulgare*	Parahydroxybenzaldehyde and hydrocyanic acid
Digitalin, $C_{35}H_{56}O_{14}$	From *Digitalis purpurea*	Digitaligenin and digitalose
Digitonin	" " "	Digitogenin and galactose
Elaterin, $C_{20}H_{28}O_5$	From *Elaterium*	
Fraxin, $C_{32}H_{36}O_{20}$	From *Fraxinus Ornus*	Fraxetin
Gentiopicrin, $C_{20}H_{30}O_{12}$	From *Gentiana lutea*	Gentiogenin
Globularin, $C_{20}H_{44}O_{14}$	From *Globularia Alypum*	Globularetin
Glycyrrhizin, $C_{44}H_{63}NO_{18}$	From *Glycyrrhiza glabra*	Glycyrrhetin
Gratiolin, $C_{20}H_{34}O_7$	From *Gratiola officinalis*	Gratioletin and gratiolaretin
Gratiosolin, $C_{46}H_{84}O_{25}$	From *Gratiola officinalis*	Gratiosoletin
Helicin, $C_{13}H_{16}O_7$	From Salicin	Salicyl aldehyde
Indican, $C_{14}H_{17}NO_6$	From *Indigofera anil*	Indoxyl
Jalapin, $C_{68}H_{112}O_{32}$	From *Exogonium purga*	Jalapinol
Lotusin, $C_{28}H_{31}NO_{16}$	From *Lotus arabicus*	Lotoflavin and hydrocyanic acid
Ononin, $C_{30}H_{34}O_{13}$	From *Ononis spinosa*	Formonetin
Phillyrin, $C_{27}H_{34}O_{11}$	From *Phillyria latifolia*	Phillygenin
Phloridzin, $C_{21}H_{24}O_{10}$, N.N.R.	From the bark of the pear, apple, cherry and plum tree	Phloretin
Pinipicrin, $C_{22}H_{36}O_{11}$	From *Thuja occidentalis*	Ericinol
Populin, $C_{20}H_{22}O_8$	From different species of Populus	Benzoic acid, saliretin
Prophetin, $C_{23}H_{36}O_7$	From *Cucumis prophetarum*	Propheretin
Quercitrin, $C_{36}H_{38}O_{30}$	From *Quercus tinctoria*	Quercetin and rhamnose
Quinovin, $C_{38}H_{62}O_{11}$	From the bark of Cinchonas	Quinovic acid
Salicin, $C_{13}H_{18}O_7$	From different species of Salix and Populus	Saligenin
Santonin, $C_{15}H_{18}O_3$	From *Artemisia pauciflora*	Santoniretin
Saponin, $C_{32}H_{22}O_{12}$	From *Saponaria officinalis*	Saponetin
Sinigrin, $C_{10}H_{18}O_{10}NKS_2$	From *Sinapis nigra*	Allyl isothiocyanate
Thujin, $C_{20}H_{22}O_{12}$	From *Thuja occidentalis*	Thujigenin and thujetin
Xanthorhamnin, $C_{48}H_{66}O_{29}$	From *Rhamnus amygdalinus*	Rhamnetin

GENTIANA. U. S. Gentian

[Gentian.—Yellow Gentian Root]

Gentian is the dried rhizome and roots of *Gentiana lutea* Linné (Fam. *Gentianaceæ*).

Gentian yields not less than 30 per cent of water-soluble extractive.

Description—In nearly cylindrical pieces or longitudinal slices, about 25 mm. thick, the upper portion closely annulate, the lower portion longitudinally wrinkled; externally deep yellowish-brown; internally lighter; somewhat flexible and tough when damp; rather brittle when dry;

fracture uneven; the bark rather thick, separated from the somewhat spongy meditullium by a black cambium line; odor peculiar, faint, more prominent when moistened; taste sweetish and persistently bitter.

For further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Gentianæ Composita.

N. F. Preparations—Elixir Gentianæ (from Fluidextract); Elixir Gentianæ et Ferri (from Fluidextract); Elixir Gentianæ et Ferri Phosphatis (from Fluidextract); Elixir Gentianæ Glycerinatum (from Fluidextract); Extractum Gentianæ; Fluidextractum Gentianæ; Infusum Gentianæ Compositum; Pilulæ Antiperiodicæ (from Extract); Pilulæ Antiperiodicæ sine Aloe (from Extract); Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ (from Extract); Tinctura Amara; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe; Tinctura Rhei et Gentianæ.

Gentian contains the glucoside *gentiopicrin*, $C_{20}H_{30}O_{12}$ (which splits, when heated with dilute acids, into gentiogenin and glucose), *gentisic acid*, $C_{14}H_{10}O_5$, pectin, sugar (*gentianose*), and a little fixed oil. A dark green coloration is produced when a ferric salt is added to a preparation of gentian; this is said to be due to the reaction with gentisic acid. If the preparation is treated with ferric hydroxide, and then filtered, or if mixed with an alkaline citrate, the tendency to become discolored is lost.

Uses—Gentian is a bitter tonic. Dose, fifteen grains (1 Gm.).

CALUMBA. U. S. Calumba

[**Calumb.**—Columba, Columbo, Colombo]

Calumba is the dried root of *Jateorrhiza palmata* (Lamarck) Miers (Fam. *Menispermaceæ*).

Calumba yields not more than 2.5 per cent of acid-insoluble ash.

Description—In nearly circular disks, 3 to 6 cm. in diameter, externally greenish-brown and wrinkled, internally yellowish or grayish-yellow, depressed in the center, with a few interrupted circles of projecting wood-bundles, distinctly radiate in the outer portion; fracture short, mealy, odor slight; taste mucilaginous, slightly aromatic, very bitter.

U. S. P. Preparation—Tinctura Calumbæ.

N. F. Preparation—Fluidextractum Calumbæ.

This African root owes its virtues to a number of principles, the most important being *columbin*, $C_{21}H_{22}O_7$, and *berberine*, both of which are very bitter; starch and colombic acid are present, with a mucilage which is often troublesome by interfering with percolating operations. Calumba must not be in very fine powder if it is to be percolated with diluted alcohol.

Uses—It is a bitter tonic. Dose, thirty grains (2 Gm.).

QUASSIA. U. S. Quassia

[**Quass.**—Bitter Wood]

Quassia is the wood of *Picrasma excelsa* (Swartz) Planchon, known in commerce as Jamaica Quassia, or of *Quassia amara* Linné, known in commerce as Surinam Quassia (Fam. *Simarubaceæ*).

Description—*Jamaica Quassia*—Usually in chips, raspings or shavings, occasionally in small cubes or billets; yellowish-white or bright yellow, with a few light gray pieces somewhat coarsely grained; fracture tough, fibrous. Odor slight; taste bitter.

Surinam Quassia—The crude drug and microscopic sections closely resemble the Jamaica variety; tracheæ usually single or in pairs, sometimes in groups of 3 or 4; medullary rays in narrower and larger groups than in the Jamaica variety, from 1 to 4 cells wide and from 10 to 30 rows deep; calcium oxalate crystals few or entirely absent, thus distinguishing the variety from Jamaica Quassia.

For further description see the U. S. P. X.

N. F. Preparations—Fluidextractum Quassiæ; Tinctura Quassiæ.

Quassia contains *quassin* (*picrasmin*), $C_{32}H_{44}O_{10}$, which is intensely bitter, and soluble in both alcohol and water; there are also present resin, mucilage, etc.

History—The drug was sent to Linnaeus in 1763 by one of his correspondents in Surinam, with the statement that it was the basis of a valuable secret remedy employed by a negro slave named "Quassi". Linnaeus therefore named the plant Quassia.

Uses—It is a bitter tonic. Dose, eight grains (0.5 Gm.).

DIGITALIS. U. S. Digitalis

[**Digit.**—Foxglove, Digitalis Folium P. I.]

Digitalis is the dried leaf of *Digitalis purpurea* Linné (Fam. *Scrophulariaceæ*).

Digitalis, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose (the minimum dose producing in one hour a stoppage of the ventricle of the heart in systole) not exceeding 0.006 cc. of tincture, equivalent to 0.00,000,05 Gm. of ouabain for each gram of body weight of frog. It contains not more than 2 per cent of browned leaves, stems, flowers, or foreign organic matter, and yields not more than 5 per cent of acid-insoluble ash.

Description—From 10 to 30 cm. long; ovate or ovate-oblong, narrowed into a petiole; crenate; dull green, densely and finely pubescent; wrinkled above; paler and reticulate beneath; midrib near the base broad; odor slight, somewhat tea-like; taste bitter, nauseous.

For a further description see the U. S. P. X.

Assay—Prepare a tincture according to the official process and proceed as directed under *Tinctura Digitalis*.

This assay is explained on page 1504.

U. S. P. Preparations—Infusum Digitalis; Tinctura Digitalis.

N. F. Preparations—Fluidextractum Digitalis; Pilulæ Digitalis, Scillæ et Hydrargyri; Pilulæ Opii, Digitalis et Quininæ.

Digitalis has been the subject of exhaustive investigation. The constituents which are recognized as being of the greatest importance are *digitalin*, a glucoside, *digitonin*, a saponin-like glucoside, *digitalein* (a mixture), and *digitoxin*. Other principles are also known, *digitoflavin*, *digitin*, *digitophyllin*, fat, etc. *Digitoxin*, $C_{34}H_{54}O_{11}$, is the chief active principle. It is given in a dose of 1/130 grain, but not more than 1/65 grain in twenty-four hours. Its effects must be carefully watched and the dose regulated accordingly. Much confusion exists concerning the commercial products sold as *digitalin*. The *French digitalin* of Nativelle (*Homolle's digitalin*) is very active; the dose is 1/250 to 1/40 grain. It must be used with caution. The *German digitalin* is chiefly digitonin, and is administered in a dose of 1/10 to 1/2 grain. *Digitalin, True* (*Schmiedeberg's Digitalin* or *Digitalinum Verum Kiliani*), $C_{35}H_{36}O_{14}$, is obtained commercially from German digitalin. Its dose is variable; 1/130 grain is usually given as the commencing dose. *Digitalein, crude*, is a mixture of glucosides from digitalis, prepared according to the process of Schmiedeberg. The dose is 1/60 to 1/30 grain, several times daily.

History—The common name Foxglove is a corruption of an old vernacular name "foxes glew" which meant "foxes music". The Norwegian name means "fox bells". The German name "finger hut" means thimble, and Füchs a German botanist of the sixteenth century Latinized this name as Digitalis. It was first official in the London Pharmacopœia of 1650. Its later extensive use in medicine arose from the publicity given it by Dr. William Withering,

Birmingham, England, in 1785; hence the infusion has often been called *Withering's infusion.*

Uses—Digitalis is used as a cardiac tonic and stimulant, slowing and strengthening the heart beat. Dose, one and one-half grains (0.1 Gm.).

Digitalis Principles and Preparations

The following discussion is an abstract from the 1925 N. N. R and the active principles and preparations of Digitalis approved by the N. N. R. are appended.

The digitalis group embraces many crude drugs and proximate principles which have a peculiar action on cardiac muscle. Digitalis and strophanthus have been investigated far more than others and much more information is available concerning their action.

Cardiac Action—The cardiac action of the individual drugs of the digitalis group is similar and the claims made for the different preparations concern the removal of the disadvantages that have been experienced in the use of the drugs belonging to the digitalis group. The first disadvantage of digitalis medication is the varying strength of the crude drugs. This uncertainty can be avoided by the use of the isolated, definite principles or to a considerable extent by the use of physiologically standardized preparations. To the latter group belong the U. S. P. Tincture of Digitalis and the N. F. Fluidextract of Digitalis. The tincture is the more dependable preparation, the fluidextract being chiefly employed in veterinary practice.

Differences in Emetic Action—The digitalis principles are irritant to certain mucous membranes and the subcutaneous tissues and it has been deduced that the nausea and vomiting which sometimes follow the oral administration of these drugs result from irritation of the gastro-intestinal tract. It has been shown, however, that digitalis does not markedly irritate the stomach or intestines directly, but that its preparations cause nausea and vomiting almost entirely through their action on the heart itself. It has been shown, also, that the emetic action is roughly proportional to the cardiac effects of the various members of the group, and when this undesired action is induced it cannot, as a rule, be avoided by changing the mode of administration or by resorting to other members of the group.

Differences in Absorption—Digitalis and its preparations representing the entire drug and also digitoxin are absorbed fairly readily from the alimentary tract, and hence their actions may be limited to the therapeutic stage, whereas strophanthus and strophanthin are absorbed more slowly and irregularly with correspondingly greater difficulty in limiting their actions to those desired, when they are administered by the mouth. This disadvantage has been overcome by administering strophanthin intramuscularly or intravenously, in much smaller doses, however.

Differences in Cumulative Action—The effects of all the digitalis bodies are said to be cumulative. This cumulative effect is especially pronounced in the case of digitalis itself and digitoxin. It is much less pronounced in the case of strophanthus, strophanthin and true digitalin.

Digitalis Principles—The disadvantages of all the drugs of the digitalis group have served as a constant stimulus in the search for pure principles suitable for subcutaneous and intravenous administration; but despite the numerous investigations directed toward this end, the chemistry of digitalis and other members of the group is very imperfectly understood. Several digitalis principles have been isolated in a greater or less degree of purity. Of these, digitoxin and digitalin together represent very nearly the crude drug digitalis. The digitalin on the market, however, is not the true digitalin, but the different brands consist of mixtures of two or more principles.

It must be remembered, therefore, that Merck's "crystallized" digitalin, Merck's "pure" digitalin and the "true" digitalin of Boehringer and Soehne, which naturally might be supposed to be identical, differ somewhat in their action.

Proprietary Digitalis Preparations—Several digitalis preparations have been introduced into therapeutic use with the claim that they are composed either of pure principles, or of purified extracts of digitalis, and that they are devoid of certain disadvantages possessed by the preparations of the U. S. Pharmacopœia.

It may be said at once that there is no proof that any of these proprietary preparations can be used to greater advantage than digitalis and its galenicals in the majority of cases of cardiac disease.

Digalen Roche (Cloetta), N. N. R.—A sterile solution containing in each cubic centimeter 0.3 Gm. of an active derivative of digitalis as isolated by Cloetta, containing 7.5 per cent of alcohol.

It is a colorless or slightly yellowish liquid of an agreeable aromatic odor, with a sweet taste which subsequently becomes bitter.

The active derivative contained in digalen-Roche (Cloetta) is an amorphous, white or slightly yellow powder. It is stated to have a solubility five times as great as that of crystallized digitoxin. It is stated to dissolve readily in alcohol and in chloroform and less readily in ether. It has an intensely bitter taste and causes violent sneezing.

Manufactured by the Hoffmann-La Roche Chemical Works, New York. No U. S. patent.

Its uses are the same as for digitalis.

The average dose is from 1 to 2 cc. (15 to 30 minims). The maximum daily dosage is 6 cc. (90 minims). Digalen-Roche (Cloetta) is also suitable for intramuscular and intravenous injection. Intravenous injections of 1 cc. (15 minims) may be repeated at intervals of one-half to one hour as necessary.

U. S. trademarks 43,593; 83,738.

Digitalein, Crude, N. N. R.—**Digitaleinum Crudum**—A mixture of glucosides from *Digitalis purpurea* prepared according to the process of Schmiedeberg, containing digitoxin, digitalin and digitalein.

Commercial digitalein is an amorphous, yellowish-white, bitter powder, soluble in water and in absolute alcohol, insoluble in chloroform and in ether. The aqueous solution foams on shaking. The solution yields a precipitate on the addition of lead acetate, ammonia water or tannic acid.

Uses—Digitalein acts like digitalis on the heart.

Its uses are the same as those of digitalis.

The dose is from 0.001 to 0.002 Gm. ($\frac{1}{60}$ to $\frac{1}{30}$ grain), two or three times a day.

Digitalin, True, N. N. R.—**Digitalinum Verum Kiliani**—Schmiedeberg's Digitalin—$C_{35}H_{36}O_{14}$—A glucoside found in the seeds and leaves of *Digitalis purpurea* and derived commercially from "German" digitalin.

It is a white amorphous powder, or in characteristic, granular masses. It melts at 217° C. and becomes yellow. It is soluble in 1000 parts of water and in 100 parts of 50 per cent alcohol, but nearly insoluble in ether and chloroform. Digitalin dissolved in alcohol, and treated with very dilute acid and heat yields digitaligenin and two sugars.

Uses—The same as those of digitalis. Its action is not so persistent as that of digitoxin. True digitalin is more actively emetic than the other digitalis bodies in proportion to its cardiac activity, and it probably has no advantages over the better known members of the group.

Dose—It is impossible at present to state the correct dose for digitalinum verum Kiliani. Some authorities have given the same dose as that of digitoxin, whereas others correctly give it as much larger. At least, it is quite certain that digitalin is not so active as digitoxin. It is best given in pills made by trituration with sugar of milk and massing with glucose. Aqueous solutions of digitalin rapidly lose their strength and should be freshly prepared.

Digitalin, "French", N. N. R.—Homolle's Digitalin—Digitaline Amorphe—Digitaline Chloroformique—A mixture obtained from *Digitalis purpurea* by the method of Homolle, consisting mainly of digitalinum verum Kiliani.

"French" digitalin is a yellowish-white amorphous powder of a peculiar aromatic odor and little taste. It is neutral to litmus, almost insoluble in water, soluble in alcohol and chloroform and insoluble in ether. It softens at 90° C. and begins to melt at 100° C. It is not precipitated by solutions of lead salts, but with tannic acid it forms a tannate insoluble in water. Concentrated sulphuric acid dissolves digitalin "French", producing a yellow color, which finally changes to an emerald-green.

Uses—Its action is like that of digitoxin. Its uses are the same as those of digitalis.

Dose—What has been said with regard to the dose of digitalinum verum applies to the "French" digitalin; the dose is variously given as from 0.00025 to 0.002 Gm. ($\frac{1}{240}$ to $\frac{1}{30}$ grain). The maximum daily dose is 0.006 Gm. ($\frac{1}{10}$ grain). It must be used with caution and its action carefully watched.

Digitalin, "German", N. N. R.—**Digitalinum Germanicum**—A mixture of glucosides obtained from digitalis seeds according to the process of Walz, and consisting largely of digitonin, with digitalin verum and other glucosides.

Note—Digitonin is given as a synonym for crystallized digitalin by some manufacturers; and it is to be observed particularly that this is quite different from "true digitalin" or the "crystalline digitaline" of the French Pharmacopœia.

"German" digitalin is a yellowish-white amorphous powder, soluble in water and alcohol, insoluble in ether and chloroform. It is said to contain from about 50 to 60 per cent of digitonin and from 5 to 6 per cent of digitalinum verum, the remainder being digitalein and other glucosides.

Sulphuric acid containing a trace of ferric sulphate produces with digitalin "German", an intense golden-yellow coloration, changing to red and finally to a permanent reddish-violet.

Uses—These are similar to those of digitalis.

Dose—What has been said of the uncertainty of dosage of true digitalin must obviously apply with even greater force to "German" digitalin, since the activity of the latter probably depends mainly on the true digitalin that it contains. The dose of "German" digitalin was formerly given as 0.001 to 0.002 Gm. ($\frac{1}{60}$ to $\frac{1}{30}$ grain), maximum dose 0.004 Gm. ($\frac{1}{15}$ grain), with a maximum per day of 0.02 Gm. ($\frac{1}{3}$ grain). Many clinicians, however, have used very much larger doses without ill effects, and the relative activity of certain specimens of the "German" digitalin and other members of the group would seem to indicate that such specimens of "German" digitalin might be given safely in daily doses of a grain, or possibly more.

As "German" digitalin (so-called *digitalinum purum*) is a mixture of very powerful active principles, the proportion of which may vary with changes in the manipulations, it is important that the directions for its preparation as given in Hager's Handbuch der pharmacistischen Praxis, 1; 1032, 1903, should be carefully followed, and caution should be exercised to purchase only such products as the manufacturers can guarantee to have been made with the necessary care.

Digitoxin, N. N. R.—**Digitoxinum**—Digitaline Cristallisés (Nativelle)—$C_{34}H_{54}O_{11}$—A glucoside occurring in the leaves of *Digitalis purpurea*. It is the chief active principle of digitalis.

Digitoxin occurs in thin, colorless, rectangular, anhydrous leaflets, odorless and having a bitter taste. It is slightly soluble in water, ether and amylic alcohol; easily soluble in alcohol and in chloroform; insoluble in benzin or carbon disulphide; slightly soluble in fatty oils. Digitoxin should not melt below 240° C. If a fragment of digitoxin is dissolved in 2 cc. of glacial acetic acid containing a trace of ferric chloride and the solution poured on 2 cc. of concentrated sulphuric acid, a brown color should be produced at the zone of contact of the two liquids. This color gradually changes to green and finally to indigo blue; after half an hour the entire acetic acid layer will become blue. Digitoxin dissolves in cold, concentrated, hydrochloric acid to a colorless solution, but if this solution be heated on the water bath for some time a green color should be obtained.

Digitoxin dissolves in concentrated sulphuric acid with the production of a green color. If dried at 100° C., digitoxin should not lose more than 1 per cent of its weight (limit of *adhering moisture*).

Uses—Digitoxin acts much like digitalis.

The cardiac action of digitoxin is persistent, and when the therapeutic effects have passed off, a smaller amount will be required as a rule to reinstate the desired effects than were needed in the first instance. Locally, it is extremely irritant; hence it cannot be used for subcutaneous or intramuscular injection.

Dose—The toxicity of digitoxin, though very great, has been exaggerated, probably owing to the appearance of symptoms after too frequent repetition of the dose, and the single dose has been given as 0.00025 Gm. ($\frac{1}{240}$ grain), and a maximum daily dose of 0.001 Gm. ($\frac{1}{60}$ grain). These doses are undoubtedly too small when it is desired to induce the therapeutic action promptly, though they are approximately accurate when the dosage is to be continued for a time after the therapeutic effects are induced. A sharp distinction should, therefore, be made between the single or daily dose for *continued use* after the desired effects have been induced and the dose required at the beginning of treatment.

The beginning single dose is 0.0005 Gm. ($\frac{1}{120}$ grain), and the maximum beginning daily dose is 0.001 Gm. ($\frac{1}{60}$ grain). The dose must be reduced, or stopped, immediately when the therapeutic effect or toxic symptoms are induced.

Antidotes: Emetics, tannin, nitroglycerin, morphine, alcoholic stimulants or camphor.

Related Digitalis Principles

Cymarin, N. N. R.—A neutral, nonglucosidal substance obtained from *Apocynum cannabinum* or *Apocynum androsemifolium*.

Cymarin occurs as colorless, thick, prismatic crystals possessing a bitter taste. It is only slightly soluble in cold water, more soluble in hot water. It is with difficulty soluble in benzene, ether and carbon disulphide, but dissolves easily in acetone, alcohol and chloroform. When heated it begins to soften at 130° C. and becomes completely liquid at from 135° to 140° C. Cymarin is very sensitive even to weak organic acids, although it is not a glucoside.

Manufactured by Farbenfabriken, vorm. Friedr. Bayer & Company, and sold by the Winthrop Chemical Company.

Uses—Its uses are much like those of digitalis, but it is not absorbed so readily from the gastro-intestinal tract, at least in animals, and probably in man; hence it is better suited for those cases in which intramuscular or intravenous injection is required to elicit the action promptly. (The usual precautions are necessary.)

Dose—Single dose for *oral administration* 0.0003 Gm. ($\frac{1}{2000}$ grain); daily 0.001 to 0.002 Gm. ($\frac{1}{60}$ to $\frac{1}{30}$ grain). Single or daily dose by intravenous or intramuscular injection, 0.0005 to 0.001 Gm. ($\frac{1}{120}$ to $\frac{1}{60}$ grain). Cymarin is sold only in the form of Tablets of Cymarin and Ampuls of Cymarin Solution.

Ouabain, Crystallized, N. N. R.—Ouabanium—Crystallized Strophanthin—G-Strophanthin Thoms—$C_{30}H_{46}O_{12}.9H_2O$—A glucoside, obtained from *Acokanthera ouabaio* by Arnaud, or, as now commonly prepared, from *Strophanthus gratus*, in which case it is also called crystallized strophantin, or g-strophanthin Thoms (see also page 1069).

Uses—The pharmacologic action of crystallized ouabain is probably qualitatively identical to that of the official strophanthus or strophanthin, but the crystallized ouabain is more active than the official strophanthin when injected subcutaneously or intravenously. This action develops more rapidly, the drug is more quickly excreted, and shows less tendency to cumulative action than does digitalis.

Crystallized ouabain is used in place of strophanthus or strophanthin as a substitute for digitalis.

Ouabain forms colorless quadratic crystals which are easily soluble in hot water, soluble in 100 parts of cold water and 30 parts of cold absolute alcohol and 30 parts of amyl alcohol. It is slightly soluble in acetic ether, ether and chloroform. Its solubilities require further study. Solutions of 1 part of ouabain in 100 parts of 95 per cent alcohol have been frequently observed to deposit crystals on standing.

Dose—Ouabain is absorbed so slowly and so irregularly from the alimentary canal that the oral administration of the drug is not to be recommended and is even considered unsafe.

For intravenous or intramuscular administration the dose is 0.0005 Gm. ($\frac{1}{120}$ grain) and this dose should not be repeated as a rule within less than twenty-four hours. It is best employed dissolved in from 4000 to 8000 parts of physiologic solution of sodium chloride. When the intramuscular or intravenous dose is to be repeated within less than twenty-four hours, a smaller amount should be administered.

Since ouabain solutions may deteriorate rapidly, only recently prepared solutions or solutions which have been recently tested should be used.

Strophanthin, U. S. P.—**Strophanthinum**—For description, see page 1069.

Digipoten, N. N. R.—A mixture of the digitalis glucosides in soluble form, diluted with milk-sugar to give the preparation an activity equal to that of digitalis leaves of standard quality. It is standardized by the "one hour frog method". The minimum lethal dose of digipoten per gram of body weight of frog is 0.0006 Gm.; or the equivalent in digipoten of 0.0005 mg. of ouabain for each gram of body weight of frog. It is virtually free from digitosaponin.

Digipoten is a pale green powder, possessing the characteristic bitter taste of digitalis. It is soluble in water and in 25 per cent alcohol.

Uses—Digipoten has the same activity as digitalis leaf of good quality and may be used like the official drug with respect to indications and dosage.

Dose—The dose is the same as that of digitalis.

Manufactured by The Abbott Laboratories, Chicago.

Digitan, N. N. R.—First introduced as *digipuratum*—A digitalis preparation said to contain digitoxin and digitalin in the form of tannates. It is standardized biologically by the method of Gottlieb. It is claimed that in digitan 85 per cent of the inactive substances found in the ordinary extract have been removed and that it is free from digitonin.

Digitan is a greenish-yellow, odorless, bitter powder. The active constituents of digitan are insoluble in cold water and diluted acids, but are easily soluble in weak alkalies.

The uses and dose are the same as those of digitalis.

Manufactured by Merck & Company, New York.

Digitol, N. N. R.—A biologically standardized fat. Free tincture of digitalis similar to the U. S. P. X tincture.

Tincture No. 111 Digitalis, N. N. R.—A fat-free tincture of digitalis claimed to be 50 per cent stronger than the tincture of the U. S. P.

The dose must be correspondingly reduced. Manufactured by Parke, Davis and Company.

SCILLA. U. S. Squill

[Scill.]

Squill is the cut and dried fleshy inner bulb scale of the white variety of *Urginea maritima* (Linné) Baker (Fam. *Liliaceæ*).

Squill, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose (minimum dose producing in one hour a stoppage of the ventricle of the heart in systole) not exceeding 0.006 cc. of tincture, equivalent to 0.00,000,05 Gm. of ouabain, for each gram of body weight of frog.

Description and Physical Properties—*Unground Squill*—In irregular, curved or flattened pieces, from 0.5 to 5 mm. in length; yellowish-white, somewhat translucent; brittle when dry and tough and flexible when damp, odor slight, taste bitter, mucilaginous and acrid.

Structure—Upper and lower epidermal layers of thin-walled cells with few stomata; mesophyll of slightly elongated thin-walled cells, sometimes containing spheroidal aggregates of a sugar; occasional bundles of spiral and reticulate tracheæ; numerous, elongated mucilage cells containing raphides of calcium oxalate; few spheroidal starch grains in the parenchyma.

Powdered Squill—Light yellowish-brown; very hygroscopic, caking in moist atmosphere; raphides of calcium oxalate numerous, up to 1 mm. in length, isolated and in bundles imbedded in mucilage; fragments of thin-walled parenchyma with occasionally spiral and reticulate tracheæ; very few starch grains.

Assay—Prepare a tincture according to the official process and proceed as directed under *Tinctura Digitalis*.

For an explanation of this assay see page 1505.

Preserve in tightly-closed containers, in a dry place.

U. S. P. Preparations—Acetum Scillæ; Fluidextractum Scillæ; Syrupus Scillæ (from Vinegar); Syrupus Scillæ Compositus (from Fluidextract); Tinctura Scillæ.

N. F. Preparations—Mistura Pectoralis, Stokes' (from Fluidextract); Oxymel Scillæ (from Vinegar); Pilulæ Digitalis, Scillæ et Hydrargyri.

Squill contains the bitter principle *scillipicrin*, also *scillin*, and *scillitoxin* (*scillain*), a poisonous glucoside. There is also present a large quantity of mucilage analogous to dextrin, which Schmiedeberg calls *sinistrin* $(C_6H_{10}O_5)_n$; also calcium oxalate, etc. Water and alcohol extract its virtues.

Uses—It is expectorant, emetic, and diuretic. Dose, one and one-half grains (0.1 Gm.). It is sometimes used as a rat poison and is said to be very effective.

STROPHANTHUS. U. S. Strophanthus

[Strophanth.—Strophanthus Seed]

Strophanthus is the dried, ripe seed of *Strophanthus Kombé* Oliver or of *Strophanthus hispidus* De Candolle (Fam. *Apocynaceæ*), deprived of the awns.

Strophanthus, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose (the minimum dose producing in one hour a stoppage of the ventricle of the heart in systole) not exceeding 0.00,006 cc. of tincture, equivalent to 0.00,000,05 Gm. of ouabain, for each gram of body weight of frog.

Description—About 15 mm. long and 4 or 5 mm. broad, oblong-lanceolate, flattened and obtusely edged, grayish-green, covered with appressed, silky hairs, one side with a ridge extending into the attenuated, pointed end; kernel white and oily, consisting of a straight embryo, having two thin cotyledons, and surrounded by a thin layer of perisperm; nearly inodorous; taste very bitter.

Assay—Prepare a tincture by the official process and proceed as directed under *Tinctura Digitalis*.

This assay is explained on page 1505.

For a further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Strophanthi.

Strophanthus contains a glucoside, *strophanthin*, kombic acid, fatty matter, resin, extractive, etc. Strophanthin is the active principle. Alcohol and water extract it. Purified petroleum benzin is used to percolate the drug to deprive it of the fatty matter before exhaustion with alcohol in making the tincture.

Uses—Strophanthus is used as a cardiac tonic and stimulant in the dose of one grain (0.06 Gm.).

STROPHANTHINUM. U. S. Strophanthin

[Strophanthin.]

A glucoside or a mixture of glucosides obtained from *Strophanthus Kombé* Oliver (Fam. *Apocynaceæ*).

Preparation—This glucoside may be made by exhausting strophanthus with alcohol acidulated with hydrochloric acid, evaporating the liquid to a soft extract, treating this with water, and shaking the aqueous liquid with chloroform to remove the fatty matter; the aqueous liquid is evaporated to obtain the crystals of strophanthin.

Description and Physical Properties—A white or yellowish powder containing varying amounts of water, which it does not lose entirely without decomposition. It is stable in the air.

Caution—Strophanthin is extremely poisonous.

Strophanthin is soluble in water and in diluted alcohol, but less soluble in dehydrated alcohol. It is nearly insoluble in chloroform, ether, and benzene.

Tests for Identity and Purity—Solutions of Strophanthin are neutral to litmus paper, and are dextrorotatory.

Sulphuric acid added to Strophanthin produces an emerald-green color, changing to brown.

Add a trace of ferric chloride T.S. and a few cc. of sulphuric acid to an aqueous solution of Strophanthin (1 in 50): a red precipitate is produced, which turns dark green after one or two hours.

A solution of 0.1 Gm. of Strophanthin in 15 cc. of distilled water, when mixed with 5 cc. of hot alkaline cupric tartrate solution, produces no precipitate. On heating an aqueous solution to 70° C. with a small amount of diluted hydrochloric acid, the Strophanthin is hydrolyzed into strophanthidin, which precipitates, and a sugar, capable of reducing alkaline cupric tartrate solution, which remains in solution.

The ash from 0.1 Gm. is negligible.

Preserve in well-closed containers, protected from light.

Uses—Strophanthin is used as a cardiac stimulant in the following dose: by the mouth, 1/60 grain (0.001 Gm.); intravenous, 1/120 grain (0.0005 Gm.).

SALICINUM. U.S. Salicin

[Salicin.]

A glucoside [$C_{13}H_{18}O_7$] obtained from several species of *Salix* and *Populus* (Fam. *Salicaceæ*).

Preparation—A boiling concentrated decoction of the bark is treated with lead oxide or basic lead acetate until it becomes nearly colorless. Gum, tannin, and extractive matter, which would impede the crystallization of the salicin, are thus removed from the liquid; while a portion of the oxide is dissolved, in combination probably with the salicin. To separate this portion of oxide, sulphuric acid is first added, and then barium sulphide, and the liquor is filtered and evaporated. Salicin is deposited, and may be purified by repeated solution and crystallization. It has been produced synthetically from helicin. It may also be prepared by boiling the bark with milk of lime to remove tannin, evaporating the filtrate to a soft extract, digesting this with alcohol, distilling off the alcohol, and obtaining the salicin in crystals from the residue. Salicin is a glucoside, splitting into saligenin and sugar under the influence of dilute acids and heat.

Description and Physical Properties—Colorless, silky, shining needles or prisms, or a white, crystalline powder. It is odorless and has a very bitter taste.

One Gm. of Salicin is soluble in 23.5 cc. of water and in 88.5 cc. of alcohol, at 25° C. One Gm. is soluble in 3.3 cc. of water at 80° C., and in 30 cc. of alcohol at 60° C. It is soluble in chloroform and in ether.

Tests for Identity—Salicin melts between 199° and 202° C.

Its aqueous solution (1 in 30) is neutral to litmus paper, and is lævorotatory.

Heat a small portion of Salicin in a test tube until it turns brown, add a few cc. of distilled water, and a drop of ferric chloride T.S.: a violet color is produced.

With sulphuric acid Salicin gives a red color which disappears on the addition of distilled water.

Heat gently about 0.1 Gm. of Salicin with about 0.2 Gm. of potassium dichromate and 2 cc. of diluted sulphuric acid: the fragrant odor of salicylic aldehyde is developed.

Tests for Purity—Ash: not more than 0.05 per cent.

Ten cc. portions of an aqueous solution of Salicin (1 in 50) yield no precipitate on the addition of 1 cc. of tannic acid T.S., picric acid T.S., or mercuric potassium iodide T.S. (*alkaloids*), and another 10 cc. portion is not colored violet by a drop of ferric chloride T.S. (*salicylic acid*).

An aqueous solution of Salicin meets the requirements of the test for *heavy metals*, page 1519.

Preserve in well-closed containers.

Uses—Salicin is used in rheumatic conditions, in doses of fifteen to thirty grains (1 to 2 Gm.).

SANTONINUM. U.S. Santonin

[Santonin.]

The inner anhydride [$C_{15}H_{18}O_3 = 246.22$] of santoninic acid. It is obtained from *Artemisia pauciflora* (Ledebour) Weber (Fam. *Compositæ*).

Preparation—It is prepared from santonica which contains santonin, artemisin, resin, volatile oil, gum, etc., and is made by exhausting the santonica mixed with lime, using diluted alcohol, distilling off the alcohol, and adding acetic acid to the residue. The precipitated santonin is purified by dissolving

it in alcohol, treating with animal charcoal, and crystallizing. Santonin forms soluble compounds with alkalies, and it may be precipitated from its solutions by acids. Soluble compounds of santonin are unsuited for medicinal uses, because the comparative insolubility of santonin in neutral or acid liquids is one of its great advantages for use as an anthelmintic.

Description and Physical Properties—Colorless, shining, flattened rhombic prisms or a white, crystalline powder. It is odorless, and nearly tasteless at first, but afterwards develops a bitter taste. It is stable in the air, but rapidly becomes yellow on exposure to light.

Santonin is almost insoluble in cold water, and only slightly soluble in boiling water. One Gm. of Santonin is soluble in 43 cc. of alcohol, 1.7 cc. of chloroform, and in 110 cc. of ether, at 25° C. One Gm. is soluble in 6.5 cc. of boiling alcohol.

Tests for Identity—Santonin melts between 169° and 171° C.

Its solution in alcohol (1 in 50) is neutral to litmus paper.

Its solutions are lævorotatory.

Heat about 0.2 Gm. of Santonin with 2 cc. of alcoholic potassium hydroxide T.S.: a red color is developed.

Shake about 0.01 Gm. of Santonin with a cool mixture of 1 cc. each of sulphuric acid and distilled water, heat the solution to 100° C., and add a drop of dilute ferric chloride solution (1 volume of ferric chloride T.S. to 10 volumes of distilled water): a violet color results.

Tests for Purity—Ash: not more than 0.1 per cent.

The solution of 0.1 Gm. of Santonin in 2 cc. of sulphuric acid is not darker than pale yellow (*readily carbonizable substances*).

Boil 0.5 Gm. of Santonin with 20 cc. of distilled water and 2 cc. of diluted sulphuric acid, cool and filter: the addition of mercuric potassium iodide T.S. or of iodine T.S. to 10 cc. of the filtrate: mixed with 10 cc. of distilled water, produces no cloudiness even after standing for three hours (*alkaloids*).

Preserve in well-closed containers protected from light.

N. F. Preparations—Tabellæ Santonini; Tabellæ Santonini Compositæ.

Uses—Santonin is used as an anthelmintic, in doses of one to two grains (0.06 to 0.125 Gm.).

SANTALUM RUBRUM. U. S. Red Saunders

See Chapter LX on coloring principles.

SARSAPARILLA. U. S. Sarsaparilla

[Sarsap.]

Sarsaparilla is the dried root of *Smilax medica* Chamisso and Schlechtendal, known in commerce as Mexican Sarsaparilla; or of *Smilax officinalis* Kunth, or of an undetermined species of *Smilax* known in commerce as Honduras Sarsaparilla, or of *Smilax ornata* Hooker filius known in commerce as Central American or Jamaica Sarsaparilla (Fam. *Liliaceæ*).

Sarsaparilla contains not more than 2 per cent of foreign organic matter, excepting the rhizome and crown portion, which must be removed before the root is ground and powdered. Mexican Sarsaparilla yields not more than 4 per cent of acid-insoluble ash. The other official varieties conform to the standards for acid-insoluble ash under Vegetable Drugs, Part IX.

Description—Sarsaparilla is nearly odorless; taste mucilaginous, somewhat sweetish and acrid.

Unground Mexican Sarsaparilla—Long roots from 3.5 to 6 mm. in diameter, frequently attached to a crown having one or more stout stems; usually shrunken, forming sharp longitudinal ridges and broad furrows; externally light grayish-brown to dark brown; the furrows may contain more or less blackish earth; finely hairy; nearly devoid of branches or fibrous rootlets; fracture of cortex brittle, of central cylinder tough and fibrous; cortex mealy and whitish or brownish and horny, woody zone yellow and porous; pith whitish and distinct.

Unground Honduras Sarsaparilla—Long roots from 2 to 5 mm., rarely 6 mm. in diameter and bound together by roots of the same plant into compact cylindrical bundles from 8 to 15 cm. in diameter; externally reddish-brown or dark brown, longitudinally wrinkled or finely furrowed with occasional fibrous rootlets; fracture short, sometimes tough and fibrous in the central cylinder; internally a reddish-brown, dark brown, or occasionally light gray cortex, a light yellow and porous woody zone and a whitish pith.

Unground Central American Sarsaparilla—Roots long, from 1 to 4, rarely 5 mm. in diameter; externally light brown or reddish-brown, longitudinally wrinkled, occasionally nearly smooth,

rarely furrowed and bearing numerous coarse fibrous rootlets; fracture short or tough and fibrous in the central cylinder; internally a white or dark brown cortex, a yellow, porous, woody zone and a yellow or white pith.

For further description see the U. S. P. X.

U. S. P. Preparations—Fluidextractum Sarsaparillæ; Syrupus Sarsaparillæ Compositum (from Fluidextract).

Sarsaparilla contains a glucoside analogous to, if not identical with, saponin, termed *parillin*. When boiled with dilute acids, it splits into *parigenin* and grape sugar. There are also present starch, resin, coloring matter, and extractive. Alcohol and water are good solvents.

History—This drug was first used in Europe in the sixteenth century as a much vaunted remedy for syphilis. The origin of the name is involved in doubt.

Uses—It is popularly believed to be an alterative. Dose, thirty grains (2 Gm.).

SENEGA. U. S. Senega

[**Seneg.**—Seneca Snakeroot, Senega Snakeroot]

Senega is the dried root of *Polygala Senega* Linné (Fam. *Polygalaceæ*).

Senega contains not more than 5 per cent of stems and other foreign organic matter.

Description—Usually in pieces; when entire, slenderly conical, with an enlarged crown; from 3 to 15 cm. in length and from 2 to 10 mm. in thickness; tortuous, somewhat branched and bearing a few rootlets; crown knotty with numerous buds and short stem-bases; externally brownish-yellow, the crown darker and rose-tinted; longitudinally wrinkled, frequently with a distinct ridge or keel; fracture short, wood pale yellow; odor suggesting methyl salicylate; taste sweetish, afterwards strongly acrid.

For further description see the U. S. P. X.

U. S. P. Preparations—Fluidextractum Senegæ; Syrupus Senegæ (from Fluidextract); Syrupus Scillæ Compositus (from Fluidextract).

N. F. Preparation—Mistura Pectoralis, Stokes' (from Fluidextract).

Senega contains *senegin*, $C_{32}H_{54}O_{18}$, *polygalic acid*, fixed oil, pectose, etc. *Senegin* is analogous to, if not identical with, saponin. Alcohol and water are good menstrua for extracting its virtues. Liquid preparations of senega are very apt to gelatinize, owing to the presence of pectin; this is obviated by using solution of potassium hydroxide or other alkali to dissolve it.

Uses—Senega is a valuable expectorant. Dose, fifteen grains (1 Gm.).

ADONIS. N. F. Adonis

[**Adon.**—Pheasant's Eye]

Adonis is the dried overground portion of *Adonis vernalis* Linné (Fam. *Ranunculaceæ*).

Adonis contains not more than 5 per cent of foreign organic matter.

It contains *adonin* or *adonidin*, also *aconitic acid*.

Description—Glabrous, with the exception of the younger portions which may be slightly grayish-puberulent; stems from 15 to 50 cm. in length, thick, but soft and weak; shining, simple or branched, the branches mostly from near the base and similar to the main stem; naked below, except for some scale-like leaf-vestiges, densely leafy above: leaves from 2 to 4 cm. in length and two-thirds or more as broad, pinnately divided into several segments, the larger of which are again divided, the ultimate segments being narrowly linear and acute; flowers terminal, yellow but usually drying to a cream color, from 3 to 6 cm. in breadth; sepals five, green or grayish-puberulent, more than half the length of the petals, oblong, obtuse, finely nerved; petals from five to twenty, oblong, obtuse, finely nerved; stamens indefinite; pistils numerous, in fruit forming an ovoid, obtuse, dense head of ovoid akenes, which are tipped with the very small, persistent styles. Odor faint; taste bitterish, afterward somewhat acrid.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Adonidis.

Uses—A substitute for digitalis, slowing the heart and increasing the heart beat. It is also used as a diuretic. Dose, two grains (0.125 Gm.).

ALETRIS. N. F. Aletris

[**Aletr.**—Unicorn Root, Star Grass]

Aletris consists of the dried rhizome and root of *Aletris farinosa* Linné (Fam. *Liliaceæ*).

Aletris contains not more than 5 per cent of foreign organic matter and yields not more than 10 per cent of acid-insoluble ash.

It contains a bitter principle and large amounts of starch.

Description—Rhizome horizontal or slightly oblique, nearly cylindrical or laterally compressed above, from 2 to 4 cm. in length and from 5 to 12 mm. in diameter; externally grayish-brown, upper portion with circular stem scars from 3 to 7 mm. in diameter and with numerous leaf bases, the sides and lower portion with numerous tough wiry, whitish or reddish-brown roots which are more or less flexuous and provided with short branches; fracture short; internally light brown, cortex from 1 to 2 mm. in thickness, central cylinder with numerous twisted and branching fibro-vascular bundles. Odor slight, acetous; taste sweetish, somewhat bitter.

For further description see the N. F. V.

N. F. Preparation—Elixir Viburni Opuli Compositum; Fluidextractum Aletridis.

Uses—It is used as a diuretic and uterine tonic. Dose, thirty grains (2 Gm.).

BRAYERA. N. F. Brayera

[**Brayer**—Kousso, Cusso]

Brayera is the dried panicle of the pistillate flowers of *Hagenia abyssinica* (Bruce) Gmelin (Fam. *Rosaceæ*).

Brayera contains not more than 10 per cent of staminate flowers or other foreign organic matter, and yields not more than 5 per cent of acid-insoluble ash. Reject stems over 3 mm. in diameter and all binding material before powdering or using the drug.

It contains a bitter, resinous principle, *kosin*, $C_{31}H_{38}O_{10}$, about 24 per cent of tannin, volatile oil, gum, etc.

Description—Usually in rolls or flattened bundles from 25 to 50 cm. in length, reddish-brown or occurring more or less loose and stripped from the larger portions of the panicles. Panicle branches cylindrical, somewhat flattened, longitudinally furrowed or wrinkled, externally light brown to yellowish, tomentose, glandular; internally, cork brownish, bast- and wood-fibers yellow, fibro-vascular, bundles in wedges, pith large and yellowish-brown; nodes distinct, each with a scar or branch and subtended by a sheathing bract; internodes mostly from 1 to 2 cm. in length; flowers subtended by two ovate, reddish, pubescent and glandular bracts; pedicel short; calyx turbinate, pubescent below, subtended by four or five rigid, spreading, obovate, purple-veined bractlets which are persistent and elongated in fruit, alternating with and larger than the five usually shriveled, reflexed calyx lobes; petals five, caducous, and usually absent in the drug; carpels two; styles exserted, stigmas broad and hairy with prominent papillæ; fruit an ovoid akene about 2 mm. in diameter, enclosed by the remains of the calyx. The staminate flowers are greenish-yellow, with about twenty fertile stamens. Odor slight; taste bitter.

N. F. Preparation—Infusum Brayeræ.

History—Bruce and other African travelers had described the tree which yields this drug but it was not used in Europe until a French physician named Brayer observed the effect of the drug as a tenifuge, when employed by a traveler who had been to Abyssinia. Brayer sent some of the drug to Kunth, the German botanist, who named the tree *Brayera anthelmintica;* hence the Latin name Brayera.

Uses—It is used as an anthelmintic. Dose, one-half ounce (15 Gm.).

CASCARA AMARGA. N. F. Cascara Amarga

[**Cascar. Amarg.**—Honduras Bark]

Cascara Amarga is the dried bark of an undetermined species of *Picramnia* (Fam. *Simarubaceæ*).

Cascara Amarga contains not more than 2 per cent of foreign organic matter.

Description and Tests—(See the N. F. V.)

Preparations—Fluidextractum Trifolii Compositum, Syrupus Trifolii Compositus.

Uses—A bitter tonic said to have specific alterative properties. *Dose*, 15 grains (1 Gm.).

CAULOPHYLLUM. N. F. Caulophyllum

[**Cauloph.**—Blue Cohosh, Papoose Root, Squaw Root]

Caulophyllum is the dried rhizome and root of *Caulophyllum thalictroides* (Linné) Michaux (Fam. *Berberidaceæ*).

Caulophyllum contains not more than 3 per cent of foreign organic matter and yields not more than 4 per cent of acid-insoluble ash.

It contains a glucoside, *leontin*, also said to contain an alkaloid, *caulophylline*, resin, starch, etc.

Description—Rhizome of horizontal growth, from 7 to 25 cm. in length and from 5 to 15 mm. in thickness, much branched, slightly compressed from above, bearing large cup-shaped stem scars on the upper surface, underneath a tangled or matted mass of long, curved, thin, tough roots which frequently conceal the rhizome; both rhizome and roots of a grayish or yellowish-gray color; fracture tough and woody. Odorless but sternutatory; taste bitter-sweet and acrid.

N. F. Preparation—Fluidextractum Caulophylli.

Uses—It is used as an antispasmodic and emmenagogue. Dose, eight grains (0.5 Gm.).

CENTAURIUM. N. F. Centaury

[Centaur.]

Centaury is the dried flowering herb of *Erythræa Centaurium* (Linné) Persoon (Fam. *Gentianaceæ*).

Centaury contains not more than 3 per cent of foreign organic matter.

It contains a bitter glucoside similar to those in gentian and chirata.

Description—Glabrous, from 1.5 to 5 dm. in height, much branched from the base, but little branched, if at all, from above; stems slender, sharply angled or narrowly winged, sparsely leafy; leaves opposite, entire, mostly three-nerved, sessile, those at the base obovate and obtuse, from 2 to 5 cm. in length, their base narrowed and petiole-like, those of above gradually changing to oval, then ovate or even lance-linear, acute; flowers in a terminal and at length compound cyme, rose-colored; calyx from 5 to 7 mm. in length, deeply five-parted, the tube short, sharply angled, lobes linear-attenuate with a sharp midrib; corolla tube nearly twice the length of the calyx, slender, the limb from 10 to 15 mm. in breadth, its lobes broadly oblong or oval; stamens five, exserted, bright-yellow, their anthers twisted when old; pistil two-carpelled. Odor faint but characteristic; taste persistently bitter.

For further description see the U. S. P. X.

N. F. Preparation—Tinctura Amara.

Uses—It is a bitter tonic. Dose, thirty grains (2 Gm.).

CHIONANTHUS. N. F. Chionanthus

[Chionanth.—Fringe Tree Bark]

Chionanthus is the dried bark of the root of *Chionanthus virginica* Linné (Fam. *Oleaceæ*).

Chionanthus contains not more than 5 per cent of wood and other foreign organic matter. It yields to 70 per cent of alcohol not less than 25 per cent of non-volatile extractive.

It contains a bitter principle and probably saponin.

Description—Usually in transversely curved pieces, occasionally in single quills from 1 to 10 cm. in length; bark from 2 to 10 mm. in thickness; heavy, some pieces of the whole drug sinking when thrown into water; outer surface usually reddish-brown, occasionally grayish-brown, with few transverse wrinkles, whitish cork patches and root scars; inner surface yellowish-brown, more or less striate and undulate; fracture short, hard, and coarsely granular due to projecting groups of stone cells: the broken surface of a light yellowish-white color. Odor characteristic; taste bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Chionanthi.

Uses—It has been used as a diuretic in hepatic and syphilitic disorders.

CHIRATA. N. F. Chirata

[Chirat.]

Chirata is the dried plant of *Swertia Chirayita* (Roxburgh) Lyons (Fam. *Gentianaceæ*). It contains a bitter glucoside, *chiratin*, $C_{26}H_{48}O_{15}$, and a bitter principle, $C_{13}H_{20}O_{10}$.

Chirata contains not more than 3 per cent of foreign organic matter.

Description—Smooth, root simple, about 7 mm. in thickness near the crown stem, about 1 M. in length, externally yellowish- or purplish-brown; cylindrical near the base, quadrangular and slightly winged above, with numerous opposite, ascending branches; wood yellowish, thin, enclosing usually a large yellowish easily separable pith; leaves opposite, sessile, ovate-lanceolate, entire, five-nerved, about 6 cm. in length; flowers numerous, panicled, small, with a four-lobed calyx and corolla, capsule ovoid, acute, one-celled, many seeded. Odor slight; taste intensely bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Chiratæ.

Uses—It is used as a bitter tonic. Dose, fifteen grains (1 Gm.).

COCILLANA. N. F. Cocillana

[Cocillan.—Grape Bark]

Cocillana is the dried bark of *Guarea Rusbyi* (Britton) Rusby (Fam. *Meliaceæ*).

Cocillana contains not more than 5 per cent of wood or other foreign organic matter.

It contains resins and an active principle claimed by some to be an alkaloid, by others to be a glucoside.

Description—In flat or curved pieces of variable size and from 3 to 5 mm. in thickness; outer surface shallowly or deeply fissured, according to age and thickness, gray-brown, often ashy-gray

from lichen growths, or of a deeper brown where the cork has been removed; inner surface of medium brown color, strongly and coarsely longitudinally striate, the striæ straight or wavy; inner bark much thicker that the outer, its fracture coarsely splintery-fibrous. Odor characteristic; taste slightly astringent, peculiar and slightly nauseous.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Cocillanæ.

Uses—It is used as an expectorant; similar to ipecac in many respects. Dose, fifteen grains (1 Gm.).

CONDURANGO. N. F. Condurango

[Conduran.]

Condurango is the dried bark of *Marsdenia Condurango* (Triana) Nichols (Fam. *Asclepiadaceæ*).

Condurango contains not more than 2 per cent of wood or other foreign organic matter.

It contains resin, tannin, and a bitter glucoside, *condurangin*. *Conduransterin*, cinnamic acid, and a minute quantity of an alkaloid are also said to be present.

Description—In quills or transversely curved pieces, usually from 4 to 13.5 cm. in length; bark 1 to 6 mm. in thickness; outer surface light grayish-brown to dark brown, nearly smooth and with numerous lenticels, or more or less scaly and considerably roughened; the scales soft, occasionally with brownish-black apothecia of a fungus; inner surface grayish-white or light brown, longitudinally striate; fracture short-fibrous and granular. Odor slightly aromatic, especially marked in the fresh drug; taste bitter and aromatic.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Condurango.

Uses—It is used as an alterative and stomachic. Dose, one drachm (4 Gm.).

CONVALLARIÆ RADIX. N. F. Convallaria Root

[Conval. Rad.—Lily-of-the-Valley Root]

Convalleria Root consists of the dried rhizome and roots of *Convallaria majalis* Linné (Fam. *Liliaceæ*).

Convalleria Root contains not more than 5 per cent of leaves or other foreign organic matter and yields not more than 6 per cent of acid-insoluble ash.

This drug contains *convallarin*, a glucoside, which is split into *convallaretin* and glucose by the action of dilute acids; it also contains another glucoside, *convallamarin* ($C_{23}H_{44}O_{12}$), which is the active principle. The fluidextract is the best preparation.

Description—Rhizome horizontal, elongated, usually branched, cylindrical, variable in length, from 1 to 3 mm. in diameter; externally yellowish-white or pale brown, with a few circular stem scars, and from the under and side portions at the nodes usually arise from three to five thin, tortuous, dark brown, branching roots; fracture short or fibrous; internally whitish. Odor faint; taste sweetish, becoming bitter and acrid.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Convallariæ Radicis.

Uses—Convallaria is a cardiac stimulant, and is often used in place of digitalis. Dose, eight grains (0.5 Gm.).

CORNUS. N. F. Cornus

[Dogwood Bark]

Cornus is the dried root bark of *Cornus florida* Linné (Fam. *Cornaceæ*).

Cornus contains not more than 5 per cent of adhering wood or more than 2 per cent of other foreign organic matter.

It contains a bitter principle, *cornin*, or *cornic acid*, resin, fixed oil, tannin, etc.

Description—In irregular, chip-like pieces, or portions of quills, usually less than 5 cm. in length and from 1 to 4 mm. in thickness; externally of a dingy-brown color, lightly fissured and thinly scaly, or reddish where the corky layer has been removed; inner surface varying from pinkish-brown to red-purple, usually harsh to the touch from numerous short striæ; fracture short, the surface whitish with yellow striæ, except the inner layer, which is light purple. Odor slight; taste bitter and astringent.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Corni.

Uses—It is a mild astringent and stomachic; formerly it was believed to act as an antiperiodic. Dose, thirty grains (2 Gm.).

CROCUS. N. F. Crocus

[Saffron]

Saffron is the stigma of *Crocus sativus* Linné (Fam. *Iridaceæ*).

Saffron contains not more than 10 per cent of the yellow styles or more than 2 per cent of other foreign matter and yields not more than 7.5 per cent of total ash.

It contains a bitter principle, *picro-crosin*, or *saffron-bitter*, $C_{38}H_{66}O_{17}$, and *crocin*, $C_{44}H_{70}O_{28}$, a glucoside. It also contains volatile oil.

Description—Stigmas 3, united or separate, attached to the summit of the style; usually about 25 mm. in length, cornucopia-shaped, of a dark, rich red color, the margin dentate or fimbriate; styles about 10 mm. in length, more or less cylindrical, solid, yellowish. Odor strong, peculiarly aromatic; taste bitterish, aromatic. When chewed it colors the saliva orange-yellow.

For further description see the N. F. V.

N. F. Preparations—Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe; Tinctura Croci; Tinctura Opii Crocata.

Uses—It has been used as an anodyne, antispasmodic, and emmenagogue, but is of little value. It is also used as a coloring agent.

FARFARA. N. F. Coltsfoot

[Coltsfoot Leaves, Tussilago Leaves]

Coltsfoot is the dried leaf of *Tussilago Farfara* Linné (Fam. *Compositæ*).

Coltsfoot contains not more than 3 per cent of foreign organic matter and yields not more than 4 per cent of acid-insoluble ash.

It contains a bitter glucoside, tannin, resin, gum, etc.

Description—Petioles long, pubescent; blades very brittle, nearly orbicular or broadly ovate-reniform, from 8 to 15 cm. in length and nearly as broad, deeply cordate at the base, angulately lobed and dentate with red-brown teeth, palmately five- to nine-veined; young leaves white floccose all over, the older leaves with upper surfaces dark green and nearly smooth, the younger densely white floccose. Odor indistinct; taste mucilaginous, faintly herbaceous, bitter.

N. F. Preparation—Species Pectorales.

Uses—It is used as a demulcent and tonic. Dose, one drachm (4 Gm.).

GOSSYPII CORTEX. N. F. Cotton Root Bark

[Gossyp. Cort.]

Cotton Root Bark is the recently-gathered air-dried bark of the root of one or more of the cultivated varieties of *Gossypium herbaceum* Linné, or of other species of *Gossypium* (Fam. *Malvaceæ*).

Cotton Root Bark contains not more than 5 per cent of wood or other foreign organic matter.

It contains a yellow resin, *chromogene*, which becomes red on exposure to air, also fixed oil, tannin, starch, sugar, etc.

Description—In flexible bands or quilled pieces, attaining a length of 30 cm. and a thickness of about 1 mm.; outer surface orange-brown, smooth, slightly wrinkled, with small circular lenticels, the outer corky layer frequently exfoliated and showing the more or less fissured and fibrous middle bark; inner surface light brown, longitudinally striate; fracture tough, fibrous, the inner bark readily separable into fibrous layers. Odor slight; taste very slightly acrid.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Gossypii Corticis.

Uses—It is used as an emmenagogue. The fresh bark, which is now official, is said to be much more active than old bark. Dose, thirty grains (2 Gm.).

HELONIAS. N. F. Helonias

[Helon.—False Unicorn]

Helonias is the dried rhizome and roots of *Chamælirium luteum* (Linné) A. Gray (Fam. *Liliaceæ*).

Helonias contains not more than 5 per cent of foreign organic matter.

It contains about 10 per cent of an amorphous glucoside, *chamælirin*, soluble in alcohol and water. With acids this yields *chamæliretin*.

Description—Rhizome upright, or oblique, nearly cylindrical, from 0.5 to 3 cm. in length and about 1 cm. in diameter; externally grayish-brown, annulate from scars of bud-scales; upper portion with leaf bases enclosing a small bud; oblique rhizomes with a few stem scars about 0.5 mm. in diameter; lower portion with numerous whitish or pale yellowish, nearly straight or slightly curved wiry roots, from 5 to 8 cm. in length; fracture hard and horny; internally grayish-yellow, cortex from 3 to 4 mm. in thickness, central cylinder with three or four circles of small, nearly circular fibro-vascular bundles. Odor distinctive; taste bitter, slightly astringent.

For further description see the N. F. V.

N. F. Preparations—Elixir Aletridis Compositum; Elixir Heloniadis Compositum; Fluidextractum Heloniadis.

Uses—It is used in dropsy and also as a vermifuge in tape worm. Dose, thirty grains (2 Gm.).

HYDRANGEA. N. F. Hydrangea

[**Hydrang.**—Seven-Barks]

Hydrangea consists of the dried rhizome and roots of *Hydrangea arborescens* Linné (Fam. *Saxifragaceæ*).

Hydrangea contains not more than 3 per cent of foreign organic matter.

It contains about 1 per cent of a glucoside, *hydrangin*, said to have the formula $C_{34}H_{25}O_{11}$.

Description—Rhizome cylindrical, usually cut into pieces from 3 to 10 cm. in length and from 3 to 20 mm. in diameter; externally light brown to yellowish-brown with a pinkish tinge, longitudinally wrinkled, marked by few elliptical lenticels and occasional prominent buds, short branches or stem scars; from the lower surface arise a few coarse fibrous roots; fracture tough, splintery; internally yellowish-white or light brown, bark thin, easily separable from the distinctly radiate wood which surrounds a prominent whitish pith. Roots attaining a length of 25 cm. and a thickness of 2 mm., irregularly bent and branching, otherwise resembling the rhizome with the exception of the pith being absent. Inodorous; taste sweetish, becoming slightly acrid.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Hydrangeæ.

Uses—It is used as a diuretic. Dose, thirty grains (2 Gm.).

LAPPA. N. F. Lappa

[**Lapp.**—Burdock Root]

Lappa is the dried first year root of *Arctium Lappa* Linné, or of *Arctium minus* Bernhardi (Fam. *Compositæ*).

Lappa contains not more than 5 per cent of its leaf bases or more than 2 per cent of other foreign organic matter.

Description—Nearly simple, fusiform, of variable length, from 5 to 20 mm. in diameter near the crown; frequently split or in broken pieces, externally grayish-brown, longitudinally wrinkled, the crown somewhat annulate, sometimes surmounted by a woolly tuft of leaf remains; fracture somewhat horny; a dark cambium separating the thick brownish bark from the yellowish porous and radiate wood, centrally hollow or containing a white, pith-like tissue. Odor slight; taste mucilaginous, sweetish, and slightly bitter.

For further description see the U. S. P. X.

N. F. Preparation—Fluidextractum Lappæ.

Uses—It is used as a diuretic and alterative especially in chronic skin diseases. Dose, thirty grains (2 Gm.).

MELILOTUS. N. F. Melilot

[**Melilot.**—Yellow Melilot, Yellow Sweet Clover]

Melilot consists of the dried leaf and flowering top of *Melilotus officinalis* (Linné) Lamarck (Fam. *Leguminosæ*).

Melilot contains not more than 3 per cent of its stems over 3 mm. in diameter or other foreign organic matter.

It contains *cumarin* and has a pungent, bitterish taste.

Description—Stems mostly less than 3 dm. in length, slender, straight, mostly simple, often leafy below, terminating in long, slender racemes, the younger portions very finely pubescent; leaves glabrous or nearly so; petiolate, trifoliate, stipulate, the stipules subulate, entire, the leaflets from 1 to 3 cm. in length, varying from narrowly oblong to oval or occasionally broader above the middle, rounded, truncate, or slightly notched at the summit, sharply serrate; racemes 1 dm. or less in length, many flowered, the flowers yellow, from 5 to 6 mm. in length; calyx bell-shaped,

the fine nearly equal lobes shorter than the tube, corolla papilionaceous, the keel shorter than the other petals, which are about equal; legumes reflexed, from 2.5 to 3.5 mm. in length, obovate wrinkled, one-seeded. Odor aromatic, tonka-like; taste sweetish, slightly pungent and bitter.

For further description see the N. F. V.

N. F. Preparation—Species Emollientes.

Uses—It is used in diarrhea, dysmenorrhea, and rheumatism, also, in the form of cigarettes, for asthma and bronchitis, but is probably inert.

PHYTOLACCA. N. F. Phytolacca

[**Phytolac.**—Poke Root]

Phytolacca is the dried root of *Phytolacca americana* Linné (Fam. *Phytolaccaceæ*).

Phytolacca contains not more than 5 per cent of its stem bases or more than 2 per cent of other foreign organic matter.

It contains an amorphous, bitter, and acrid glucosidal substance, similar to saponin, which is the most active substance. There is present also a small amount of an alkaloid, *phytolaccine*, and *phytolaccic acid*.

Description—Cylindrical, somewhat tapering, sparingly branched from 3 to 7 cm. in thickness, mostly in transverse or longitudinal slices; externally yellowish-brown, finely longitudinally or spirally wrinkled and thickly annulate with lighter colored, low ridges; fracture fibrous, characterized by alternating layers of fibro-vascular tissue and parenchyma, the layers of the latter being much retracted. Odor slight; taste sweetish, afterwards highly acrid.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Phytolaccæ.

Uses—It is used as an alterative, in doses of two grains (0.125 Gm.), and as an emetic, in doses of fifteen grains (1 Gm.).

TRIFOLIUM. N. F. Trifolium

[**Trifol.**—Red Clover Blossoms]

Trifolium is the dried inflorescence of *Trifolium pratense* Linné (Fam. *Leguminosæ*).

Trifolium contains not more than 2 per cent of foreign organic matter.

It contains sugars and a bitter principle but none of the ingredients are very active.

Description—Heads ovoid with rounded summit, mostly from 12 to 25 mm. in length and breadth, shriveled, purplish and more or less brown from drying, consisting of many small papilionaceous flowers, crowded together and clothed at the base with broad, pointed ciliate stipules of a pale green color with darker veins, and which may or may not be accompanied by diminutive trifoliate leaves. Flowers from 12 to 15 mm. in length, longer than the four nearly equal teeth and shorter than the narrower fifth tooth; calyx-teeth subulate, tapering; petals united into a tube below, the standard longer than the wings but when recurved appearing shorter; stamens diadelphous (nine and one); style slender. Odor faintly aromatic and somewhat tea-like; taste sweetish, then slightly bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Trifolii.

Uses—It is used as an expectorant and alterative. Dose, one drachm (4 Gm.).

QUILLAJA. N. F. Quillaja

[**Quillaj.**—Soap-tree Bark]

Quillaja is the dried inner bark of *Quillaja Saponaria* Molina (Fam. *Rosaceæ*).

Quillaja contains not more than 5 per cent of the outer bark and not more than 1 per cent of foreign organic matter.

This South American bark owes its activity to a peculiar principle, *saponin*, $C_{32}H_{54}O_{18}$, a glucoside, splitting upon heating with dilute acid into *sapogenin* and sugar. Saponin is a sternutatory, white powder, soluble in alcohol and hot water; its aqueous solution froths when agitated, like soapsuds; it is found in several other drugs. Quillaja also contains calcium oxalate and calcium sulphate.

Description—In flat pieces of variable lengths, from 3 to 8 mm. in thickness, or in small chips; outer surface brownish-white, often with small patches of cork attached, otherwise nearly smooth; inner surface yellowish-white, nearly smooth, with occasional circular depressions, conical projections of transverse channels; fracture uneven and strongly fibrous, the laminæ oblique to each other. Odor slight; taste acrid. For further description see the N. F. IV.

N. F. Preparations—Liquor Picis Carbonis; Tinctura Quillajæ.

Uses—It is used principally for cleansing silk; in pharmacy it is used as an emulsifying agent, but, as saponin is not an inert substance, it is unfitted for this purpose. It is sometimes used in medicine, as a nauseating expectorant. Dose, three grains (0.2 Gm.).

TARAXACUM. N. F. Taraxacum

[Tarax.—Dandelion]

Taraxacum consists of the dried rhizome and roots of *Leontodon Taraxacum* Linné (Fam. *Compositæ*). Taraxacum contains not more than 2 per cent of foreign organic matter and yields not more than 4 per cent of acid-insoluble ash. Preserve Taraxacum in tightly-closed containers.

Taraxacum owes its bitterness to taraxacin, an acrid crystalline principle, soluble in alcohol and water. It also contains pectin, sugar, resin, gum, etc.

Description—Cylindrical or somewhat flattened, gradually tapering, usually in broken pieces from 6 to 15 cm. in length and from 5 to 15 mm. in thickness; externally brown or blackish-brown, longitudinally wrinkled, having numerous root and rootlet-scars; crown simple or branched with numerous leaf-bases showing annulate markings. Odor slight or inodorous; taste bitter.

For further description see the N. F. V.

N. F. Preparations—Elixir Gentianæ Glycerinatum (from Fluidextract); Elixir Taraxaci Compositum (from Fluidextract); Extractum Taraxaci; Fluidextractum Taraxaci.

Uses—It is used as a cholagogue and as a diuretic. Dose, two drachms (8 Gm.).

Unofficial Drugs Containing Glucosides or Bitter Principles

Arbutin, N. N. R.	A glucoside ($C_{12}H_{16}O_7.\frac{1}{2}H_2O$) occurring in the leaves of *Arctostaphylos uva ursi*, and other genera of the Fam. *Ericaceæ*. A urinary antiseptic and diuretic. Dose, 3 to 8 grains (0.2 to 0.5 Gm.) three or four times a day. Merck and Co., distributors
Azedarach Azedarach	The bark of the root of *Melia Azadirachta*. It contains a resinous principle, and is used as an emetic and anthelmintic, in doses of fifteen to thirty grains (1 to 2 Gm.)
Cassia Marilandica American Senna	Cathartic. Used in the form of infusion
Chamælirium Starwort	The rhizome of *C. luteum* and other species. It contains about 8 per cent of the glucoside *chamælirin*
Convallaria Flowers (N. F. IV) Lily-of-the-valley Flowers	The dried inflorescence of *Convallaria majalis* Linné (Fam. *Liliaceæ*). Its other constituents are similar to those in the root but in smaller amounts (see page 1075). A cardiac stimulant; dose, eight grains (0.5 Gm.)
Coronilla Scorpioides	Cardiac stimulant, diuretic
Frasera American Columbo	The root of *F. Walteri*, indigenous to the United States. It contains *gentisic acid* and *gentiopicrin*
Gillenia Gillenia	The rhizome of *G. trifoliata* and others, indigenous to the United States. It contains the bitter principle *gillenin*, resin, tannin, etc.
Gratiola Hedge Hyssop	From *G. officinalis*, indigenous to Southern Europe. It contains a bitter glucoside, *gratiolin*, etc.
Hedera Helix Ivy	Contains a glucoside, and hederic and tannic acids. Dose, twenty grains (1.3 Gm.) or more, dried and powdered, given in the atrophy of children
Helleborus Black Hellebore	The rhizome of *H. niger*, grown in Europe. It contains a crystalline glucoside *helleborin*, $C_{26}H_{44}O_{15}$
Ilex Holly	The leaves of different species of *Ilex*, indigenous to the United States. It contains *ilixanthin*, $C_{17}H_{22}O_{11}$, and *ilicic acid*
Ledum Marsh Tea	The leaves of *L. palustre*, grown in North America. It contains the glucoside *ericolin*, $C_{34}H_{56}O_{21}$; also about 1 per cent of volatile oil
Ligustrum Privet	The leaves of *L. vulgare*, indigenous to Southern Europe. It contains *ligustrin*, etc.
Liriodendron Tulip Tree Bark	The bark of *L. tulipifera*, found in the Northern United States. It contains *liriodendrin*, which occurs in white prisms
Lupinus Albus Lupin	Contains a glucoside, *lupinin*, $C_{29}H_{32}O_{16}$. The seeds are used as an anthelmintic, diuretic, and emmenagogue
Megarrhiza Californica (Man Root)	It contains a resinous substance called *megarrhizitin*, and a glucoside called *megarrhin*, possessing mydriatic properties
Menyanthes (N. F. IV) Buckbean Marsh Trefoil	The dried leaves of *Menyanthes trifoliata* Linné (Fam. *Gentianaceæ*). The chief constituent is the glucoside *menyanthin*, $C_{30}H_{46}O_{14}$; *meliatin* is also said to be present. It is used as a tonic. Dose, fifteen grains (1 Gm.)
Panax Ginseng	The root of *P. quinquefolium*, found in North America. It contains *panaquilon*, $C_{12}H_{25}O_9$
Phlorhizin, N. N. R. Phlorizin	A glucoside from the root of the apple, pear, cherry, etc., $C_{21}H_{24}O_{10}.2H_2O$. It has been used in malaria but is not recommended. Used to test the functional activity of the kidney. Dose, ¼ gr. (0.005 Gm.) in 15 min. (1 cc.) 0.5 per cent solution of sodium carbonate, by injection, for kidney test. Merck and Co., distributors
Picrotoxinum, $C_{30}H_{34}O_{13}$ Picrotoxin. (U. S. P. 1890)	A neutral principle obtained from the seed of *Anamirta paniculata* Colebrook (Fam. *Menispermaceæ*). Odorless, bitter, colorless crystals, or a microcrystalline powder, used as a tonic and antispasmodic, in doses of one-sixtieth grain (0.001 Gm.). Very poisonous in large doses
Piscidia Erythrina Jamaica Dogwood	Narcotic, anodyne. Dose of fluidextract is one fluidrachm (4 cc.), to be increased carefully
Prinos Black Alder	The bark of *Prinos verticillatus*. It contains a bitter principle. It is a tonic, astringent, and alterative
Rhus Toxicodendron Poison Ivy (U. S. P. 1890)	The fresh leaves of *Rhus radicans* Linné. Fam. *Anacardiaceæ*. It contains *toxicodendric acid*, fixed oil, etc. It is toxic, irritant, and rubefacient. Dose, five grains (0.32 Gm.)

Unofficial Drugs Containing Glucosides or Bitter Principles—*Continued*

Ruta Rue	The leaves of *R. graveolens*, which grows in Southern Europe. It contains a volatile oil and *rutin*, $C_{25}H_{28}O_{15}$, which occurs in needle-shaped crystals. Emmenagogue. Dose, fifteen to thirty grains (1 to 2 Gm.), two or three times a day, preferably given in infusion
Sabbatia American Centaury	A simple bitter. Dose, one drachm (4 Gm.), given in the form of fluidextract or decoction
Salix Willow	The bark of *Salix alba*, and of other species of Salix. It contains a glucoside, *salicin*, ($C_{13}H_{18}O_7$).
Saponaria Officinalis Soapwort Bouncing Bet	Contains a glucoside, saponin
Simaruba Simaruba	The bark of the root of *S. officinalis*, grown in South America. It contains a bitter principle, a volatile oil, etc. Tonic. Dose, from twenty to sixty grains (1.3 to 4 Gm.), best given in infusion
Taxus Yew	From *Taxus baccata*, grown in Asia. It contains volatile oil, *taxina*, etc.
Ustilago Corn Smut	From *Zea Mays*. It contains a principle analogous to sclerotic acid. Used as a parturient. Dose, fifteen to thirty grains (1 to 2 Gm.)
Verbena (N. F. IV) Blue Vervain	The dried over-ground portion of *Verbena hastata* Linné (Fam. *Verbenaceæ*), collected when flowering. It is said to contain a bitter glucoside, but has not been carefully investigated. It is a weak expectorant and diaphoretic in doses of fifteen grains (1 Gm.)
Viola Tricolor Pansy	The flowering herb of *Viola tricolor*. It contains a bitter principle, salicylic acid, etc. It is expectorant and alterative, in doses of fifteen to forty grains (1 to 2.6 Gm.)
White Ash Bark (N. F. IV)	The dried bark of *Fraxinus americana* Linné (Fam. *Oleaceæ*), and probably of other species of *Fraxinus* deprived of the corky layer. It contains a bitter glucoside, *fraxin*, $C_{16}H_{18}O_{10}$, and also *fraxetin*, $C_{10}H_8O_5$, tannin, etc. It is a bitter tonic and astringent. Dose, thirty grains (2 Gm.)

Drugs Containing Cathartic Principles, and their Preparations

ALOE. U.S. Aloe

Aloe is the inspissated juice of the leaves of *Aloe Perryi* Baker, known in commerce as Socotrine Aloe; of *Aloe vera* Linné, known in commerce as Curaçao Aloe; or of *Aloe ferox* Miller, known in commerce as Cape Aloe (Fam. *Liliaceæ*).

Aloe yields not more than 4 per cent of ash, not more than 10 per cent of moisture, and not less than 50 per cent of water-soluble extractive.

Aloe contains *aloin*, *emodin*, a trace of volatile oil, and a substance which has been improperly called resin. The aloin present in Socotrine aloe is *socaloin*, $C_{15}H_{16}O_7$. This may be distinguished from *nataloin* and *barbaloin* by tests found in the U. S. P. text.

Description—*Socotrine Aloe*—In yellowish-brown to blackish-brown, opaque, smooth and glistening masses; fractured surface somewhat conchoidal; odor characteristic.

Curaçao Aloe—In orange to blackish-brown, opaque masses; fractured surface uneven, waxy, somewhat resinous; odor characteristic, disagreeable.

Cape Aloe—In reddish-brown masses, usually covered with a yellowish powder, or in thin, transparent fragments, of a reddish-brown color; fracture smooth and glassy; odor characteristic, sour and disagreeable.

The taste of each variety of Aloe is nauseous and very bitter.

Tests for Identity—Powdered Aloe dissolves in nitric acid with effervescence, Socotrine Aloe forming a yellowish to reddish-brown solution; Curaçao Aloe, a deep red solution; Cape Aloe a reddish-brown solution, changing to purplish-brown and finally to greenish.

Intimately mix in a flask or bottle about 1 Gm. of powdered Aloe, accurately weighed, with 25 cc. of cold water, shake occasionally during two hours, transfer to a filter, tared after it has been dried over sulphuric acid, and wash with sufficient cold water to make the filtrate measure 100 cc.: the residue on the filter after drying over sulphuric acid should not exceed 50 per cent of the weight of powdered Aloe taken. The color of the filtrate, viewed in the bulb of a 100 cc. volumetric flask, is light yellowish-brown with Socotrine Aloe, reddish-brown with Curaçao Aloe, and yellowish with Cape Aloe. The filtrate darkens upon standing.

To 5 cc. of the filtrate mentioned above, add 2 cc. of nitric acid: the mixture is of a yellowish to yellowish-brown color with Socotrine Aloe; a deep red color with Curaçao Aloe; a reddish-brown color, changing to vivid green, with Cape Aloe.

To 5 cc. of the filtrate mentioned above, add 45 cc. of water and 20 cc. of sodium borate solution (1 in 20): a greenish fluorescence results and, upon standing, the liquid acquires a brownish color.

To 10 cc. of the filtrate mentioned above, add 90 cc. of water and shake with 10 cc. of benzene: upon separating the benzene layer, and adding to it 5 cc. of ammonia T.S., a permanent, deep rose color is produced in the lower layer.

For further description see the U. S. P. X.

Assay—Proceed as directed under water-soluble extractive, page 1523.

No aloin assay was adopted by the U. S. P. X, as it was found that the available methods would not estimate the aloin in Cape Aloes which was an important commercial variety. The following assay method was suggested by J. P. Snyder, and is used in estimating the value of aloes for the manufacture of aloin.

Assay of Aloe for Aloin

A sample of fifty grams of Aloe is mixed with about 300 cc. of hot water and 2 cc. of HCl and allowed to boil until solution results. Let stand until cool and decant the supernatant liquid from the separated resins completely. To the liquid add 50 cc. of strong ammonia, then add slowly with stirring, a solution of 15 Gm. of calcium chloride in 30 cc. of water. Let stand for fifteen or twenty minutes in order to insure complete precipitation. Then transfer to a 3-inch Buchner funnel and drain as dry as possible by using vacuum. Remove the cake from the funnel by tapping the sides and place between two layers of heavy filter paper, using six or eight sheets of paper on each side of the cake. Place in a letter press, or other convenient form of hand press and apply pressure until no more moisture can be squeezed from the cake. Separate the cake completely from the filter paper and place in an evaporating dish. Now break the cake up thoroughly with a glass rod and add HCl slowly, a few drops at a time until there is an excess of acid. Allow the aloin to crystallize completely, which usually requires about 30 minutes. Transfer to a Buchner funnel again and wash three or four times with a saturated aqueous solution of Aloin. Drain as dry as possible, squeeze out all moisture possible with a press as before and transfer the cake of moist aloin to a weighed dish. Dry at a low heat, not over 50° C. for several hours and weigh. This determination gives results in terms of dry aloin. Upon standing, this Aloin will take up from 2 to 3 per cent of moisture.

U. S. P. Preparations—Extractum Colocynthidis Compositum; Pilulæ Aloes; Tinctura Aloes; Tinctura Benzoini Composita.

N. F. Preparations—Pilulæ Aloes et Asafœtidæ; Pilulæ Aloes et Ferri; Pilulæ Aloes et Mastiches; Pilulæ Aloes et Myrrhæ; Pilulæ Aloes et Podophylli Compositæ; Pilulæ Aloes Hydrargyri et Scammonii Compositæ (from Tincture of Aloes and Myrrh); Pilulæ Antiperiodicæ (from Extract); Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ; Pulvis Aloes et Canellæ; Tinctura Aloes et Myrrhæ; Tinctura Antiperiodica (from Extract).

History—This drug was mentioned by Dioscorides in the first century of the Christian Era. He advised its use in doses of from one to three drachms, especially for *urbani et literatim cupidi* (city men and men of letters), *i.e.*, those of sedentary habits. It was an ingredient in the ancient *hieras* (see Pulvis Aloes et Canellæ) and in many compound pills and other laxative preparations.

Uses—Aloe is used as a cathartic and emmenagogue. Dose, four to twenty grains (0.25 to 1.3 Gm.).

ALOINUM. U. S. Aloin

[Aloin.]

A pentoside or mixture of pentosides obtained from aloe. It varies in chemical composition and in physical and chemical properties according to the variety of aloe from which it is obtained.

Aloin is usually made by dissolving 1 part of Curaçao or Barbadoes Aloes in 10 parts of boiling water acidulated with hydrochloric acid, and, after cooling, the liquid is decanted from the resinous matter, evaporated to about 2 parts, and set aside for two weeks for crystals to form. The crystals are washed with acetic ether and dried. Socaloin and nataloin are not often found in commerce, as the aloes from which they would be prepared are scarce and the products would be expensive.

Description and Physical Properties—A lemon-yellow to dark yellow microcrystalline powder or minute crystals. It is odorless, or has a slight odor of aloe. The taste is intensely bitter. Aloin darkens on exposure to light and air.

Aloin is soluble in water, alcohol, and acetone, the degree of solubility varying with its composition. It is also soluble in ammonia water and in solutions of alkali hydroxide, forming red solutions (or yellow solutions that soon become red) having a green fluorescence. It is slightly soluble in ether.

Tests for Identity—A saturated aqueous solution of Aloin is yellow, changing to brown on standing. The solution is neutral or not more than faintly acid to litmus paper.

Aloin is rapidly decomposed when added to alkaline solutions; when mixed with acid solutions, decomposition is slower.

A drop of ferric chloride T.S. added to an alcoholic solution of Aloin produces a brownish-green color.

Tests for Purity—Ash: not more than 0.5 per cent.

Shake 1 Gm. of Aloin with 10 cc. of benzene for one minute and filter; the filtrate imparts not more than a faint pink color to an equal volume of 5 per cent ammonia water when shaken with it (*emodin*).

Dissolve 1 Gm. of Aloin, accurately weighed, in 120 cc. of distilled water at 25° C. by shaking frequently during two hours. Collect the insoluble residue, if any, on a filter, or a Gooch crucible, tared after it has been dried at 100° C., and wash the residue with 25 cc. of distilled water: this residue when dried at 100° C. does not exceed 1.5 per cent.

Preserve in well-closed containers, protected from light.

N. F. Preparations—Pilulæ Aloini Compositæ; Pilulæ Aloini, Strychninæ et Belladonnæ; Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ; Pilulæ Laxativæ Compositæ.

Uses—Aloin is used as a cathartic, in doses of two grains (0.125 Gm.). The laxative dose is one-quarter to one grain (0.015 to 0.06 Gm.).

CASCARA SAGRADA. U. S. Cascara Sagrada

[**Casc. Sagr.**—RHAMNUS PURSHIANA]

Cascara Sagrada is the dried bark of *Rhamnus Purshiana* De Candolle (Fam. *Rhamnaceæ*).

NOTE—Cascara Sagrada should be collected at least one year before being used for making medicinal preparations.

The following review of the chemistry of cascara sagrada and other cathartic drugs is abstracted from an article by L. E. Warren *J. A. Ph. A.* 1924, page 254.

Cascara belongs to the drugs known as the "anthracene purgatives", the designation indicating that the active constituents are derivatives of the hydrocarbon, anthracene. This class of drugs includes one or more species of aloe, morinda, rhamnus, rhubarb, rumex, senna, xanthoxylum, and perhaps others.

It appears to be accepted that the active constituents of this group of drugs for the most part are derivatives of hydroxymethyl anthraquinone. More work has been done on rhubarb and aloe than on the other members of the group. Consequently the knowledge of the anthraquinone purgatives has been mostly obtained from these drugs rather than from cascara. The chief constituents isolated from cascara are compounds containing emodin, 1-4-6 trihydroxy 8-methyl anthraquinone, chrysophanol 1-4 dihydroxy 8-methyl anthraquinone and emodin monoethyl ether, 1-4 dihydroxy 6-methoxy 8-methyl anthraquinone. The position of the methyl group is not known with certainty. Its presence appears to have but little pharmacologic significance. Emodin and its compounds are present in much greater proportions in cascara than are the other anthraquinones. Most of the emodin is combined. Free emodin is a relatively weak laxative.

The exact composition of the anthraquinone complexes is not known but they are believed to be glucosides and pentasides since, on hydrolysis with mineral acids, they yield glucose or pentose and anthraquinone compounds. They are believed to produce catharsis by the slow hydrolysis of the anthraquinone complex through the action of a ferment in the lower bowel. It is believed by some that this ferment is activated by the presence of mineral salts such as calcium acid phosphate. It is known that the action of emodin-bearing drugs is enhanced if they are administered with certain ferments, such as emulsin. It has recently been found by Casparis and Godelin (*Schweiz, Ap. Ztg.*, 61, 389, 1923) that rhubarb extracts if prepared in a vacuum apparatus are nearly four times as effective when tested on white mice as similar extracts prepared in the usual way. This would suggest that the action of a ferment is necessary in the pharmacologic action of the anthraquinone purgatives, such a ferment being preserved by the low temperature of the vacuum, but killed or inactivated by the high temperature of ordinary evaporations. It is admitted that no chemical assay of the anthraquinone drugs is entirely successful. The most satisfactory method is that perfected by Daels (*Bull. Acad. Roy. Med. Belg.* (4), 27,350, 1913). It consists in extracting the anthraquinones from the drug with chloroform both before and after acid hydrolysis. The total anthraquinones are weighed and the results calculated as "free" and "combined" anthraquinones. In the case of rhubarb the Daels values have been found to parallel the physiologic assay moderately well if the physiologic test be made on extracts prepared by the vacuum method.

When ground Cascara Sagrada is moistened and mixed with a hydroxide (magnesium hydroxide or calcium hydroxide preferably) the drug loses its intensely bitter taste, the acid constituents being neutralized and apparently rendered insoluble. Such treatment seems to lessen its activity.

Description—Usually in flattened or transversely curved pieces, occasionally in quills; bark from 1 to 5 mm. in thickness; outer surface dark brown or brownish-red, longitudinally ridged, with grayish or whitish lichen patches, sometimes with numerous lenticels and occasionally with moss; inner surface longitudinally striate, light yellow to dark reddish-brown or dark brown in old matured bark; fracture short with projections of bast-bundles in the inner bark; odor distinct; taste bitter and slightly acrid.

For further description see the U. S. P. X.

U. S. P. Preparations—Extractum Cascaræ Sagradæ; Fluidextractum Cascaræ Sagradæ; Fluidextractum Cascaræ Sagradæ Aromaticum.

N. F. Preparations—Elixir Cascaræ Sagradæ (from Aromatic Fluidextract); Elixir Cascaræ Sagradæ Compositum (from Aromatic Fluidextract); Fluidglyceratum Cascaræ Sagradæ; Fluidglyceratum Cascaræ Sagradæ Aromaticum; Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ (from Extract); Syrupus Ficorum Compositus (from Aromatic Fluidglycerate).

Uses—Cascara Sagrada is a laxative. Dose, fifteen grains (1 Gm.).

RHEUM. U. S. Rhubarb

Rhubarb consists of the dried rhizome and roots of *Rheum officinale* Baillon or of *Rheum palmatum* Linné (Fam. *Polygonaceæ*) or other species of *Rheum* grown in China and Tibet, deprived of periderm tissues.

Rhubarb yields not less than 30 per cent of diluted alcohol-soluble extractive.

Description—In subcylindrical or flattened pieces, frequently showing a large perforation; from 5 to 17 cm. in length and from 4 to 10 cm. in diameter; outer surface yellowish-brown with lighter colored striations and occasional small patches of brown cork; more or less covered with yellowish-brown powder; hard; fracture uneven, showing stellate vascular bundles and a granular, yellowish or pinkish-brown mottled surface; odor aromatic, agreeable; taste bitter and astringent.

For further description see the U. S. P. X.

Assay—Proceed as under diluted alcohol-soluble extractive, page 1523.

U. S. P. Preparations—Extractum Rhei; Fluidextractum Rhei; Pulvis Rhei Compositus; Syrupus Rhei (from Fluidextract); Syrupus Rhei Aromaticus (from Aromatic Tincture); Tinctura Rhei; Tinctura Rhei Aromatica.

N. F. Preparations—Elixir Catharticum Compositum (from Fluidextract); Fluidglyceratum Rhei; Mistura Opii et Rhei Composita (from Tincture); Mistura Rhei Alkalina (from Fluidextract); Mistura Rhei Composita (from Fluidextract); Pilulæ Antiperiodicæ; Pilulæ Antiperiodicæ sine Aloe; Pilulæ Rhei; Pilulæ Rhei Compositæ; Pulvis Rhei et Magnesiæ Anisatus; Syrupus Sennæ Aromaticus; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe; Tinctura Rhei Aquosa; Tinctura Rhei Dulcis; Tinctura Rhei et Gentianæ.

Rhubarb contains *chrysophanic acid*, or dioxymethylanthraquinone, $C_{15}H_8O_2(OH)_2$; *emodin*, or trioxymethylanthraquinone, $C_{15}H_7O_2(OH)_3$; *rhein*, or tetraoxymethylanthraquinone, $C_{15}H_{10}O_6$; *rhabarberon*, $C_{15}H_{10}O_5$; and the resins, *erythroretin*, *phæretin*, and *aporetin*. The astringent properties of rhubarb are due to *rheotannic acid*, $C_{26}H_{26}O_{14}$; calcium oxalate is also present.

Uses—The therapeutic properties of rhubarb depend upon the valuable natural combination of its cathartic and astringent constituents. It is given in doses of ten to twenty grains (0.6 to 1.3 Gm.).

SENNA. U. S. Senna

[Senn.]

Senna consists of the dried leaflets of *Cassia Senna* Linné, known in commerce as Alexandria Senna, or of *Cassia angustifolia* Vahl, known in commerce as Tinnevelly Senna (Fam. *Leguminosæ*).

Senna contains not more than 10 per cent of its stems, and not more than 2 per cent of its pods or other foreign organic matter, and yields not more than 3 per cent of acid-insoluble ash.

Description—*Alexandria Senna*—Inequilaterally lanceolate or lance-ovate, frequently broken; from 2 to 3.5 cm. in length and from 6 to 10 mm. in width, unequal at the base, with very short, stout petioles; acutely cuspidate, entire, brittle, subcoriaceous; hairs short and somewhat appressed, few on the upper surface, more numerous on the lower surface, where they occur spreading on the midrib, especially on the lower part; color light grayish-green; odor characteristic; taste mucilaginous, slightly bitter.

Tinnevelly Senna—Usually unbroken, from 2 to 5 cm. in length, from 6 to 15 mm. in width; broadly acute at the apex, slightly hairy; light yellowish-green and otherwise resembling Alexandria Senna.

For further description see the U. S. P. X.

U. S. P. Preparations—Fluidextractum Sennæ; Pulvis Glycyrrhizæ Compositus; Syrupus Sennæ (from Fluidextract).

N. F. Preparations—Confectio Sennæ; Elixir Cascaræ Sagradæ Compositum (from Fluidextract); Elixir Catharticæ Compositum (from Fluidextract); Infusum Sennæ Compositum; Species Laxativæ; Syrupus Ficorum Compositus; Syrupus Sennæ Aromaticus.

Senna, according to Tschirch, contains *anthroglucosennin, emodin, chrysophanic acid,* isoemodin, glucosennin, sennanigrin, and sennarhamnetin. Emodin and chrysophanic acids are oxymethylanthraquinones upon which the cathartic action is believed to depend. *Cathartic acid* was formerly believed to be the chief purgative principle. When senna leaves are macerated in strong alcohol, the principles which produce griping and give odor and taste are said to be dissolved, while the purgative properties are unaffected. Water and diluted alcohol are good solvents for its virtues. It is an important ingredient in the compound powder of glycyrrhiza.

Uses—Senna is a cathartic. The dose is one to four drachms (4 to 16 Gm.), when given in infusion.

CHRYSAROBINUM. U. S. Chrysarobin

[Chrysarob.]

A mixture of neutral principles obtained from Goa powder, a substance deposited in the wood of *Vouacapoua Araroba* (Aguiar) Druce (Fam. *Leguminosæ*).

Description and Physical Properties—A brownish or orange-yellow, microcrystalline powder. It is tasteless, odorless, and irritating to the mucous membrane.

Chrysarobin is very slightly soluble in water. One Gm. dissolves in 385 cc. of alcohol, 30 cc. of benzene, 180 cc. of carbon disulphide, 13 cc. of chloroform, and in 160 cc. of ether, at 25° C.

Tests for Identity—Chrysarobin dissolves in solutions of alkali hydroxides and in sulphuric acid, producing deep red solutions. On pouring the sulphuric acid solution into water, Chrysarobin is deposited unchanged.

Mix about 0.002 Gm. of Chrysarobin with 2 drops of fuming nitric acid: a red-brown mixture is produced which becomes violet-red on the addition of a few drops of ammonia T.S. (*difference from chrysophanic acid,* which produces a yellow liquid).

Tests for Purity—Boil 0.1 Gm. of Chrysarobin with 20 cc. of distilled water, and filter: the filtrate is neutral to litmus paper.

Ash: not more than 0.25 per cent.

Preserve in well-closed containers, protected from light.

U. S. P. Preparation—Unguentum Chrysarobini.

Uses—Chrysarobin has been largely used in certain skin diseases, notably psoriasis. It has fallen into disuse mainly on account of the almost indelible stain produced upon the skin and clothing when it is employed. Internally, chrysarobin is cathartic, in the dose of one-half grain (0.03 Gm.).

Unofficial Preparation

Neorobin, N. N. R.—A product obtained by the reduction of chrysarobin.

Neorobin is a yellow or yellowish-gray powder, slightly soluble in ether and methyl alcohol; more soluble in glacial acetic acid, chloroform, benzene and ethyl alcohol; readily soluble in acetone. Neorobin readily oxidizes when exposed to the air; also when in contact with fats.

Uses—The same as those of chrysarobin. It is claimed that neorobin is somewhat more active than chrysarobin and that it has the advantage over chrysarobin in that its staining qualities are markedly less.

It is applied in the form of ointments made with petrolatum, containing from 0.2 to 1 per cent (1 to 5 grains per ounce). Ointments must be freshly made, dispensed in collapsible tubes and used within two weeks from the time of preparation.

Manufactured by the H. K. Mulford Company, Philadelphia.

CAMBOGIA. U. S. Gamboge
[Cambog.—Pipe Gamboge]

Gamboge is the gum resin obtained from *Garcinia Hanburyi* Hooker filius (Fam. *Guttiferæ*).

Gamboge contains not more than 1 per cent of foreign organic matter, and yields not more than 1 per cent of acid-insoluble ash, and not less than 65 per cent of alcohol-soluble extractive.

Description—Cylindrical pieces, frequently hollow at the center, from 2 to 5 cm. in diameter, up to 20 cm. in length, longitudinally striate, grayish orange-brown; fracture brittle, conchoidal, presenting a smooth, rather dull, orange-red surface; odorless; taste acrid.

For further description see the U. S. P. X.

Assay—Proceed as directed under alcohol-soluble extractive, page 1523.

U. S. P. Preparation—Pilulæ Hydrargyri Chloridi Mitis Compositæ.

Gamboge contains about 75 per cent of resin called *gambogic acid*, which is dissolved by alkaline solutions, producing a red color; 20 per cent of gum is present, and this enables gamboge to be emulsified like the other gum resins.

Uses—It is a powerful hydragogue cathartic, and is generally used in combination with other substances, which modify its action. Dose, one-half to three grains (0.03 to 0.2 Gm.).

JALAPA. U. S. Jalap
[Jalap.]

Jalap is the dried tuberous root of *Exogonium Jalapa* (Nuttal et Coxe) Baillon (Fam. *Convolvulaceæ*).

Jalap yields not less than 7 per cent of the total resins of Jalap.

Description—Fusiform, irregularly ovoid or pyriform, the larger roots often incised or cut into pieces; from 4 to 15 cm. in length and from 1 to 10 cm. in diameter; externally dark brown, longitudinally wrinkled or furrowed and with numerous lenticels; hard, compact, not fibrous, internally light grayish-brown to dark brown, with a distinct brown cambium line; odors light but distinctive and smoky; taste somewhat sweet and acrid.

For further description see the U. S. P. X.

Assay—Place 10 Gm. of Jalap in fine powder in a dry flask, add 50 cc. of alcohol and stopper the flask with a perforated cork holding a reflux condenser. (An open glass tube of not less than 0.6 M. in length will suffice.) Place the flask on a water bath, and digest for three hours with occasional shaking. Then transfer to a small percolator, allow to drain, and percolate with alcohol, until the percolate measures 100 cc. Allow to cool to room temperature, and add alcohol to make exactly 100 cc. Mix well.

Transfer 20 cc. of this tincture, accurately measured, representing 2 Gm. of Jalap, to a separator, and add 10 cc. of chloroform and 20 cc. of a saturated solution of potassium citrate (20 Gm. of potassium citrate dissolved in 12 cc. of distilled water). Shake well during two minutes, then set aside for not less than ten hours or overnight. Draw off and discard the lower aqueous liquid, and filter the alcohol-chloroform solution through a small filter, wetted with alcohol-chloroform, into a tared flask or beaker. Rinse the separator with a mixture of 10 cc. of alcohol and 5 cc. of chloroform, and pass the rinsing through the filter. Mix the chloroformic liquids, evaporate on a water bath, dry at 100° C., and weigh.

U. S. P. Preparations—Pilulæ Hydrargyri Chloridi Mitis Compositæ; Pulvis Jalapæ Compositus; Resina Jalapæ.

N. F. Preparations—Fluidextractum Jalapæ, Pilulæ Catharticæ Vegetabiles (from Resin); Pulvis Hydrargyri Chloridi Mitis et Jalapæ; Syrupus Sennæ Aromaticus; Tinctura Jalapæ; Tinctura Jalapæ Compositæ.

Jalap contains from 8 to 16 per cent of resin, the greater part of which is *convolvulin*, or *jalapurgin*, $C_{62}H_{100}O_{32}$, a glucoside insoluble in ether; there are also present gum, sugar, starch, etc. The value of jalap depends exclusively upon the amount of convolvulin present, and the U. S. Pharmacopœia gives an assay for the resins.

Uses—Jalap is an esteemed cathartic, and is generally used in combination with substances having similar properties. Dose, ten to twenty grains (0.6 to 1.3 Gm.).

IPOMŒA. U. S. Ipomea

[Ipom.—Orizaba Jalap Root, Mexican Scammony Root]

Ipomea is the dried root of *Ipomœa orizabensis* Ledenois (Fam. *Convolvulaceæ*).

Ipomea yields not less than 15 per cent of the total resins of Ipomea, and not more than 3 per cent of acid-insoluble ash.

Because of the difficulty of obtaining *Levant Scammony*, Ipomea, which is claimed to possess practically identical therapeutic activity, has replaced the true scammony in all official preparations. The chemical constituents of Ipomea are not identical with those of Scammony but are related. It is also official in the British Pharmacopœia (1914).

Description—Nearly flat transverse slices, from 2 to 12 cm. in diameter, and from 1 to 5.5 cm. in thickness; externally light to dark brown, very deeply wrinkled; fracture tough, fibrous; cut surface light brown, showing concentric rings from which coarse fibers protrude; odor distinct, somewhat aromatic; taste slightly sweet, becoming somewhat acrid.

For further description see the U. S. P. X.

Assay—Proceed as directed under *Jalapa*, page 1085.

U. S. P. Preparations—Extractum Colocynthidis Compositum (from Resin); Resina Ipomœæ.

N. F. Preparations—Pilulæ Aloes, Hydrargyri et Scammonii Compositum (from Resin); Pilulæ Colocynthidis Compositæ (from Resin); Pilulæ Colocynthidis et Hyoscyami (from Resin); Tinctura Jalapæ Composita (from Resin).

True scammony root, of the U. S. P. IX, was the dried root of *Convolvulus Scammonia* Linné (Fam. *Convolvulaceæ*). It was required to yield not less than 8 per cent of the total resins of scammony root.

Scammony root contains from 8 to 9 per cent of a resin having cathartic properties, called *scammonin*, or *orizabin*, $C_{34}H_{56}O_{16}$; this is identical with the jalapin obtained from *Ipomœa orizabensis* (see *U. S. Dispensatory*, 20th edition).

Uses—Ipomea and scammony are hydragogue cathartics; they are usually combined with other purgatives. Dose, four to ten grains (0.25 to 0.6 Gm.).

PODOPHYLLUM. U. S. Podophyllum

[Podoph.—Mandrake, May Apple Rhizome]

Podophyllum consists of the dried rhizome and roots of *Podophyllum peltatum* Linné (Fam. *Berberidaceæ*).

Podophyllum yields not less than 3 per cent of the resin of podophyllum.

Description—Rhizome nearly cylindrical, jointed, compressed on the upper and lower surfaces, sometimes branched; in pieces usually less than 20 cm. in length, the internodes from 2 to 9 mm. in diameter, some of the nodes thickened; dark brown; longitudinally wrinkled or nearly smooth, with irregular somewhat V-shaped scars of scale leaves; some of the nodes annulate, the upper portion with large, circular, depressed stem-scars and with buds or stem-bases; on the lower portion numerous root-scars or roots from 2 to 7 cm. in length and about 2 mm. in thickness; fracture short; internally the cork light brown, the wood portion a circle of small yellowish vascular bundles and the pith large and white; odor slight; taste disagreeably bitter and acrid.

For further description see the U. S. P. X.

Assay—Proceed as directed under *Jalapa*, page 1085, using 10 Gm. of Podophyllum in fine powder.

U. S. P. Preparation—Resina Podophylli.

N. F. Preparations—Pilulæ Aloes et Podophylli Compositæ (from Resin); Pilulæ Aloes, Hydrargyri et Podophylli (from Resin); Pilulæ Aloini Compositæ (from Resin); Pilulæ Catharticæ Vegetabiles (from Resin).

Podophyllum contains *picropodophyllin*, *podophyllotoxin*, and *podophyllinic acid*. The resinous substances extracted from the powdered rhizome with alcohol contain the purgative principles.

Uses—It is cholagogue and cathartic, in doses of eight to twenty grains (0.5 to 1.3 Gm.).

COLOCYNTHIS. U. S. Colocynth

[Colocyn.—Colocynth Pulp, Bitter Apple, Colocynth Apple]

Colocynth is the dried pulp of the unripe but fully-grown fruit of *Citrullus Colocynthis* (Linné) Schrader (Fam. *Cucurbitaceæ*).

Colocynth contains not more than 5 per cent of seed and not more than 2 per cent of epicarp, and yields not more than 2 per cent of extractive with purified petroleum benzin, and not more than 6 per cent of acid-insoluble ash.

Description—In light, spongy, easily-broken pieces; yellowish-white or light brown with occasional small patches of darker epicarp; odor slight; taste intensely bitter. Fruits before removal of seed, nearly globular, from 4 to 10 cm. in diameter, with three large lenticular cavities between the three carpels, hence easily separable longitudinally into three parts. Seeds ovoid, compressed, light yellow to brown.

For further description see the U. S. P. X.

Assay—Proceed as directed under non-volatile ether-soluble extractive, page 1523, using purified petroleum benzin as the solvent.

U. S. P. Preparations—Extractum Colocynthidis; Extractum Colocynthidis Compositum (from Extract); Pilulæ Hydrargyri Chloridi Mitis Compositæ (from Compound Extract).

N. F. Preparations—Pilulæ Antiperiodicæ (from Compound Extract); Pilulæ Catharticæ Vegetabiles (from Compound Extract).

Colocynth contains *colocynthin*, $C_{56}H_{84}O_{23}$, *colocynthitin*, gum, resin, etc. Colocynthin is a very bitter glucoside, splitting under the action of diluted acids into colocynthein and grape sugar. The seeds should be rejected as far as possible, not more than 5 per cent being permitted by the U. S. P.

Uses—Colocynth is a hydragogue cathartic. Dose, one to five grains (0.06 to 0.3 Gm.).

ELATERINUM. U. S. Elaterin

[Elaterin.]

A substance obtained from the juice of the fruit of *Ecballium Elaterium* (Linné) A. Richard (Fam. *Cucurbitaceæ*).

Preparation—It may be made by evaporating an alcoholic tincture of elaterium to the consistence of thin oil, and throwing the residue while yet warm into a weak boiling solution of potassium hydroxide. The potassium hydroxide holds the green resin in solution, and the elaterin crystallizes as the liquor cools. It may also be made by exhausting elaterium with chloroform, and adding ether to the solution, which precipitates the elaterin.

Elaterium—When the fruit of the squirting cucumber is sliced and placed upon a sieve, a perfectly limpid and colorless juice flows out, which soon becomes turbid, and in the course of a few hours begins to deposit a sediment. This, when collected and carefully dried, is very light, and pulverulent, of a yellowish-white color, slightly tinged with green, and is called elaterium. The yield is small—only six grains from forty cucumbers—but the elaterium is very active, one-eighth of a grain purging violently. Commercial elaterium is not usually made in this way, but by expression or other processes, whereby the yield is increased; this elaterium is, of course, weaker.

Description and Physical Properties—Minute, white scales or prismatic crystals.

It is odorless, and is stable in the air.

Elaterin is insoluble in water. One Gm. is soluble in 325 cc. of alcohol, 310 cc. of benzene, 15.5 cc. of chloroform, and 450 cc. of ether, at 25° C. One Gm. is soluble in 100 cc. of boiling alcohol.

Tests for Identity—Its alcoholic solution is neutral to moistened litmus paper.

To a solution of about 0.01 Gm. of Elaterin in 5 Gm. of melted phenol, add a few drops of sulphuric acid: the mixture becomes crimson, the color rapidly changing to scarlet.

Tests for Purity—The ash from 0.1 Gm. is negligible.

Shake 0.1 Gm. of Elaterin with a mixture of 9 cc. of distilled water and 1 cc. of diluted hydrochloric acid, and filter; separate portions of the filtrate yield no turbidity with 0.5 cc. of mercuric potassium iodide T.S. or iodine T.S. (*alkaloids*).

Uses—Elaterin is the purgative principle of elaterium. The dose is one-twentieth to one-twelfth of a grain (0.003 to 0.005 Gm.).

BRYONIA. N. F. Bryonia

[Bryony]

Bryonia is the dried root of *Bryonia alba* Linné or of *Bryonia dioica* Jacquin (Fam. *Cucurbitaceæ*).

Bryonia contains not more than 5 per cent of foreign organic matter.

It contains starch, gum, sugar and *bryoresin* and the glucosides *bryonin* and *bryonidin*. *Bryogenin*, a resin, is also present.

Description—Usually in circular or elliptical slices, obtained by cutting the root more or less transversely, from 1.5 to 10 cm. in breadth and from 3 to 15 mm. in thickness; the edges light gray or yellowish, rough and striate, the cut surface white or faintly yellow, showing a thin cortex and a wood with numerous projecting, collateral fibro-vascular bundles arranged in concentric zones; fracture short and mealy, whitish internally. Odor faint, but distinct and characteristic; taste bitter and nauseous.

For further description see the N. F. V.

N. F. Preparation—Tinctura Bryoniæ.

Uses—It is used as a hydragogue purgative. Dose, fifteen grains (1 Gm.).

CASSIA FISTULA. N. F. Cassia Fistula

[**Cass. Fist.**—Purging Cassia]

Cassia Fistula is the dried fruit of *Cathartocarpus Fistula* (Linné) Persoon (Fam. *Leguminosæ*).

Cassia Fistula contains not more than 2 per cent of foreign organic matter.

It yields about 25 per cent of pulp, which contains pectin, sugar, albuminous principles, salts, etc.

Description—Cylindrical, from 25 to 50 cm. in length, about 20 mm. in diameter, chestnut-brown in color, on one side a longitudinal groove and on the other a smooth line or slight ridge, indicating the sutures; indehiscent, the cavity divided transversely into numerous compartments, each containing a reddish-brown, glossy, flattish-ovoid seed embedded in a blackish-brown sweet pulp. Odor resembling that of prunes.

For further description see the N. F. V.

N. F. Preparation—Confectio Sennæ.

Uses—The pulp is laxative. Dose, one drachm (4 Gm.).

EUONYMUS. N. F. Euonymus

[**Euonym.**—Wahoo Bark]

Euonymus is the dried bark of the root of *Euonymus atropurpureus* Jacquin (Fam. *Celastraceæ*).

Euonymus contains not more than 5 per cent of adhering wood or more than 2 per cent of other foreign organic matter, and yields not more than 4 per cent of acid-insoluble ash.

This bark contains resins, a bitter principle called *euonymin*, *euonic acid*, starch, asparagin, and pectin.

Description—Usually in transversely curved pieces, occasionally in single quills from 2 to 7 cm. in length; bark from 1 to 2.5 mm. in thickness; very light in weight; outer surface grayish or light brown, somewhat wrinkled, occasionally transversely fissured from the lenticels and with scale patches of soft cork; inner surface grayish-white, longitudinally striate and somewhat porous; fracture short with silky, projecting elastic fibers. Odor distinct; taste bitter and acrid.

For further description see the N. F. V.

N. F. Preparations—Extractum Euonymi; Fluidextractum Euonymi.

Uses—Euonymus is used as a cholagogue cathartic. It is stated to exert a digitalis-like action on the circulation. The dose is five to thirty grains (0.3 to 2 Gm.).

Caution—It has been stated that the absorption of Euonymus in the gastro-intestinal tract is uncertain and irregular. To avoid an accumulation of the drug or toxic action, the physician should carefully guard the dosage and determine in each case the tolerance of the patient.

FICUS. N.F. Fig

Ficus is the clean, sound, partially dried fruit of *Ficus Carica* Linné (Fam. *Moraceæ*). It contains mucilaginous constituents, sugar, fat, gum, etc.

Description—Usually compressed, of irregular rounded shapes, from 2.5 to 5 cm. in diameter, fleshy, light brown to yellow, frequently with an efflorescence of sugar; summit with a small, scaly orifice; base with a scar or short stalk; internally hollow, with numerous small, brownish-yellow, glossy, and hard akenes. Odor distinctive, fruity; taste sweet, pleasant.
For further description see the N. F. V.

N.F. Preparations—Confectio Sennæ; Syrupus Ficorum Compositus.

Uses—Figs are nutritious, demulcent, and laxative.

FRANGULA. N.F. Frangula
(U. S. P. IX)
[Frang.—Buckthorn Bark]

Frangula is the dried bark of *Rhamnus Frangula* Linné (Fam. *Rhamnaceæ*).
Frangula contains not more than 2 per cent of foreign organic matter.

Description—In quills varying in length, frequently flattened or crushed; from 0.5 to 1 mm. in thickness; outer surface grayish-brown or purplish-black, with numerous prominent, lighter colored, transverse lenticels and occasional patches of foliaceous lichens bearing small, blackish, apothecia; inner surface smooth, dark brown with occasional purplish blotches, longitudinally striate, becoming red when moistened with solutions of the alkalies; fracture short, slightly fibrous in the inner layer. Odor distinctive; taste slightly bitter.
For further description see the N. F. V.

N.F. Preparations—Elixir Catharticum Compositum (from Fluidextract); Fluidextractum Frangulæ; Syrupus Sennæ Compositus (from Fluidextract).

This bark contains *frangulin*, $C_{20}H_{20}O_9$, emodin, *frangulic acid*, isoemodin, tannin, resin, and other constituents.

Uses—When frangula is fresh, it is emetic; when old, it is a useful cathartic. The dose is fifteen grains (1 Gm.).

JUGLANS. N.F. Juglans
[Butternut Bark]

Juglans is the dried inner bark of the root of *Juglans cinerea* Linné (Fam. *Juglandaceæ*).
Juglans contains not more than 2 per cent of adhering wood or other foreign organic matter.
It contains a crystalline resin, *juglandic acid*, gum, sugar, etc.

Description—In quills, curved strips, or in chips, from 3 to 10 mm. in thickness; of a deep brown color on both surfaces and throughout, except for the faint, intersecting, whitish, radial and tangential lines shown in the transverse section; outer surface smooth, somewhat warty inner surface smooth and striate, bearing fragments of thin stringy fiber; fracture short, rather weak, somewhat fibrous. Odor faintly aromatic; taste bitter, astringent, somewhat acrid.
For further description see the N. F. V.

N.F. Preparations—Elixir Cascaræ Sagradæ Compositum (from Fluidextract); Fluidextractum Juglandis.

Uses—A mild cathartic and hepatic stimulant. Dose, one drachm (4 Gm.).

LEPTANDRA. N.F. Leptandra
[Leptand.—Culver's Root]

Leptandra consists of the dried rhizome and root of *Veronica virginica* Linné (Fam. *Scrophulariaceæ*).
Leptandra contains not more than 5 per cent of its stem bases or other foreign organic matter and yields not more than 6 per cent of acid-insoluble ash.

Leptandra contains a crystalline principle, *leptandrin*, resin, tannin, saponin, gum, mannite, etc. Crystalline leptandrin is bitter, and soluble in water, alcohol, and ether.

Description—Rhizome usually of horizontal growth, nearly cylindrical, somewhat branched, branches readily separable from the main rhizome, from 4 to 10 cm. in length and from 4 to 13 mm. in diameter; externally grayish-brown to dark reddish-brown, annulate from circular scars of bud-scales, upper surface with short stem remnants, occasionally with buds and numerous circular stem-scars; from the under and lateral portions arise numerous coarse roots; fracture very tough and woody; internally, bark rather thin, dark brown and resinous, wood about the same thickness as the bark, light brown and porous, pith large, more or less hollow, the color being similar to that of the bark. Roots from 1 to 10 cm. in length and from 1 to 2 mm. in diameter; externally dark brown to purplish-brown, smooth and faintly longitudinally wrinkled; fracture short; internally with a thick brownish-black bark and small light brown central cylinder. Nearly odorless; taste very bitter and acrid.

For further description see the N. F. V.

N. F. Preparations—Extractum Leptandræ; Fluidextractum Leptandræ; Pilulæ Catharticæ Vegetabiles (from Extract).

Uses—Leptandra is a cholagogue cathartic, in doses of fifteen to forty grains (1 to 2.6 Gm.).

PRUNUM. N. F. Prune

Prune is the partly dried, ripe fruit of *Prunus domestica* Linné (Fam. *Rosaceæ*).

Prune should contain 30 to 35 per cent of its natural moisture when used for pharmaceutical purposes. This fruit contains sugar, malic acid, pectin, salts, etc.

Description—Oblong, ellipsoidal, more or less compressed, from 3 to 4 cm. in length; externally brownish-black, shriveled; the sarcocarp sweet and acidulous; putamen hard, smooth or irregularly ridged; seed, shaped like that of the almond but smaller; bitter almond-like taste.

N. F. Preparation—Confectio Sennæ.

Uses—The pulp is laxative.

RHAMNUS CATHARTICA. N. F. Rhamnus Cathartica

[Rhamn. Cathart.—Buckthorn Berries, Baccæ Spinæ Cervinæ]

Rhamnus Cathartica is the dried, ripe fruit of *Rhamnus cathartica* Linné (Fam. *Rhamnaceæ*).

Rhamnus Cathartica contains not more than 5 per cent of unripe fruit or other foreign organic matter.

It contains *rhamnonigrin*, a glucoside, also *emodin*, coloring matter, fat, pectin, gum, etc.

Description—Flattened, globoid, or ovoid, from 4 to 8 mm. in diameter; externally purplish-black, wrinkled from shrinking of the mesocarp in drying; three- to four-celled, each cell containing a brown, triangular-convex, seed-like nutlet; in the fully dried, ripe fruit the pedicel is usually lacking. Odor faint, unpleasant; taste at first sweetish, then nauseating and bitter; it colors the saliva purplish-red.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Rhamni Catharticæ; Syrupus Rhamni Catharticæ (from Fluidextract).

Uses—A cathartic, used chiefly in veterinary practice. Dose, fifteen grains (1 Gm.).

Unofficial Drugs containing Cathartic Principles

Colutea Bladder Senna	The leaves of *Colutea arborescens* Linné (Fam. *Leguminosæ*). It is slightly purgative and is used chiefly in domestic treatment, in infusions (℥i to Oi)
Kamala (Rottlera).	The glands and hairs from the capsules of *Mallotus philippinensis* (Lamarck) Mueller Arg. (Fam. *Euphorbiaceæ*). It contains *rottlerin*, resins, coloring matter, etc. Used as a tænifuge and purgative in doses of one to three drachms (4 to 12 Gm.) suspended in mucilage or syrup

Drugs Containing Astringent Principles, and their Preparations

The term tannin is used specifically to denote gallotannic acid or digallic acid (Acidum Tannicum U. S. P.), or as a generic term for a large group of substances possessing certain properties in common.

The distinguishing properties of the tannins have been summarized as follows:

They are colloidal and possess astringent properties.

They precipitate gelatin from solution and form insoluble compounds with certain animal tissues, which is taken advantage of in conversion of hide into leather.

They all give dark blue or dark green reactions in solution with ferric salts, a fact which is utilized in the manufacture of ink.

They are precipitated from solution by many metallic salts as lead acetate, etc.

They are precipitated from solution by solution of potassium dichromate or by solution of chromic acid.

They precipitate alkaloids from solution and also precipitate organic colors of basic character.

In alkaline solutions they readily absorb oxygen and become darker in color.

With solution of potassium ferricyanide and ammonia, a deep red color is produced.

Tannins are widely distributed in the vegetable kingdom. The constitution of many of the tannins is very complex. A simple relationship exists between tannic acid from nutgalls (gallotannic acid, the U. S. P. tannic acid) and gallic acid, the former being considered an anhydride of the latter as shown by the following reaction:

$$\underset{\text{gallotannic acid}}{C_{14}H_{10}O_9} = \underset{\text{gallic acid}}{2C_7H_6O_5} + \underset{\text{water}}{H_2O}$$

This change takes place spontaneously in aqueous solutions of tannic acid and is an explanation of the necessity of using glycerin as a solvent for stable solutions of tannic acid, and the use of hydroalcoholic menstrua, usually with glycerin also, in the extraction of the astringent drugs.

Many of the tannins are of a glucosidal nature and exist in the plant in combination with carbohydrates.

Many varieties of tannin are named from the plant in which they occur as gallotannic acid, catechutannic acid, kinotannic acid, quercitannic acid, caffetannic acid, etc.

Among the decomposition products of the tannins are the substances known as *phlobaphenes* which are characterized by a red color and their insolubility in water.

In the tannin-containing drugs these compounds frequently occur as distinctive coloring matters along with the tannins and are named according to their origins as kola red, oak bark red, etc.

GALLA. U. S. Nutgall

[Gall.—Aleppo Galls, Smyrna Galls]

Nutgall is the gall from the young twigs of *Quercus infectoria* Olivier and other allied species of *Quercus* (Fam. *Fagaceæ*).

Description—Nearly globular, from 0.8 to 2.5 cm. in diameter, heavy, mostly sinking in water; externally dark olive-green to dark grayish, tuberculated on upper portion; basal portion smooth and contracted into a short stalk; fracture short, horny; internally grayish to dark brown, with a central slightly radiate portion; occasionally with a central cavity connected by a narrow, radial canal to the external surface; odor slight; taste strongly and persistently astringent.

For further description see the U. S. P. X.

U. S. P. Preparation—Unguentum Gallæ.

N. F. Preparation—Tinctura Gallæ.

Nutgall contains about 50 per cent of tannin, 2 per cent of gallic acid, sugar, gum, resin, and starch.

Uses—It is used an an external astringent. Dose, eight to fifteen grains (0.5 to 1 Gm.).

ACIDUM TANNICUM. U. S. Tannic Acid

[Acid. Tann.—Gallotannic Acid, Tannin]

A tannin usually obtained from nutgall.

Preparation—In manufacturing tannic acid on the large scale, the finely powdered galls are stirred with sufficient water at 50° to 60° C. to form a concentrated aqueous extract, and after filtration the clear liquid is agitated with one-fourth of its volume of ether until an emulsion results. After standing for several days, the upper ethereal liquid, which contains fatty and waxy impurities, is removed, and the lower layer, which contains all the tannin, is run into a still and the ether is recovered. After cooling the syrupy liquid is spread out on sheets of tin, and heated by means of a steam coil, when the product rapidly puffs up and dries.

Thus prepared the commercial tannin contains some quantity of gallic acid, plant wax, glucose and other impurities; to remove these, the material may be washed with ether, or the aqueous liquid fractionally precipitated with common salt, the precipitate dissolved in ethyl acetate, and the tannin recovered by evaporation under reduced pressure.

Description and Physical Properties—An amorphous powder, glistening scales, or spongy masses, varying in color from yellowish-white to light brown. It is odorless, or has a faint, characteristic odor and a strongly astringent taste.

Tannic Acid is very soluble in water, acetone, and alcohol. It is freely soluble in diluted alcohol and slightly soluble in dehydrated alcohol. It is almost insoluble in benzene, chloroform, ether, and in petroleum benzin. One Gm. of Tannic Acid dissolves in about 1 cc. of warm glycerin.

Tests for Identity—The addition of a small quantity of ferric chloride T.S. to an aqueous solution of the Acid produces a bluish-black color or precipitate.

An aqueous solution of Tannic Acid produces precipitates in solutions of most of the alkaloids and glucosides and also in solutions of gelatin, albumin, and starch.

Tests for Purity—Tannic Acid loses not more than 12 per cent of its weight when dried to constant weight at 100° C.

Ash: not more than 0.5 per cent.

Dissolve 2 Gm. of Tannic Acid in 10 cc. of hot distilled water: the solution is not more than slightly turbid and no turbidity is produced upon diluting separate 5 cc. portions of the cooled and filtered solution with 10 cc. of alcohol (*gum or dextrin*), or with 10 cc. of distilled water (*resinous substances*).

Preserve in well-closed containers, in a cool place, protected from light.

U. S. P. Preparations—Glyceritum Acidi Tannici; Trochisci Acidi Tannici; Unguentum Acidi Tannici.

N. F. Preparations—Collodium Stypticum; Syrupus Iodotannicus.

Uses—Tannic acid is powerfully astringent, in doses of three to ten grains (0.2 to 0.6 Gm.). It is frequently employed as an astringent in the form of ointment, chiefly for hemorrhoids. Its solution in glycerin is a valuable liquid form of administration.

Official Tannic Acid Derivatives

The following abstract is taken from the N. N. R: "The pharmacologic actions of tannic acid are due to its property of precipitating protein. Internally, tannic acid has been used in diarrhea; but if tannic acid is given as such, it is rapidly dissolved in the stomach, and may then produce excessive gastric irritation, nausea and even vomiting. The desire to avoid these effects has prompted the introduction of relatively insoluble compounds of tannin, which would act but little, if at all, in the stomach and whose action would extend farther down the intestines. This was sought to be accom-

plished by utilizing the differences in reaction (hydrogen ion concentration) at the various levels of the alimentary tract. It was therefore aimed to make the compounds insoluble in diluted acids, and soluble in diluted alkalies. This object, however, has not been entirely attained and is probably not really desirable in view of the frequent slightly acid reaction of the intestinal contents. It is probably more important that the compound should be but slowly soluble in any reaction that occurs in the alimentary tract."

Four such types have been marketed: (1) organic esters of tannic acid, represented by the official acetyltannic acid; (2) coagulated tannin proteinate, represented by the official albumin tannate; (3) tannin caseinate (protan); (4) a heterogeneous group of other compounds, such as bismuth salts, exemplified by the official bismuth subgallate. The third type is not recognized by the U. S. P. or the N. N. R.

Importance of Differences in Solubility—All the compounds are somewhat soluble in water; but not sufficiently soluble to affect their therapeutic usefulness. From the latter standpoint, the solubility in acid gastric juice and the solubility in sodium bicarbonate solution, representing the maximum alkalinity of the intestines, are most important. The speed or slowness of solution is at least as important as the absolute solubility.

Of the three types, the acetyltannic acid is the least soluble in gastric juice; albumin tannate is fairly soluble, but the solution occurs rather slowly; protan is the most soluble, and the solution occurs more rapidly.

Uses—The sparingly soluble tannic acid preparations are used in diarrheal affections, particularly those of children. They should be employed, not as the principal curative agent, but as an occasional adjunct to the proper physical and dietetic remedies when the discharges are unduly profuse.

As has been explained, acetyltannic acid and albumin tannate act at all levels of the intestine.

For a method for testing tannic acid compounds for solubility in the intestines see the N. N. R.

ACIDUM ACETYLTANNICUM. U. S. Acetyltannic Acid

[**Acid. Acetyltan.**—Diacetyltannic Acid, Tannyl Acetate, Acetannin]

Tannigen is the name under which the product is sold by the Bayer Company.

Acetyltannic Acid is a product obtained by the acetylization of tannic acid.

Description and Physical Properties—A yellowish-white, or a grayish-white powder which darkens on exposure to light. It is odorless or has a slight acetous odor.

Acetyltannic Acid is only slightly soluble in water and in alcohol, but is soluble in ethyl acetate. It is soluble with gradual decomposition in aqueous solutions of alkali hydroxides and carbonates. It is also soluble in aqueous solutions of sodium borate and of sodium phosphate.

Tests for Identity—Warm 0.2 Gm. of Acetyltannic Acid with 2 cc. of alcohol and 2 cc. of sulphuric acid: the odor of ethyl acetate is noticeable. A solution of Acetyltannic Acid in sodium phosphate T.S. (1 in 100) after standing for several hours precipitates albumin solution, but this property is destroyed by the presence of an excess of alkali. When dissolved in an aqueous solution of sodium borate (1 in 25), it does not precipitate albumin.

Tests for Purity—Ash: not more than 0.3 per cent.

Dry about 1 Gm. of Acetyltannic Acid, accurately weighed, for three hours at 100° C.: the loss does not exceed 3 per cent.

Shake 1 Gm. of Acetyltannic Acid with 50 cc. of distilled water during five minutes and filter; a 25 cc. portion of the filtrate requires for neutralization not more than 1.2 cc. of tenth-normal sodium hydroxide, using 3 drops of phenolphthalein T.S. as indicator (*free acid*). To the remainder of the filtrate add 2 drops of ferric chloride T.S.: a green but not a blue color is produced (*free tannic acid*).

Digest 1 Gm. of Acetyltannic Acid with a solution of 2 Gm. of sodium bicarbonate in 200 cc. of distilled water for three hours at about 40° C., filter through a counterbalanced filter or a Gooch crucible, wash the insoluble residue with 4 portions of distilled water, 10 cc. each, and dry to constant weight at 110° C. The weight of the residue does not exceed 0.15 Gm.

Digest 1 Gm. of Acetyltannic Acid with 200 cc. of distilled water for two hours, shaking at frequent intervals. Filter, through a dry filter into a dry flask, rejecting the first 20 cc. of the filtrate, evaporate 100 cc. of the subsequent filtrate to dryness on a water bath, and dry the residue for three hours at 100° C. The weight of the residue does not exceed 0.03 Gm. (*soluble substances*).

Preserve in well-closed containers, protected from light.

Uses—See the general article above.

Average dose—10 grains (0.6 gm.).

ALBUMINI TANNAS. U. S. Albumin Tannate

[**Album. Tan.**—ALBUTANNIN]

A compound of albumin and tannic acid.

Description and Physical Properties—A yellowish-white, odorless powder.

It is almost insoluble in water, alcohol, chloroform, and ether. It is decomposed by aqueous solutions of alkali hydroxides and carbonates.

Tests for Purity—Ash: not more than 0.3 per cent.

Dry about 1 Gm. of Albumin Tannate for three hours at 100° C.: the loss does not exceed 6 per cent.

Shake 1 Gm. of Albumin Tannate with 50 cc. of distilled water for five minutes and filter: a 25 cc. portion of the filtrate requires for neutralization not more than 1 cc. of tenth-normal sodium hydroxide, using 3 drops of phenolphthalein T.S. as indicator (*free acid*).

Digest 1 Gm. of Albumin Tannate with 200 cc. of distilled water for two hours, shaking at frequent intervals. Filter through a filter, which has not been previously moistened, into a dry flask, rejecting the first 20 cc. of the filtrate. Evaporate 100 cc. of the subsequent filtrate to dryness on a water bath and dry the residue for three hours at 100° C.: the weight of the residue does not exceed 0.06 Gm. (*soluble substances*).

Place 1.5 Gm. of Albumin Tannate in a 500 cc. glass-stoppered flask. Dissolve 2.5 Gm. of sodium bicarbonate in 250 cc. of distilled water, warm the solution to 40° C., and gradually add it with agitation to the Albumin Tannate. Then add a filtered aqueous solution of 0.25 Gm. of pancreatin in 5 cc. of distilled water. Place the flask in a suitable bath, maintain at 40° C. for two hours, inverting the flask every ten minutes. Allow to remain in the bath for one-half hour longer without inverting. Filter through a counterbalanced filter, wash the undissolved residue with four 10 cc. portions of cold distilled water, and dry to constant weight at 110° C.: the weight of the residue does not exceed 0.45 Gm.

Place 1.5 Gm. of Albumin Tannate in a 500 cc. glass-stoppered flask. Mix 20 cc. of normal hydrochloric acid with 230 cc. of distilled water, warm the mixture to a temperature of 40° C., and add it gradually with agitation to the Albumin Tannate. Then add a filtered aqueous solution of 0.25 Gm. of pepsin in 5 cc. of distilled water. Place the flask in a suitable bath and maintain at 40° C. for two hours, inverting the flask during the digestion every ten minutes. Allow the flask to remain in the bath for another half hour without inverting. Filter through a counterbalanced filter, wash the undissolved residue with four 10 cc. portions of cold distilled water, and dry at 110° C. to constant weight: the weight of the residue is not less than 0.6 Gm.

Preserve protected from light.

Uses—See the general article above.

Average dose—30 grains (2 Gm.).

Unofficial Tannic Acid Derivatives

Protan. N. N. R.—Tannin Nucleo-Proteid-Mulford—A chemical combination of casein with tannic acid containing about 50 per cent tannic acid.

Protan is made by adding a solution of tannic acid to an alkaline solution of casein, collecting and drying the precipitate.

It is a light brown powder, tasteless, and free from astringent action on the mouth and stomach; insoluble in water or dilute acids, and does not coagulate albumin or precipitate pepsin or peptones.

Actions and Uses—Protan is said to be useful as an intestinal astringent in all forms of diarrhea.

Dose—For infants and children, from 0.3 to 0.6 Gm. (5 to 10 grains) every hour; in acute catarrhal diarrhea (cholera morbus), from 1 to 2 Gm. (15 to 30 grains) every one or two hours; in chronic diarrhea from 1.3 to 2 Gm. (20 to 30 grains) every hour or two hours.

Manufactured by The H. K. Mulford Company, Philadelphia.

ACIDUM GALLICUM. (U. S. P. IX) Gallic Acid

An organic acid [$C_7H_6O_5.H_2O$ or $C_6H_2(OH)_3.COOH1:3:4:5.H_2O = 188.10$].

Preparation—Gallic Acid may be prepared as follows: Take of nutgall, in fine powder, 36 oz., purified animal charcoal, distilled water, each, a sufficient quantity. Mix the nutgall with sufficient distilled water to form a thin paste, and expose the mixture to the air, in a shallow glass or porcelain vessel, in a warm place for a month, occasionally stirring it with a glass rod, and adding from time to time sufficient distilled water to preserve the semifluid consistence. Then submit the paste to expression, and reject the expressed liquor, boil the residue in 8 pints of distilled water for a few minutes, and filter while hot, through purified animal charcoal. Set the liquid aside that crystals may form, and dry them on bibulous paper. If the crystals are

not sufficiently free from color, they may be purified by dissolving them in boiling distilled water, filtering through a fresh portion of purified animal charcoal, and again crystallizing. Gallic acid may be prepared synthetically. It is closely related to tannic acid, and both are usually found together in the same plants.

Description—White, or pale fawn-colored, silky, interlaced needles, or in triclinic prisms.

Odor, Taste, and Reaction—Odorless and having an astringent and slightly acidulous taste permanent in the air. A saturated aqueous solution of Gallic Acid is acid to litmus.

Solubility—One Gm. of Gallic Acid dissolves in 87 cc. of water, 4.6 cc. of alcohol, 10 cc. of glycerin, and in about 100 cc. of ether at 25° C.; also in about 3 cc. of boiling water almost insoluble in chloroform.

Tests for Identity—Add 6 drops of sodium hydroxide T.S. to 5 cc. of a cold, saturated aqueous solution of the Acid: a deep green color gradually develops, which is changed to reddish or brownish-red by acids.

Gallic Acid neither colors nor precipitates solutions of pure ferrous salts, but it forms a bluish-black precipitate with ferric salts.

Impurities and Tests for Impurities—When dried to constant weight at 100° C. the Acid loses not more than 12 per cent of its weight.

Incinerate about 1 Gm. of Gallic acid; not more than 0.1 per cent of ash remains.

Tannic Acid—A cold saturated aqueous solution of Gallic Acid yields no precipitate with gelatin T.S. or starch T.S.

Uses—Gallic acid is used as an internal astringent. Dose, five to fifteen grains (0.3 to 1 Gm.).

KRAMERIA. U.S. Krameria

[Rhatany]

Krameria is the dried root of *Krameria triandra* Ruiz et Pavon, known in commerce as Peruvian Rhatany, or of *Krameria argentea* Martius, known in commerce as Para or Brazilian Rhatany (Fam. *Leguminosæ*).

The chief constituent is *krameria-tannic acid*, also starch, sugar, gum, and *krameric acid*.

Description—*Peruvian Rhatany*—Crown knotty, several- to many-headed, with numerous branching roots; the latter up to 50 cm. in length and usually less than 1 cm. in thickness, cylindrical or somewhat tapering, flexuous or wavy, externally light reddish-brown or brownish-red, more or less marked with darker scaly cork especially in the upper portion, somewhat longitudinally wrinkled but devoid of transverse fissures; fracture of bark slightly fibrous, of wood tough and splintery; the bark pinkish-brown internally and less than one-third of the radius, the wood yellowish or pinkish-white and finely radiate; inodorous; bark astringent, wood nearly tasteless.

Para Rhatany—Roots usually separate from the crown, less flexuous, tapering, tough and internally darker in color than those of Peruvian Rhatany, and usually not exceeding 12 mm. in thickness; externally purplish-brown or chocolate-brown and marked with numerous fissures; the bark about two-fifths or more of the radius.

For further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Krameriæ.

N. F. Preparations—Extractum Krameriæ; Fluidextractum Krameriæ; Fluidglyceratum Krameriæ; Syrupus Krameriæ.

Uses—It is an astringent, used in diarrhea and leucorrhea. Dose, fifteen grains (1 Gm.).

PYROGALLOL. U.S. Pyrogallol

[**Pyrogall.**—Pyrogallic Acid]

Trihydroxybenzene [$C_6H_3(OH)_3$ 1:2:3 = 126.08].

When gallic acid is sublimed, it is converted by the heat into pyrogallol and carbon dioxide.

$$\underset{\text{gallic acid}}{C_7H_6O_5} = \underset{\text{pyrogallol}}{C_6H_6O_3} + \underset{\substack{\text{carbon}\\\text{dioxide}}}{CO_2}$$

Description and Physical Properties—Light, white, or nearly white, odorless leaflets or fine needles. It acquires a grayish tint on exposure to air and light.

One Gm. of pyrogallol is soluble in 1.7 cc. of water, in 1.3 cc. of alcohol, and in 1.6 cc. of ether at 25° C. It is very soluble in boiling water and in boiling alcohol.

Tests for Identity—Pyrogallol melts between 130° and 133° C.

An aqueous solution of Pyrogallol on exposure to air acquires a brown color and an acid reaction due to oxidation by the air. Absorption of oxygen and change of color take place very rapidly after the solution is rendered alkaline with an alkali hydroxide.

An aqueous solution of Pyrogallol (1 in 10) reduces solutions of the salts of silver, gold, and mercury even in the cold.

When freshly prepared, 1 cc. of an aqueous solution of Pyrogallol (1 in 20) is colored brownish-red by a few drops of ferric chloride T. S. Freshly prepared ferrous sulphate T. S. produces a blue color in an aqueous solution of Pyrogallol (1 in 20).

Tests for Purity—Ash: not more than 0.1 per cent.

A freshly prepared solution of Pyrogallol (1 in 20) in recently boiled, distilled water is colorless or at most slightly yellow, and is neutral or only slightly acid to litmus paper.

Preserve in well-closed containers, protected from light.

Uses—Pyrogallol is used in the form of ointment in the treatment of psoriasis, although its use is not without danger. It is also employed in photography as a developer.

GAMBIR. U. S. Gambir

[Pale Catechu]

Gambir is the dried aqueous extract prepared from the leaves and twigs of *Ourouparia Gambir* (Hunter) Baillon (Fam. *Rubiaceæ*).

Gambir yields not less than 70 per cent of water-soluble extractive and not less than 60 per cent of alcohol-soluble extractive.

Description—Masses approximately cubical or rectangular, from 20 to 30 mm. in diameter; externally pale grayish-brown to reddish-brown, more or less dull and porous; friable, internally of a light brown or dark gray color; inodorous; taste bitterish and very astringent.

For further description see the U. S. P. X.

Assay—Proceed as directed under water-soluble extractive, page 1523, and alcohol-soluble extractive, page 1523.

U. S. P. Preparation—Tinctura Gambir Composita.

N. F. Preparation—Tinctura Opii et Gambir Composita (from Compound Tincture).

Gambir was introduced into the U. S. P. to replace the formerly official catechu, because the former can be obtained in commerce much more uniform in quality. It contains *catechutannic acid*, a peculiar form of tannin, which is insoluble in ether and turns greenish-black with ferric salts. *Catechin* and *catechol* are also present. Owing to the decomposition of the tannic acid, the liquid preparations often gelatinize.

Uses—It is used as an astringent, especially in diarrhea. Dose, fifteen grains (1 Gm.).

KINO. U. S. Kino

Kino is the dried juice obtained from the trunk of *Pterocarpus Marsupium* Roxburgh (Fam. *Leguminosæ*).

Kino yields not less than 45 per cent of alcohol-soluble extractive and not less than 80 per cent of water-soluble extractive.

Description—Small, brittle, angular fragments, usually less than 10 mm. in diameter, varying in color from dark reddish-brown to reddish-black; inodorous; taste very astringent; upon mastication coloring the saliva pink.

For further description see the U. S. P. X.

Assay—Proceed as directed under alcohol-soluble extractive (page 1523), and water-soluble extractive (page 1523).

U. S. P. Preparation—Tinctura Kino.

Kino contains *kinotannic acid*, pyrocatechin, kino-red, kinoin, gum, etc. Owing to the decomposition of the kinotannic acid, the liquid preparations, if not protected, frequently gelatinize. Tincture of kino is heated to destroy an enzyme which it is said induces gelatinization by aiding in the decomposition of the kinotannic acid.

Uses—Kino is used as an astringent, especially for diarrhea. Dose, five to twenty grains (0.3 to 1.3 Gm.).

ROSA U. S. Rose

[Rosa Gallica U. S. P. IX, Red Rose]

Rose is the dried petals of *Rosa gallica* Linné (Fam. *Rosaceæ*), collected just before the expansion of the flowers.

Description—Petals either separate or imbricated in small cones, broadly ovate, summit rounded and deeply notched, margin entire and somewhat recurved, base obtuse; externally of a purplish-red color, except the light brown claw; texture velvety; when dry brittle; odor agreeable, taste astringent and slightly bitter.

U. S. P. Preparations—Fluidextractum Rosæ; Mel Rosæ (from Fluidextract).
N. F. Preparations—Confectio Rosæ; Infusum Rosæ Compositum; Pilulæ Aloes et Mastiches; Syrupus Rosæ (from Fluidextract).

Red rose contains *quercitrin* and *quercitannic acid*. The pale red coloring matter is made bright red by the addition of sulphuric acid.

Uses—It is slightly astringent, but is used chiefly for its odor and color. The infusion of red rose is a useful vehicle for many substances. (See page 361.)

UVA URSI. U. S. Uva Ursi

[Bearberry]

Uva Ursi is the dried leaf of *Arctostaphylos Uva-ursi* (Linné) Sprengel (Fam. *Ericaceæ*).

Uva Ursi contains not more than 5 per cent of its stems or other foreign organic matter.

Description—Usually unbroken, obovate, oblong or spatulate, from 12 to 30 mm. in length, from 5 to 13 mm. in breadth; apex obtuse or rounded; margin entire slightly revolute; base cuneate, tapering into a short, stout petiole, upper surface dark green, glabrous and shiny, finely reticulate; under surface yellowish-green and slightly pubescent, especially on the midrib; coriaceous; fracture short; odor slightly aromatic, tea-like; taste astringent and somewhat bitter.
For further description see the U. S. P. X.

U. S. P. Preparation—Fluidextractum Uvæ Ursi.
N. F. Preparations—Elixir Buchu Compositum (from Compound Fluidextract of Buchu); Fluidextractum Buchu Compositum.

Uva Ursi contains about 6 per cent of tannic acid, with gallic acid, *ursón*, *arbutin*, *ericolin*, gum, resin, coloring matter, etc.

Uses—It is used as a urinary antiseptic. Dose, thirty grains (2 Gm.).

CASTANEA. N. F. Castanea

[Castan.—Chestnut Leaves]

Castanea consists of the dried leaf of *Castanea dentata* (Marshall) Vorkhausen (Fam. *Fagaceæ*).

Castanea contains not more than 5 per cent of its stems or other foreign organic matter.
It contains about 9 per cent of tannic acid and also mucilage.

Description—Petioles stout, about 12 mm. in length; blades entire or slightly broken and usually folded or matted together; about 15 to 25 cm. in length and about 5 cm. in breadth, oblong-lanceolate, apex attenuate, acute at the base, coarsely and sharply serrate with ascending attenuate teeth, nearly smooth, coriaceous in texture; the upper surface dark green, the lower light green; distinctly pinnately veined, the veins of the first order diverging at an angle of about 60 degrees, each terminating in one of the teeth. Odor slight; taste astringent.
For further description see the N. F. V.

N. F. Preparation—Fluidextractum Castaneæ.

Uses—It is used in whooping-cough. Dose, one drachm (4 Gm.).

CHIMAPHILA. N. F. Chimaphila

[**Chimaph.**—Pipsissewa]

Chimaphila consists of the dried leaf of *Chimaphila umbellata* (Linné) Barton (Fam. *Ericaceæ*).

Chimaphila contains not more than 5 per cent of its stems and other foreign organic matter.

Chimaphila contains about 5 per cent of tannic acid, with *chimaphilin, ericolin, arbutin, urson, sugar, gum,* etc.

Description—Oblanceolate, from 2.5 to 7 cm. in length and from 8 to 20 mm. in breadth, the upper portion coarsely and sharply serrate, acute or somewhat obtuse, the lower wedge-shaped and nearly entire; coriaceous, smooth and uniformly dark green on the upper surface, paler beneath, the veins prominent. Odor slight; taste astringent and bitter.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Chimaphilæ; Fluidextractum Stillingiæ Compositum.

Uses—It is used in inflammations of the genito-urinary organs, in doses of thirty grains (2 Gm.).

GERANIUM. N. F. Geranium

[**Geran.**—Cranesbill]

Geranium is the dried rhizome of *Geranium maculatum* Linné (Fam. *Geraniaceæ*).

Geranium yields not more than 2 per cent of foreign organic matter.

Geranium contains about 15 per cent of tannic acid, with brownish-red coloring matter, starch, sugar, pectin, etc.

Description—Rhizome cylindraceous, somewhat branched, bent, flattened and strongly tuberculated, from 2.5 to 10 cm. in length and from 3 to 15 mm. in diameter; surface marked with root scars and remnants of slender roots, longitudinally wrinkled; externally dark purple-brown; internally light purple-brown; fracture short, non-fibrous, the section shows a thin bark, a distinct cambium, irregular in outline, large central pith, wood indistinct, the fibro-vascular bundles few and at unequal distances. Odorless; taste strongly astringent.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Geranii.

Uses—It is used as an astringent. Dose, fifteen grains (1 Gm.).

HÆMATOXYLON. N. F. Hæmatoxylon

See Chapter LX on Coloring Substances.

HAMAMELIS FOLIA. N. F. Hamamelis Leaves

[**Hamamel. Fol.**—Witch Hazel Leaves]

Hamamelis leaves consists of the dried leaf of *Hamamelis virginiana* Linné (Fam. *Hamamelidaceæ*).

Hamamelis leaves contains not more than 5 per cent of stems or more than 2 per cent of other foreign organic matter.

It contains small amounts of tannin and bitter principles and a volatile oil.

Description—Petioles from 1 to 1.5 cm. in length; laminæ when entire, broadly elliptical or rhomboid-ovate, usually inequilateral, mostly from 8 to 12 cm. in length; summits usually acute, sometimes rounded or acuminate; bases slightly heart-shaped and oblique; margins sinuate or sinuate-dentate; upper surfaces pale or brownish-green, occasionally dark brown with a few stiff, straight hairs; lower surfaces lighter in color, somewhat hairy, midrib and veins prominent. Odor slight; taste astringent, slightly aromatic and bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Hamamelidis Foliorum.

Uses—It has been extensively used as an astringent and hemostatic, but its virtues have been greatly exaggerated. Dose, thirty grains (2 Gm.).

QUERCUS. N. F. Quercus

[Querc.—White Oak Bark]

Quercus is the dried inner bark of the trunk and branches of *Quercus alba* Linné (Fam. *Fagaceæ*).

Quercus contains not more than 2 per cent of its outer bark or wood or other foreign organic matter.

The most important constituents are *quercitannic acid* and *oak-red*, also pectin, resin, wax, fat, the sugar *quercit*, etc.

Description—In nearly flat pieces, from 2 to 10 mm. in thickness; externally light brown, becoming darker with age, rough-fibrous; fracture uneven, coarsely fibrous. Odor distinct; taste strongly astringent; not tingeing the saliva yellow when chewed.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Quercus.

Uses—It is an astringent, used in leucorrhea, and in hemorrhoids. Dose, fifteen grains (1 Gm.).

RUBUS. N. F. Rubus

[Blackberry Bark]

Rubus consists of the dried bark of the rhizome and roots of the section *Eubatus* Focke, of the genus *Rubus* Linné (Fam. *Rosaceæ*).

Rubus contains not more than 10 per cent of adhering wood and not more than 2 per cent of other foreign organic matter.

Rubus owes its astringent properties to tannic acid. There are also present gum, coloring matter, etc.

Description—In elongated, tough, flexible quills or bands, from 3 to 6 mm. in diameter, the bark from 1 to 2 mm. in thickness; outer surface deep red-brown or dark gray-brown, occasionally blackish-brown, somewhat scaly; inner surface yellow or pale brown, strongly and coarsely long straight-striate; fracture tough-fibrous; readily splitting. Inodorous; taste strongly astringent and bitter.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Rubi; Syrupus Rubi (from Fluidextract).

Uses—Rubus is used as an astringent chiefly in diarrhea. The dose is fifteen grains (1 Gm.).

RUMEX. N. F. Rumex

[Yellow Dock, Curled Dock]

Rumex is the dried root of *Rumex crispus* Linné, or of *Rumex obtusifolius* Linné (Fam. *Polygonaceæ*).

Rumex contains not more than 5 per cent of its stem bases or other foreign organic matter.

It contains *rumicin*, said to be isomeric with chrysophanic acid. *Nepodin* and *lapodin* are also present.

Description—Usually split longitudinally or cut into transverse pieces about 2 cm. in length. The entire root, nearly simple, slightly tapering, with few if any rootlets, somewhat twisted, up to 30 cm. in length and 7 cm. in diameter, externally reddish-brown or grayish from adhering soil, finely annulate above, deeply wrinkled longitudinally, marked with small indented root scars which are often transversely elongated and with occasional stem scars or remains of stems, the latter being hollow and finely striated; leaf buds few, obconical; fracture short and dusty, somewhat fibrous.

The transverse section exhibits a yellowish or brownish cortex and a whitish or yellowish wood which is finely radiate in the outer portion. When examined under the microscope, it exhibits a thick cortex with several layers of cork, beneath which is an interrupted row of stone cells; a distinct cambium; and vascular bundles with few fibers.

Tests for Identity and Purity—The powder, when examined under the microscope, shows calcium oxalate crystals in rosette aggregates from 0.025 mm. to 0.06 mm. in diameter; numerous starch grains ellipsoidal or narrowly elongated, sometimes truncate, up to 0.025 mm. in length, stone cells from 0.04 mm. to 0.2 mm. in diameter with walls somewhat lamellated, from 0.008 mm. to 0.025 mm. in thickness and with few simple pores; sclerenchymatous fibers, few, thin-walled with simple pores; tracheæ up to 0.1 mm. in width with scalariform or reticulate thickenings of the wall; cork cells light brown.

Rumex yields not more than 10 per cent of ash.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Rumicis.

Uses—It is used as an astringent, applied locally in scrofulous disorders. Dose, one drachm (4 Gm.).

Unofficial Astringent Substances

Agrimonia Agrimony	From *A. Eupatoria*, grown in North America. It contains tannin and bitter principle
Areca Nut Semen Arecæ (Betel Nut)	Vermifuge. Dose, one to two drachms (4 to 8 Gm.)
Bistorta Bistort	The rhizome of *Polygonum B.*, grown in Canada and the United States. It contains about 20 per cent of tannin, etc.
Catechu Catechu	From *Uncaria Gambir*, grown in the East India Islands. It contains catechin, catechutannin, etc. (see Gambir, p. 1096)
Comptonia Sweet Fern	The leaves of *C. asplenifolia*, found in North America. It contains volatile oil, tannin, etc.
Diospyros Persimmon	The bark of *D. virginiana*, grown in the United States. It contains tannin and malic acid
Epigæa Trailing Arbutus	From *E. repens*, found in North America. It contains tannin, and the principles common to the *Ericaceæ*
Epilobium Willow Herb	From *E. angustifolium*, found in the Northern Hemisphere. It contains tannin, mucilage, etc.
Epiphegus Beech-drop	From *E. virginiana*, a parasitic plant found in North America. It contains tannin, bitter principle, etc.
Eugallol (Pyrogallol-mono-acetate)	A brownish-yellow, syrupy liquid, soluble in water. Used like pyrogallol in skin diseases. Applied externally
Gallanol (Gallic Acid Anilide, Gallinol, Gallanilide), $C_6H_5NH.CO.C_6H_2(OH)_3$	Prepared by boiling tannic acid with aniline. In grayish scales or powder, having a bitter taste, soluble in water, alcohol, and ether; very astringent. Used in skin diseases, in 3 to 20 per cent ointments, and as a dusting powder when mixed with talc
Hepatica Liverwort	The leaves of *H. triloba*, found in North America. It contains tannin, mucilage, etc.
Heuchera Alum root	The root of *H. americana*, found in the United States. It contains about 20 per cent of tannin
Hieraceum Hawkweed	From different species of *Hieraceum*, found in North America. It contains tannin
Hippocastanum Horsechestnut Bark	The bark of *Æsculus Hippocastanum*, grown in North America. It contains tannin and various other principles
Ilex Paraguayensis Maté, Paraguay Tea	The leaves of *I. paraguayensis*, grown in Brazil. It contains tannin and 10 to 15 per cent of caffeine, etc.
Monesia Monesia	From *Chrysophyllum glycyphlæum*, found in Brazil. A vegetable extract alterative and astringent. Dose, from two to ten grains (0.125 to 0.6 Gm.) every hour or two
Myrobalanus Myrobalans	From different species of *Terminalia*, grown in Southern Asia. It contains about 45 per cent of gallotannic acid
Nymphæa Water Lily	The rhizome of *N. odorata*, found in the United States. It contains tannin and mucilage
Potentilla Cinquefoil	From *P. canadensis*, found in North America. It contains tannin
Pulmonaria Lungwort	From *P. officinalis*, grown in Europe. It contains tannin
Quercus Tinctoria Black Oak Bark	From *Q. coccinea*, var. *tinctoria*, grown in the United States. It contains tannin, etc.
Rhus Aromatica Sweet Sumach	From *R. aromatica*. It contains tannin, coloring matter, gum resin, etc.
Rosa Centifolia Pale Rose	The petals of *Rosa centifolia* Linné (Fam. *Rosaceæ*). It contains tannin, volatile oil, sugar, etc. Used as a flavor
Saligallol (Pyrogallol Disalicylate)	A resinous solid, sold in the form of a 33 per cent solution in acetone. Used in skin diseases, and as a vehicle for other dermic preparations. It is applied externally in the form of a 2 to 15 per cent solution
Spiræa Hardhack	From *S. tomentosa*, found in North America. It contains tannin and bitter principle
Statice Marsh Rosemary	The root of *S. Limonium*, grown in Europe. It contains tannin and volatile oil
Tannoform (Methylene-ditannin, Tannin-formaldehyde) $CH_2(C_{14}H_9O_9)_2$	Obtained by adding formaldehyde to an aqueous solution of tannic acid and precipitating with hydrochloric acid. A reddish-brown powder insoluble in water. Used as a dusting powder, as a drying antiseptic, and in intestinal disorders. Dose, four to eight grains (0.25 to 0.5 Gm.)
Tormentilla Tormentil	From *T. erecta*, grown in Europe. It contains about 20 per cent of tannin

CHAPTER LXXIII

ALKALOIDS

SERTÜRNER'S paper, in 1817, "Morphia, a New Salt-forming Substance, and Meconic Acid, as the Chief Constituents of Opium", opened a new era of discovery in organic plant chemistry. His description of the first alkaloid separated was immediately followed by the isolation of narcotine by Robiquet and strychnine by Pelletier and Caventou. This class of principles was at first called vegetable alkalies, which was later changed to alkaloids, meaning alkali-like.

Alkaloids as the active principles of many plants were isolated and announced in rapid succession by various investigators until today they number hundreds, a few being obtained from Cryptogams (flowerless plants), but mainly from the Phanerogams (flowering plants), most of those isolated being from dicotyledons.

They are undoubtedly the most important organic compounds with which the pharmacist has to deal, and the most active, and potent substances he dispenses. His interest in them is two-fold—first for their medicinal value and, secondly, because of the intimate association of early pharmacists in their isolation and identification.

Alkaloids are obtained from the animal as well as from the vegetable kingdom. The term *leucomaines* is generally applied to those from living animal tissues and *ptomaines* to the product of decomposition in dead animal tissues. When found in plants, they occur in nearly all of the organs, and several theories, each of which has supporting facts, have been advanced as to the mode of formation. A more detailed discussion of these can be had by consulting one of the more extensive treatises on alkaloids, such as those referred to later.

Chemically they are all closely related to some simpler compound such as pyridine or quinoline, yet classification is difficult, as they often contain conflicting nuclei. The classification adopted below is based upon their main nucleus.

Pyridine—Piperine, coniine, pilocarpine, and nicotine.

Tropine—Atropine and the other solanaceous alkaloids. also cocaine and the coca alkaloids.

Quinoline—Quinine and other cinchona alkaloids, also strychnine and brucine.

Iso-quinoline—Papaverine, narcotine, hydrastine, berberine, and narceine.

Phenanthrene—Morphine, codeine, and thebaine.

Purine—Caffeine, theobromine, and theophylline.[1]

Gloxaline—Pilocarpine.

Unclassified—Physostigmine, aconitine, pelletierine, colchicine, and emetine.

Their distinctive chemical and physical features are as follows:

1. They are all nitrogenous and in addition contain carbon, hydrogen, and generally oxygen.

[1] Caffeine, theobromine and theophylline are grouped under alkaloids as they are similar in many respects and are still classed as such by many authorities. They however lack certain properties that most alkaloids possess, this is recognized by the Pharmacopœia in describing them as "feebly basic substances". A strict classification would place them under the derivatives of uric acid.

2. Most of the non-volatile alkaloids are solid; the volatile ones are mainly liquid and some contain no oxygen.

3. Alkaloids unite with acids to form additive salts. They are alkaline in reaction and are freed from their acid combinations by the addition of alkalies.

4. Most of them are physiologically active, some being extremely poisonous. In the majority of instances they are the medicinally important substances of the plants from which they are derived.

5. They are mainly crystallizable, though a few are liquid while some are amorphous.

6. They are generally colorless though berberine is yellow and sanguinarine, itself colorless, yields red salts.

7. They are either insoluble or sparingly soluble in water (a few exceptions, as colchicine) but soluble in alcohol, chloroform, benzene, some in ether, and a few in petroleum benzin. Their salts behave conversely in the matter of solubility.

8. Nearly all alkaloids exhibit definite optical activity, only a few being inactive. Some alkaloids, when salified, exhibit an optical activity directly opposite that shown in the free state.

9. They are precipitated by one or more of the following reagents; with some they form definite chemical compounds which are used for their identification: mercuric-potassium iodide (Mayer's reagent); potassium-cadmium iodide (Marme's reagent); potassium-bismuth iodide (Dragendorff's reagent); phosphomolybdic acid (Sonnenschein's reagent); a solution of iodine with potassium iodide (Wagner's reagent); phosphotungstic acid (Scheibler's reagent); gold chloride; tannic acid; and picric acid.

The manufacture of alkaloids is so highly specialized that the firms engaged in their commercial production make it a specialty and have devoted years to perfecting the processes. The operations involved are based on the physical as well as the chemical properties of the alkaloids sought. In many instances their commercial production requires merely a large scale operation similar to the methods employed in proximate assaying.

Purification is usually accomplished by the crystallization of the alkaloidal salts. A few alkaloids are made synthetically, as homatropine and codeine, and there are also numerous synthetic drugs of an alkaloidal character which do not occur naturally in any plants.

To identify separated alkaloids which have been properly purified, the melting point of the free alkaloid and of one of its salts may be obtained, also some other factors, as optical rotation, crystalline form, etc., Most alkaloids show characteristic specific rotation and the microscopic examination of the crystals obtained from the use of alkaloidal solutions of known concentration using suitable precipitants has given exceptionally good results.[1]

Color reactions are also used in establishing identity, but they should not be relied on solely, since the effect noted is often produced by impurities.

The alkaloids will be considered in this chapter in the order of their importance.

OPIUM. U.S. Opium

Opium is the air-dried, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné or its variety *album* De Candolle (Fam. *Papaveraceæ*).

[1]For further information the reader is referred to one of the following books:
Commercial Organic Analysis—Allen; Microchemical Test for Alkaloids—Stephenson; Plant Alkaloids—Henry; Chemistry and Analysis of Drugs and Medicines—Fuller; Vegetable Alkaloids—Pictet-Biddle; New and Non-Official Remedies.

Opium in its normal, moist condition yields not less than 9.5 per cent of anhydrous morphine.

Description—In more or less rounded, somewhat flattened masses, usually about 8 to 15 cm. in diameter; externally dark brown, covered with fragments of poppy leaves and at times with fruits of a species of rumex adhering from the packing; more or less plastic when fresh, becoming hard and brittle or tough on keeping; internally dark brown interspersed with lighter areas, somewhat lustrous; odor characteristic, narcotic; taste very bitter, characteristic.

Assay—Place 8 Gm. of Opium, which if fresh should be in very small pieces, and if dry in fine powder, into an Erlenmeyer flask having a capacity of about 250 cc., add 80 cc. of distilled water, stopper the flask, and agitate it every ten minutes (or continuously in a mechanical shaker) during three hours. Then pour the contents as evenly as possible upon a wetted filter having a diameter of not over 12 cm. and, when the liquid has drained off, wash the residue with distilled water, carefully dropped upon the edges of the filter and its contents until a filtrate of 120 cc. has been obtained. Carefully transfer the moist Opium to a mortar by means of a spatula and rub to a smooth paste, then rinse into the original flask with 50 cc. of distilled water, agitate it thoroughly, and return the whole to the filter. When the liquid has drained off, wash the residue with 75 cc. of distilled water. Evaporate the mixed filtrates and washings on a water bath to about 40 Gm.; transfer the extract to a 50 cc. graduated flask, and wash the evaporating dish with sufficient distilled water to make the entire volume measure exactly 50 cc. when cooled to room temperature. Place in a small mortar 4 Gm. of freshly slaked lime (page 1536), add about 10 cc. of the Opium extract and rub to a smooth paste, then add the remainder of the extract, and rinse the flask with exactly 10 cc. of distilled water, adding the rinsings to the mortar, and stir frequently during fifteen minutes, avoiding unnecessary loss by evaporation. Filter through a dry filter, about 10 cm. in diameter, and transfer exactly 30 cc. of the filtrate, representing 4 Gm. of Opium, to an Erlenmeyer flask of suitable capacity. To this add 2 cc. of alcohol and 15 cc. of ether, and after shaking the mixture add 1 Gm. of ammonium chloride, stopper the flask and shake it frequently during half an hour, then set it aside in a cool place for twelve hours or overnight. Remove the stopper, and brush any adhering crystals back into the flask. Decant the ethereal layer into a small funnel, the neck of which has been previously closed with a pledget of purified cotton. (A small filter paper may be used if preferred.) Rinse the flask and contents with 15 cc. of ether, and, when the ether has passed through, wash the funnel and cotton with a small quantity of ether, and then pour the aqueous liquid into the funnel without trying to remove the crystals. Wash the crystals in the flask and the contents of the funnel with distilled water previously saturated with morphine, until the washings are colorless. Then add a few drops of distilled water to replace the morphinated water. Incline the edge of the funnel over the mouth of the flask, and by means of a glass rod carefully transfer the cotton with adhering crystals to the flask. Insert the funnel into the neck of the flask and wash the funnel with 20 cc. of tenth-normal sulphuric acid, followed by 10 cc. of distilled water applied, drop by drop, around the edge of the funnel. Remove the funnel, replace the cork, warm gently, and agitate until the crystals are dissolved. Rinse the cork with distilled water and titrate the excess of acid with fiftieth-normal sodium hydroxide. Each cc. of tenth-normal sulphuric acid corresponds to 0.02853 Gm. of anhydrous morphine.

U. S. P. Preparations—Mistura Glycyrrhizæ Composita (from Camphorated Tincture); Opii Pulvis; Opium Deodoratum; Opium Granulatum; Pulvis Ipecacuanhæ et Opii; Tinctura Opii; Tinctura Opii Camphorata.

N. F. Preparations—Linimentum Opii Compositum; Lotio Plumbi et Opii; Mistura Carminativa; Mistura Magnesiæ, Asafœtidæ et Opii; Mistura Opii et Chloroformi Composita; Mistura Opii et Rhei Composita; Mistura Pectoralis, Stokes'; Pilulæ Opii et Camphoræ; Pilulæ Opii et Plumbi; Pulvis Cretæ et Opii Aromaticus; Syrupus Ipecacuanhæ et Opii (from Tincture); Tinctura Ipecacuanhæ et Opii (from Tincture of Deodorized Opium); Tinctura Opii Crocata.

History—The ancients recognized several kinds of opium. The superior kind was called *opion* and was the juice which exuded from the living poppy capsule, the inferior kind was called *meconion* and was in reality a solid extract made from the crushed leaves and capsules.

Dioscorides, in the second century, was the first writer to discuss opium and its uses at length. He gave the receipt for a preparation called *diacodion* which is the prototype of our official syrup of poppies. Paracelsus used opium extensively in the fifteenth century and referred to it as the "stone of immortality". Van Helmont, early in the seventeenth century used opium so freely that he was referred to as Doctor Opiatus. Sydenham a little later in the same century praised opium as the most valuable gift of God to mankind.

Uses—(See page 1107).

OPIUM PULVERATUM. U. S. Powdered Opium

[**Opium Pulv.**—Opii Pulvis U. S. P. IX, Opii Pulvis P. I.]

Opium dried at a temperature not exceeding 70° C. and reduced to a very fine powder.

Powdered Opium yields not less than 10 per cent and not more than 10.5 per cent of anhydrous morphine. Powdered Opium of a higher morphine percentage is to be reduced to the official standard by admixture with powdered opium of a lower percentage, or with some inert diluent.

Description—Light brown, consisting chiefly of yellowish-brown to brownish-red, more or less irregular and granular fragments.
Assay—Proceed as directed under *Opium*.
Preserve in well-closed containers.
For a further description see the U. S. P. X.

U. S. P. Preparations—Pulvis Ipecacuanhæ et Opii; Tinctura Opii Camphorata.
N. F. Preparations—Pilulæ Opii, Digitalis et Quininæ: Pilulæ Opii et Camphoræ; Pilulæ Opii et Plumbi; Pulvis Cretæ et Opii Aromaticus.

Uses—(See page 1107).

OPIUM GRANULATUM. U. S. Granulated Opium

[**Opium Gran.**]

Opium dried at a temperature not exceeding 70° C., and reduced to a coarse powder.

Granulated Opium yields not less than 10 per cent and not more than 10.5 per cent of anhydrous morphine. Granulated Opium of a higher morphine percentage may be brought within the required limits of strength by admixture with granulated opium of a lower percentage, or with some inert diluent.

Description and Physical Properties—When powdered, Granulated Opium corresponds to the description under *Opium Pulveratum*.
Assay—Proceed as directed under *Opium*.
Preserve in well-closed containers.

U. S. P. Preparation—Tinctura Opii.
N. F. Preparation—Tinctura Opii Crocata.

Uses—(See page 1107).

Opium Alkaloids, etc.—Opium as a drug has been cultivated for many centuries, but it was not until the investigations of Sertürner, published in 1817, that it was known that the drug contained certain definite principles now called *alkaloids*. Opium is produced almost entirely in European and Asiatic tropical and sub-tropical countries. That which is used in the manufacture of medicinal products comes mainly from Turkey and Smyrna. Persian and Indian opium is imported chiefly for the manufacture of the opium alkaloids. Opium owes its value to the narcotic alkaloids present in it. More than twenty-five alkaloids have been proved to exist in various kinds of opium, and several more have been announced, but their existence has not been confirmed. Two acids are found in opium combined with the alkaloids—*i.e.*, meconic and lactic acids; there are also present *meconin*, $C_{10}H_{10}O_4$, *meconoiosin*, $C_8H_{10}O_2$, both neutral principles, pectin, glucose, mucilage, caoutchouc, wax, and odorous, fatty, and coloring matters. *Meconic acid* is colored red by ferric salts, the color not being discharged by solution of mercuric chloride. A solution of potassium sulphocyanate is colored in a similar manner by ferric salts, but

this color is discharged by solution of mercuric chloride. The known alkaloids are as follows:

Morphine, $C_{17}H_{19}O_3N$
Codeine, $C_{18}H_{21}O_3N$
Neopine, $C_{18}H_{21}O_4N$ or $C_{18}H_{21}O_3N$
Pseudomorphine, $(C_{17}H_{18}O_3N)_2$
Thebaine, $C_{19}H_{21}O_3N$
Narcotine, $C_{22}H_{23}O_7N$
Gnoscopine (dl-narcotine), $C_{22}H_{23}O_7N$
Oxynarcotine, $C_{22}H_{23}O_8N$
Narceine, $C_{23}H_{27}O_8N$
Papaverine, $C_{20}H_{21}O_4N$
Laudanosine, $C_{21}H_{27}O_4N$
Laudanine, $C_{20}H_{25}O_4N$
Laudanidine, $C_{20}H_{25}O_4N$
Codamine, $C_{20}H_{25}O_4N$
Pseudopapaverine, $C_{21}H_{21}O_4N$
Papaveramine, $C_{21}H_{25}O_6N$
Xanthaline (Papaveraldine), $C_{20}H_{19}O_5N$
Protopapaverine, $C_{19}H_{19}O_4N$
Meconidine, $C_{21}H_{23}O_4N$
Lanthopine, $C_{23}H_{25}O_4N$
Protopine, $C_{20}H_{19}O_5N$
Cryptopine, $C_{21}H_{23}O_5N$
Tritopine, $(C_{21}H_{27}O_3N)_2O$
Rhœadine, $C_{21}H_{21}O_6N$
Hydrocotarnine, $C_{12}H_{15}O_3N$

Morphine, $C_{17}H_{19}O_3N.H_2O$, is the chief principle of opium and the first alkaloid discovered (see separate article, page 1107).

Codeine, $C_{18}H_{21}O_3N.H_2O$, is an important narcotic alkaloid obtained from opium (see page 1109).

Narcotine, $C_{22}H_{23}O_7N$. Derosne, in 1803, obtained from opium a substance, "opium salt", which was a mixture of narcotine and morphine. He erroneously supposed it to be the narcotic principle, and did not recognize its alkaloidal character. Narcotine was isolated by Robiquet in 1817. It is white, tasteless, and inodorous, and crystallizes in silky, flexible needles, usually larger than the crystals of morphine, $[a]_D$ $-198.0°$ in chloroform, $+50°$ in 1 per cent hydrochloric acid, melting point 176° C., insoluble in cold water, soluble in 400 parts of boiling water, in 100 parts of cold alcohol, and in 24 parts of boiling alcohol, which deposits it upon cooling, and in 166 parts of ether at 16° C., readily soluble in benzene, acetone, or ethyl acetate. When opium is extracted with water to obtain the morphine and codeine, the narcotine remains in the insoluble residue. It is present in opium from 1 to 9 per cent. It is colored red by a mixture of sulphuric and nitric acids. It is *not narcotic*, but is said to be antiperiodic.

Thebaine (Paramorphine). This alkaloid occurs in opium to the extent of 0.1 to 1 per cent and was obtained originally by Thiboumery, who named it *paramorphine*, $C_{19}H_{21}O_3N$. Crystallized from alcohol in white leaflets of an acrid and styptic rather than bitter taste, $[a]_D$ $-218.6°$ in alcohol, melting point about 193° C., scarcely soluble in water, very soluble in alcohol, chloroform and benzene, and sparingly soluble in ether when cold, and even more insoluble when heated. Alkalies precipitate it from its acid solutions, and, unless in very concentrated solution, do not dissolve it when added in excess. Unlike morphine, it is not reddened by nitric acid, nor does it become blue with solutions of ferric salts. It is colored blood-red by sulphuric acid which on warming turns orange-yellow and finally olive green. It is not narcotic, but in its effects on the system is closely analogous to strychnine, producing tetanic spasms in the dose of a grain (0.06 Gm.).

Papaverine, $C_{20}H_{21}O_4N$, was isolated by Merck in 1848. Crystallizable in needles, melting point 147° C., $[a]_D$ 0°., and volatilizable at 154.4° C. It is insoluble in water, very sparingly soluble in cold alcohol or ether, more soluble in these liquids when boiling hot, and deposited by them on cooling: soluble in benzene and chloroform. Dissolves in pure cold sulphuric acid to a colorless solution, becoming rose-red at 110° C, violet at 200° C, the color being discharged by water. It is narcotic.

Narceine, $C_{23}H_{29}O_9N.3H_2O$. Discovered by Pelletier in 1832. Crystallizes from alcohol in white, silky crystals, inodorous, of a bitter taste, $[a]_D$ 0°, melting

point 170° C., and volatilizable at 215.5° C. (420° F.), soluble in 1285 parts of cold and 220 of boiling water, slightly soluble in cold 80 per cent alcohol (1 in 945 at 13°), and insoluble in ether. It forms a bluish compound with a little iodine, the color of which is destroyed by heat and the alkalies. It is rendered blue by the action of mineral acids diluted so as not to decompose it; but, unlike morphine, it does not become blue by the action of ferric salts, or red by that of nitric acid. Narceine is narcotic, and may be given in doses of one-third to one-half of a grain (0.02 to 0.03 Gm.).

Hydrocotarnine, $C_{12}H_{15}O_5N$, is soluble in alcohol, acetone, chloroform, petroleum benzin, and ether. It melts at 55° C., and loses at a somewhat greater heat the half molecule of water with which it crystallizes. Sulphuric acid dissolves it, coloring it yellow in the cold, and crimson red if heated. Nitric acid colors it yellow; ferric chloride does not affect its color.

Pseudomorphine, $C_{34}H_{36}O_6N_2$, isolated by Pelletier in 1835, shows several reactions like morphine. It dissolves in concentrated nitric acid with an intense orange-red color, and in solution of ferric chloride with a blue color. It may be prepared by oxidation of morphine. Silky crystals insoluble in water or organic solvents but soluble in aqueous or alcoholic ammonia. It is tasteless and physiologically inactive.

Cryptopine, $C_{21}H_{23}O_5N$, produces a blue color with sulphuric acid; it is but slightly soluble in water or alcohol. It is narcotic.

Protopine, $C_{20}H_{19}O_5N$, is insoluble in water, soluble in alcohol and chloroform.

Laudanine, $C_{20}H_{25}O_4N$. Crystallizes from dilute alcohol in prisms; melting point 166° C.; $[a]_D$ 0°; soluble in chloroform, benzene or alcohol. Gives a deep red color with sulphuric acid and iron oxide. A strong tetanic poison.

Codamine, $C_{20}H_{25}O_4N$. Isomeric with laudanine. Crystallizes from ether in hexagonal prisms. Melting point 126° C. Moderately soluble in water and soluble in alcohol; colored green with nitric acid and ferric chloride.

Rhœadine, $C_{21}H_{21}O_6N$. Nearly insoluble in water, alcohol, ether, petroleum benzin, and chloroform; melting point 232° C. With sulphuric acid or hydrochloric acid it turns a purple color. It is non-toxic.

Meconidine, $C_{21}H_{23}O_4N$. Amorphous; easily soluble in alcohol, ether, benzene, and chloroform; melting point 58° C., colored olive-green by sulphuric acid, orange-red by nitric acid.

Laudanosine, $C_{21}H_{27}O_4N$. Produces rose color with sulphuric acid, violet when heated; soluble in ether.

Lanthopine, $C_{23}H_{25}O_4N$. Sparingly soluble in chloroform, melting point 200° C. With sulphuric acid a pale violet color is given which changes to brown on heating.

Gnoscopine (*dl*-narcotine), $C_{22}H_{23}O_7N$. This alkaloid presumably does not exist in opium but is produced from narcotine by racemization. Colorless needles, melting point 229° C.

Neopine, $C_{18}H_{21}O_4N$. An amorphous alkaloid soluble in water, alcohol, ether, chloroform or benzene. It gives color reactions similar to those of codeine.

Laudanidine, $C_{20}H_{25}O_4N$. Occurs with laudanine, of which it is supposed to be the lævo-form. Melting point 177° C, $[a]_D$ −87.8° in chloroform.

Pseudopapaverine, $C_{21}H_{21}O_4N$. Usually a constituent of commercial papaverine. Melting point 147° C.

Papaveramine, $C_{21}H_{25}O_6N$. Colorless prisms. Melting point 128° to 129° C.

Xanthaline (Papaveraldine), $C_{20}H_{19}O_5N$. Colorless scales; melting point 210° C.

Protopapaverine, $C_{19}H_{19}O_4N$.

Tritopine, $(C_{21}H_{27}O_6N)_2O$. This alkaloid is said to be physiologically inactive. It has a melting point of 182° C. It is easily soluble in chloroform but insoluble in ether.

Oxynarcotine, $C_{22}H_{23}O_8N$. Nearly insoluble in water, alcohol, chloroform, and benzene, but soluble in alkaline solutions.

Uses—Opium is narcotic, sedative, and antispasmodic. The dose of powdered opium is one grain (0.065 Gm.). The official preparations are listed on page 1103.

The use and sale of opium, its alkaloids and derivatives and other narcotics and habit-forming drugs, are subject to rigid Federal regulation under the *Harrison Act*, and by many states which have enacted similar regulations. These are explained in a special Chapter on Laws. See Part VII.

MORPHINA

Morphine, $C_{17}H_{19}O_3N$. Morphine in the form of the pure alkaloid is no longer official, as the salts are more soluble and better adapted for use in medicine. It was the first alkaloid to be discovered.

In the seventeenth and eighteenth centuries many attempts were made to separate from opium the principle to which its activity was due. Preparations claimed to represent these active principles, but which were really extracts, were employed in medicine under the name of *Magisterium Opii*. Bucholz was the first to endeavor to obtain a crystalline product from opium. About 1800 a number of learned apothecaries of the time were devoting their attention to the separation of the suspected active principle. In 1806, Friedrich William Adam Sertürner, an apothecary of Eimbeck, Germany, announced the separation of a basic crystalline substance which existed in opium in combination with a special acid. He later published, in 1817, the results of further investigation in which he named the substance *morphium* and described it as a *vegetable alkali*. Sertürner was later awarded a prize of 2000 francs for his discovery, by the French Institute of Science. Liebig, in 1831, assigned to it the formula $C_{34}H_{36}O_6N$, which was later modified by Laurent to $C_{17}H_{19}O_3N$.

Preparation—Morphine may be prepared by the former official process, as follows:

Opium, sliced, 12 oz. troy; ammonia water, 6 fl. oz.; animal charcoal, in fine powder, alcohol, distilled water, each, a sufficient quantity. Macerate the opium with 4 pints of distilled water for twenty-four hours, and, having worked it with the hand, again macerate for twenty-four hours and strain. In like manner, maccrate the residue twice successively with the same quantity of distilled water and strain. Mix the infusions, evaporate to 6 pints, and filter; then add 5 pints of alcohol, and afterwards 3 fl. oz. of the ammonia water, previously mixed with 8 fl. oz. of alcohol. After twenty-four hours, pour in the remainder of the ammonia water, mixed, as before, with 8 fl. oz. of alcohol; and set the liquid aside for twenty-four hours that crystals may form. To purify these, boil them with 2 pints of alcohol until they are dissolved, filter the solution, while hot, through animal charcoal, and set it aside to crystallize.

In this process the infusions containing the morphine, in combination with meconic and lactic acids, are treated with alcohol and ammonia water. The former retains the coloring matter, caoutchouc, resins, etc., in solution, while the ammonia combines with the natural acids, the morphine being precipitated as an insoluble precipitate.

Description—In colorless or white, shining, rhombic prisms, in fine needles, or as a crystalline powder; permanent in the air. Odorless. A saturated aqueous solution of Morphine is alkaline to litmus.

Solubility—One Gm. of Morphine dissolves in 3340 cc. of water, 210 cc. of alcohol, 1220 cc. of chloroform, 6250 cc. of ether, and 100 cc. of lime water, at 25° C., also in 1075 cc. of boiling water and 98 cc. of boiling alcohol; insoluble in benzene.

Tests for Identity and Purity—(See Morphine Sulphate).

MORPHINÆ HYDROCHLORIDUM. U.S. Morphine Hydrochloride

[Morph. Hydrochl.—Morphine Chloride]

The hydrochloride $[C_{17}H_{19}O_3N.HCl.3H_2O = 375.76]$ of an alkaloid obtained from opium.

Preparation—This salt may be prepared by mixing morphine with distilled water and carefully adding hydrochloric acid, drop by drop, until the

morphine is neutralized and dissolved. Evaporate the solution on a water bath, to the consistence of a syrup and set it aside until it crystallizes. Lastly dry the mass at a gentle heat.

Description and Physical Properties—White, silky, glistening needles, or cubical masses, or a white, crystalline powder. It is odorless, and is stable in the air.

One Gm. of Morphine Hydrochloride is soluble in 17.5 cc. of water and in 52 cc. of alcohol, at 25° C. One Gm. is soluble in 0.5 cc. of boiling water and in 46 cc. of alcohol at 60° C. It is soluble in glycerin, but insoluble in chloroform and in ether.

Tests for Identity—Silver nitrate T.S. added to an aqueous solution of the salt produces a white precipitate, insoluble in nitric acid.

Morphine Hydrochloride responds to the tests for identity for morphine under *Morphinæ Sulphas*.

Tests for Purity—Morphine Hydrochloride loses not more than 15 per cent when dried to constant weight at 100° C. (*water*).

Add 2 cc. of potassium carbonate T.S. to 5 cc. of an aqueous solution of the salt (1 in 30), and gently shake the mixture: a white precipitate is produced which does not become green on exposure to air, or color chloroform when shaken with it (*apomorphine*).

Morphine Hydrochloride also complies with the tests for purity under *Morphinæ Sulphas*.

Preserve in well-closed containers, protected from light.

Uses—Morphine hydrochloride is preferred to the sulphate in Great Britain as a narcotic and sedative. The dose is one-eighth to one-fourth of a grain (0.008 to 0.015 Gm.).

MORPHINÆ SULPHAS. U.S. Morphine Sulphate

[Morph. Sulph.]

The sulphate $[(C_{17}H_{19}O_3N)_2.H_2SO_4.5H_2O = 758.65]$ of an alkaloid obtained from opium.

Preparation—This useful salt may be made by the former official process, as follows:

Take of morphine, in fine powder, 1 oz. troy: distilled water, 8 fl. oz.; diluted sulphuric acid, a sufficient quantity. Mix the morphine with the distilled water, then carefully drop in diluted sulphuric acid, constantly stirring until the morphine is neutralized and dissolved. Evaporate the solution by means of a water bath, so that on cooling it may crystallize. Lastly, drain the crystals, and dry them on bibulous paper.

Description and Physical Properties—White, feathery, silky crystals, or cubical masses, or a white, crystalline powder. It is odorless, and is stable in the air.

One Gm. of Morphine Sulphate is soluble in 15.5 cc. of water and in 565 cc. of alcohol, at 25° C. One Gm. is soluble in 0.7 cc. of water at 80° C. and in 240 cc. of alcohol at 60° C. It is insoluble in chloroform and in ether.

Tests for Identity—Add a few drops of ammonia T.S. to 5 cc. of an aqueous solution of Morphine Sulphate (1 in 30), and gently shake the mixture: a white precipitate is formed, which dissolves upon the subsequent addition of a few cc. of sodium hydroxide T.S.

Sulphuric acid containing 0.005 Gm. of selenous acid in each cc. gives with Morphine Sulphate a blue color, changing to green and then to brown. (*Codeine* yields a green color, changing to blue and afterward to grass-green.) Sulphuric acid containing 0.005 Gm. of molybdic acid in each cc. gives a purple color, changing to blue. Sulphuric acid containing in each cc. one drop of formaldehyde T.S. yields an intensely purple color. With nitric acid Morphine Sulphate produces an orange-red color fading to yellow.

The addition of a few drops of freshly prepared ferric chloride T.S. to an aqueous solution of Morphine Sulphate (1 in 100) produces a blue color, which is destroyed by acids, alcohol, or by heating. Add potassium ferricyanide T.S., containing 1 drop of ferric chloride T.S. in each cc., to an aqueous solution of the salt (1 in 100): a deep blue color is produced at once (*difference from codeine*).

Barium chloride T.S. produces in an aqueous solution of the salt a white precipitate, insoluble in hydrochloric acid.

Tests for Purity—A solution of 0.5 Gm. of the salt in 15 cc. of distilled water requires not more than 0.5 cc. of fiftieth-normal sodium hydroxide for neutralization, using one drop of methyl red T.S. as indicator.

Dried to constant weight at 130° C., Morphine Sulphate loses not more than 12 per cent (*water*).

The ash from 0.5 Gm. is negligible.

Warm 0.2 Gm. of Morphine Sulphate with 5 cc. of sodium hydroxide T.S.: the odor of ammonia is not noticeable (*ammonium salts*).

Add a few drops of ferric chloride T.S. to 5 cc. of an aqueous solution of the salt (1 in 30), previously mixed with 5 cc. of diluted hydrochloric acid: no red color is produced (*meconate*).

Dissolve 1 Gm. of Morphine Sulphate in 10 cc. of sodium hydroxide T.S. in a separator, and shake the solution with three successive portions of 15, 10, and 10 cc. of chloroform, passing the

chloroform solutions through a small filter previously moistened with chloroform. Shake the combined chloroform solutions with 5 cc. of distilled water, separate the chloroform, and evaporate it carefully to dryness on a water bath. Add to the residue thus obtained 10 cc. of fiftieth-normal sulphuric acid, heat gently until dissolved, cool, add two drops of methyl red T.S., and titrate the excess of acid with fiftieth-normal sodium hydroxide: not less than 7.5 cc. of the latter is required (*foreign alkaloids*).

Preserve in well-closed containers, protected from light.

N. F. Preparations—Mistura Chloroformi et Morphinæ Composita; Syrupus Pini Albæ Compositus cum Morphina.

Uses—Morphine sulphate is much more largely prescribed in the United States than any other salt of morphine. The dose is one-eighth to one-fourth of a grain (0.008 to 0.015 Gm.). The *solution of morphine sulphate* formerly official was made by dissolving one grain of morphine sulphate in one fluidounce of distilled water. Although the solution is more stable than that of any other of the morphine salts in use, it will in time deteriorate, either through the presence of microscopic plants or from other causes and, hence, it is not desirable to keep it on hand. This solution must not be confounded with *Magendie's solution*, which is *sixteen times as strong — i.e.*, sixteen grains in a fluidounce. This solution is often used hypodermically.

CODEINA. U. S. Codeine

[**Codein.**—Methylmorphine]

An alkaloid [$C_{17}H_{18}(CH_3)O_3N.H_2O$ = 317.28] obtained from opium or prepared from morphine by methylation.

Preparation—While codeine is obtained from opium directly after crystallization of the morphine from the aqueous extract, its largest source is by the methylation of morphine. Codeine is a substituted morphine in which one of the hydroxyls is replaced by methoxyl (OCH_3). Replacement can be made in many ways for which numerous patents have been issued as by the action of dimethyl sulphate on the alkaline earth combinations of morphine.

Codeine, which was isolated by Robiquet in 1832, is remarkable for being, with the exception of colchicine, the most soluble alkaloid in use, there being no necessity for salifying it. Its salts are frequently used and are even more soluble. In alcohol it has an $[a]_D$ −137°, or −111.5° in chloroform. It is usually seen in larger crystals than any other alkaloid.

Description and Physical Properties—Colorless, translucent crystals, or a white, crystalline powder. It is odorless, and is slightly efflorescent in warm air.

One Gm. of Codeine is soluble in 120 cc. of water, 2 cc. of alcohol, 0.5 cc. of chloroform, 18 cc. of ether, and in 13 cc. of benzene, at 25° C. One Gm. is soluble in 1.2 cc. of alcohol at 60° C.

Tests for Identity—When heated in an amount of water insufficient for complete solution, Codeine melts to oily drops, which crystallize on cooling.

Codeine rendered anhydrous by drying at 80° C. melts between 154° and 156° C.

A saturated, aqueous solution of Codeine is alkaline to litmus paper, and is lævorotatory.

Sulphuric acid, containing 0.005 Gm. of selenous acid in each cc., produces with Codeine a green color, which changes rapidly to blue, then slowly back to green.

Dissolve about 0.01 Gm. of Codeine in 5 cc. of sulphuric acid, add a drop of ferric chloride T.S., and warm: the solution becomes blue, changing to red on the addition of a drop of nitric acid.

Tests for Purity—When dried to constant weight at 80° C., Codeine loses not more than .6 per cent of its weight (*water*).

The ash from 0.5 Gm. is negligible.

About 0.01 Gm. of Codeine dissolves in 5 cc. of sulphuric acid (free from nitrous compounds) without producing other than a transient, pinkish tint (*readily carbonizable substances*).

Dissolve about 0.05 Gm. of potassium ferricyanide in 10 cc. of distilled water, add 1 drop of ferric chloride T.S. and 1 cc. of a neutral, or slightly acid, aqueous solution of Codeine (1 in 100) made with the aid of sulphuric acid: no blue color is produced at once (*morphine*).

Preserve in well-closed containers, protected from light.

N. F. Preparation—Elixir Terpini Hydratis et Codeinæ.

Uses—Codeine is a sedative, in doses of one-fourth to one grain (0.015 to 0.065 Gm.).

CODEINÆ PHOSPHAS. U.S. Codeine Phosphate

[Codein. Phos.]

Codeine Phosphate [$C_{17}H_{18}(CH_3)O_3N.H_3PO_4.2H_2O = 433.36$] contains not less than 67 per cent of anhydrous codeine [$C_{17}H_{18}(CH_3)O_3N = 299.27$].

Preparation—Codeine phosphate may be made by evaporating and crystallizing a solution of codeine in phosphoric acid.

Description and Physical Properties—Fine, white, needle-shaped crystals, or a white, crystalline powder. It is odorless. Codeine Phosphate readily loses water on exposure to air.

One Gm. of Codeine Phosphate is soluble in 2.3 cc. of water, 325 cc. of alcohol, 4500 cc. of chloroform, and in 1875 cc. of ether, at 25° C. One Gm. is soluble in 0.5 cc. of water at 80° C., and in 125 cc. of boiling alcohol.

Tests for Identity—An aqueous solution of Codeine Phosphate (1 in 20) is acid to litmus paper.

It responds to the identity tests with selenous acid, ferric chloride, and nitric acid under *Codeina*.

In an aqueous solution of Codeine Phosphate neutralized with ammonia water, silver nitrate T.S. produces a yellow precipitate, which is soluble in diluted nitric acid and in ammonia water.

Tests for Purity—Separate portions of 10 cc. each of an aqueous solution of Codeine Phosphate (1 in 100) show no turbidity at once on the addition of a few drops of barium chloride T.S. (*sulphate*), and no opalescence with a few drops of silver nitrate T.S. (*chloride*).

Codeine Phosphate complies with the test for *morphine* under *Codeina*.

Assay—Dissolve about 0.5 Gm. of Codeine Phosphate, accurately weighed, in 10 cc. of distilled water, in a separator, add 10 cc. of sodium hydroxide T.S., and extract the codeine by shaking with four successive portions of 15 cc., 10 cc., 10 cc., and 5 cc. of chloroform, or a sufficient quantity to complete the extraction. Shake the combined chloroform solutions with 5 cc. of distilled water, and completely separate the chloroform from the aqueous layer. Evaporate the chloroform almost to dryness on a water bath, dissolve the residue by warming with 15 cc. of tenth-normal sulphuric acid, heat the solution on the water bath until the odor of chloroform is no longer evolved, cool, dilute with about 10 cc. of distilled water, and titrate the excess of acid with tenth-normal sodium hydroxide, using 2 drops of methyl red T.S. as indicator. Each cc. of tenth-normal sulphuric acid corresponds to 0.02993 Gm. of anhydrous codeine ($C_{18}H_{21}O_3N$).

This assay is explained on page 1458.

Preserve in well-closed containers, protected from light.

Uses—Codeine phosphate is a valuable sedative, and is often preferred to other morphine salts. Dose, one-half grain (0.03 Gm.).

CODEINÆ SULPHAS. U.S. Codeine Sulphate

[Codein. Sulph.]

[$C_{17}H_{18}(CH_3)O_3N_2H_2SO_4.5H_2O = 786.69$].

Preparation—Codeine sulphate is made by crystallizing from a solution of codeine in diluted sulphuric acid.

Description and Physical Properties—Long, glistening, white, needle-shaped crystals or rhombic prisms, or a crystalline powder. It is odorless, and is efflorescent in the air.

One Gm. of Codeine Sulphate is soluble in 30 cc. of water and in 1280 cc. of alcohol, at 25° C. One Gm. is soluble in 6.5 cc. of water at 80° C. and in 440 cc. of alcohol at 60° C. It is insoluble in chloroform and in ether.

Tests for Identity—It responds to the identity tests with selenous acid, ferric chloride and nitric acid under *Codeina*.

Barium chloride T.S. produces in an aqueous solution of the salt a white precipitate which is insoluble in hydrochloric acid.

Tests for Purity—When dried to constant weight at 100° C., Codeine Sulphate loses not more than 12 per cent of its weight (*water*).

The ash from 0.5 Gm. is negligible.

A solution of 0.5 Gm. of Codeine Sulphate in 15 cc. of distilled water requires not more than 0.3 cc. of fiftieth-normal sulphuric acid for neutralization, using one drop of methyl red T.S. as indicator.

Codeine Sulphate complies with the tests for *morphine* and *readily carbonizable substances* under *Codeina*.

Preserve in well-closed containers, protected from light.

Uses—Codeine sulphate is preferred by many practitioners to morphine sulphate. It is used as a sedative and narcotic. Dose, one-half grain (0.03 Gm.).

APOMORPHINÆ HYDROCHLORIDUM. U.S. **Apomorphine Hydrochloride**

[Apomorph. Hydrochl.—APOMORPHINE CHLORIDE]

The hydrochloride [$C_{17}H_{17}O_2NHCl.\frac{1}{2}H_2O = 312.71$] of an alkaloid prepared from morphine by the abstraction of one molecule of water.

Caution—Apomorphine Hydrochloride must be rejected if it at once imparts an emerald-green color to 100 parts of distilled water when shaken with it in a test tube.

Preparation—It may be made by heating morphine in a closed tube with a great excess of hydrochloric acid for two or three hours to the temperature of 140° to 150° C. The contents of the tube are then dissolved in water, an excess of sodium bicarbonate added, and the mixture extracted with chloroform or ether in which the alkaloid, unlike morphine, is readily soluble. It may be crystallized from the ether or chloroform solution by evaporation, in the absence of oxygen, or by shaking the solvent with a small amount of hydrochloric acid, when the apomorphine separates. The process is one of dehydration—the morphine parting with one molecule of water, thus:

$$\underset{\text{morphine}}{C_{17}H_{19}O_3N} = \underset{\text{apomorphine}}{C_{17}H_{17}O_2N} + \underset{\text{water}}{H_2O}$$

Description and Physical Properties—Minute, white or grayish-white, glistening crystals, acquiring a greenish tint upon exposure to light and air. It is odorless.

One Gm. of Apomorphine Hydrochloride is soluble in 50 cc. of water and in 50 cc. of alcohol, at 25° C. One Gm. is soluble in 17 cc. of water at 80° C., and is very slightly soluble in chloroform and in ether.

Tests for Identity—The addition of a solution of sodium bicarbonate to an aqueous solution of the salt (1 in 100) produces a white, or pale greenish-white precipitate, which rapidly becomes green on exposure to air and when dissolved in ether, produces a violet color; in chloroform, a violet-blue color.

Apomorphine Hydrochloride dissolves in nitric acid, producing a dark purple solution.

Silver nitrate T.S. added to an aqueous solution of the salt produces a white precipitate, insoluble in nitric acid. This precipitate soon turns black by reduction to metallic silver, and is instantly reduced by the addition of ammonia water.

Tests for Purity—A saturated aqueous solution of Apomorphine Hydrochloride is neutral to litmus paper.

The ash from 0.2 Gm. is negligible.

Shake 0.1 Gm. of the salt with 5 cc. of ether: the latter acquires not more than a pale reddish color (*decomposition products*).

Preserve in small, dark amber-colored, well-stoppered vials, which have been previously rinsed with diluted hydrochloric acid and dried.

Uses—This remarkable compound is devoid of narcotic properties, but is expectorant in doses of one-sixtieth of a grain (0.001 Gm.), and a powerful emetic, hypodermically, in one-twelfth grain (0.005 Gm.) doses; it should be employed with caution to avoid excessive emesis.

ÆTHYLMORPHINÆ HYDROCHLORIDUM. U.S. **Ethylmorphine Hydrochloride**

[Æthylmorph. Hydrochl.—ETHYLMORPHINE CHLORIDE]

The hydrochloride [$C_{17}H_{18}O_2N(OC_2H_5).HCl.2H_2O = 385.79$] of a synthetic alkaloid prepared from morphine by ethylation.

Preparation—It is prepared by subjecting morphine to the action of ethyl iodide in the presence of sodium or potassium hydroxide and purifying and salifying the resulting product.

Description and Physical Properties—A white or faintly yellow, microcrystalline powder, having no odor.

One Gm. of Ethylmorphine Hydrochloride is soluble in 8 cc. of water, and in 22 cc. of alcohol, at 25° C. It is slightly soluble in ether and in chloroform.

Tests for Identity—It melts at about 123° C. with decomposition.

Add a drop of ferric chloride T.S. to a solution of about 0.01 Gm. of the salt in 10 cc. of sulphuric acid, and warm it on a water bath: the mixture will become at first green, then deep violet-blue, and, after the addition of a drop of nitric acid, deep red.

Silver nitrate T.S. produces in an aqueous solution of the salt (1 in 20) a white precipitate which is insoluble in nitric acid.

Tests for Purity—An aqueous solution of the salt (1 in 20) is neutral to litmus paper.

The ash from 0.2 Gm. is negligible.

Ethylmorphine Hydrochloride loses not more than 10 per cent of its weight when dried to constant weight at 100° C. (*water*).

Heat 5 cc. of an aqueous solution of the salt (1 in 20) with 5 cc. of sodium hydroxide T.S. on a water bath: no vapors showing an alkaline reaction to litmus paper are evolved at once (*ammonium compounds*).

Dissolve about 0.05 Gm. of potassium ferricyanide in 10 cc. of distilled water, add 1 cc. of diluted ferric chloride solution (1 volume of ferric chloride T.S. to 9 volumes of water), and 1 cc. of an aqueous solution of Ethylmorphine Hydrochloride (1 in 100): no green or blue color is produced at once (*morphine*).

Add 1 cc. of ammonia T.S. to 5 cc. of an aqueous solution of Ethylmorphine Hydrochloride (1 in 25): a white turbidity is produced at once (*difference from codeine hydrochloride*).

Preserve in well-closed containers, protected from light.

Uses—This alkaloid is commonly sold under the name *dionin*, and is used as a substitute for morphine, although it is less likely to cause nausea and depression. Dose. one-fourth grain (0.015 Gm.).

COTARNINÆ CHLORIDUM. U.S. Cotarnine Chloride

[**Cotarn. Chlor.**—COTARNINÆ HYDROCHLORIDUM U.S.P. IX]

The chloride [$C_{12}H_{14}O_3NCl.H_2O = 273.66$] of an alkaloid prepared from narcotine.

Preparation—The base was obtained by Wöhler by the oxidation of narcotine with manganese dioxide, in the presence of sulphuric acid. It can be readily made by oxidizing narcotine with nitric acid or by boiling narcotine with water until hydrolized.

Description and Physical Properties—A yellow, odorless, crystalline powder. It is deliquescent in moist air.

Cotarnine Chloride is very soluble in water and in alcohol, the solutions being yellow.

Tests for Identity—Dissolve about 0.5 Gm. of Cotarnine Chloride in 10 cc. of distilled water, and add 2 cc. of a 15 per cent aqueous solution of sodium hydroxide: a milk-white precipitate is produced which dissolves on agitation, but is reprecipitated from the solution after standing for some time, leaving the supernatant liquor clear but faintly yellow.

Silver nitrate T.S. added to an aqueous solution of Cotarnine Chloride produces a white precipitate insoluble in nitric acid.

About 0.2 Gm. of Cotarnine Chloride dissolved in 10 cc. of distilled water yields a brown precipitate of cotarnine periodide on the addition of 10 cc. of tenth-normal iodine. When this precipitate is collected on a filter, and dried to constant weight over sulphuric acid, it melts between 142° and 144° C.

Tests for Purity—An aqueous solution of Cotarnine Chloride (1 in 20) is neutral to litmus paper.

Heat gradually 0.1 Gm. of Cotarnine Chloride over a Bunsen burner: it is decomposed, evolving characteristic, disagreeable vapors and yielding a reddish-brown liquid, which gradually changes to a hard, charred mass. The ash remaining on the incineration of this mass is negligible.

Uses—It is used to check bleeding from small blood vessels, in certain forms of nose bleeding and slow hemorrhages. It is known commercially as *stypticin*, and cotarnine phthalate as *styptol*. Dose, one grain (0.06 Gm.).

Unofficial Opium Principles, Derivatives and Preparations

OPIUM DEODORATUM (U.S.P. IX) Deodorized Opium

Deodorized Opium yields not less than 10 per cent nor more than 10.5 per cent of anhydrous morphine.

Prepare by macerating 500 Gm. of powdered opium for twenty-four hours in a wide-mouthed, well-closed bottle with sufficient purified petroleum benzin to cover it completely, shaking the mixture occasionally. Then decant the clear benzin layer as closely as possible and repeat the maceration for twenty-four hours with another portion of purified petroleum benzin. Again decant the clear benzin layer and transfer the remaining contents of the bottle to a plain filter. Closely cover the funnel, allow the mixture to drain and then slowly percolate the residue with purified petroleum benzin until the latter passes through without color. Remove the filter containing the Opium from the funnel, expose the powder to the open air, so that it may dry thoroughly, and add sufficient sugar of milk to restore the original weight. Care should be used to guard against the danger due to the inflammability of the benzin. Granulated opium may also be deodorized in the manner directed above.

Assay—Proceed as directed under *Opium*.

Pantopon-Roche—*Pantopium Hydrochloricum*, N. N. R.—A mixture of the hydrochlorides of the alkaloids of opium in the proportion in which they exist in Smyrna opium, containing 50 per cent of anhydrous morphine hydrochloride.

Pantopon-Roche (pantopium hydrochloricum) is a yellowish-gray, crystalline powder which is readily soluble in water.

Uses—Pantopon produces essentially the effects of opium, but, being devoid of its extractive, it may be used for hypodermic administration. It is probably absorbed rather more promptly, and is free from the nauseant odor and taste of the ordinary opium preparations. It is used in the same conditions as those in which opium is indicated.

Dose—For adults, $\frac{1}{12}$ to $\frac{1}{3}$ grain (0.005 to 0.02 Gm.) hypodermically or by mouth. One grain of pantopon is equivalent to:

2.5 grains of extract of opium, U. S. P.
5.0 grains of powdered opium, U. S. P.
45.0 minims of tincture of opium, U. S. P.
0.6 grain of morphine sulphate, U. S. P.

Manufactured by F. Hoffmann-LaRoche and Company.

Papaverine—*Papaverina*, N. N. R.—$C_{20}H_{21}O_4N$.—An alkaloid obtained from opium, belonging to the benzyl iso-quinoline group (that is, it is not a morphine derivative).

In fine, white, rhombic prisms or needles or sometimes in scales; it is odorless and tasteless. It is nearly insoluble in cold water; slightly soluble in alcohol, ether, chloroform and benzene, if cold; somewhat more soluble in these liquids when hot, but deposited by them on cooling, and soluble in warm petroleum ether and in acetone. It melts at 147° C.

Uses—Papaverine relaxes smooth muscle in general, although different organs are affected in a varying degree.

Papaverine is most effective in hypertonic conditions, while it does not interfere materially with the normal movements, for instance, of the intestines. It is also a rather feeble central analgesic and a local anesthetic. Its toxicity is low, and neither tolerance nor habituation has been reported. These actions have prompted its use, with reported success, in various spasmodic conditions of the smooth muscles, especially in all kinds of gastric and intestinal spasms, in biliary colic, and in bronchial spasm.

Dose—The oral and hypodermic single dose is from $\frac{1}{2}$ to $\frac{1}{4}$ grain (0.03 to 0.02 Gm.); daily dose to $7\frac{1}{2}$ grains (0.5 Gm.). Single doses of even 15 grains (1 Gm.) are said to be non-toxic.

Papaverine Hydrochloride—*Papaverinæ Hydrochloridum*, N. N. R.—$C_{20}H_{21}O_4N.HCl$.—The hydrochloride of the alkaloid papaverine, containing no less than 88 per cent of papaverine.

Uses and Dose—See Papaverine.

Papaverine hydrochloride occurs in a fine, white, crystalline powder or in small monoclinic plates or prisms; odorless and having a bitter taste; permanent in the air. It is sparingly soluble in water; soluble in alcohol; very soluble in chloroform, and insoluble in ether. An aqueous solution of papaverine hydrochloride has an acid reaction toward litmus paper.

CINCHONA. U. S. Cinchona

[Cinch.—Yellow Cinchona, Calisaya Bark, Peruvian Bark]

Cinchona is the dried bark of *Cinchona succirubra* Pavon or of its hybrids, known in commerce as Red Cinchona, or of *Cinchona Ledgeriana* Moens, *Cinchona Calisaya* Weddell and of hybrids of these with other species of *Cinchona*, known in commerce as Calisaya Bark or Yellow Cinchona (Fam. *Rubiaceæ*).

Cinchona yields not less than 5 per cent of the alkaloids of Cinchona.

The value of cinchona bark depends entirely upon the percentage of alkaloids present in it; and as barks are found in the market greatly varying in quality, it is necessary to prove their worth by assay. The official description and assay are as follows:

Description—In quills or curved pieces or in broken fragments; bark from 2 to 8 mm. in thickness; externally brown or reddish-brown, usually with white or gray lichens, more or less roughened with corky ridges or protuberances, and with transverse fissures, rarely numerous or much intersected and having their sides sloping (*Red Cinchona*), or with numerous intersecting transverse and longitudinal fissures having nearly vertical sides (*Yellow Cinchona*); inner surface brown or reddish-brown and striate; fracture short and granular in the outer bark, rather splintery in the inner bark; odor faintly aromatic; taste astringent and very bitter.

For further description see the U. S. P. X.

Assay—Heat 5 Gm. of Cinchona, in fine powder, for one hour, in a 500 cc. flask on a water bath, with 5 cc. of diluted hydrochloric acid and 10 cc. of distilled water. Cool, add 200 cc. of ether-chloroform mixture, and 10 cc. of strong ammonia T.S. Proceed by Type Process A, decanting an aliquot portion of 160 cc., representing 4 Gm. of Cinchona, and determine the alkaloids gravimetrically. Use chloroform for the final extraction.

This assay is explained on page 1497.

U. S. P. Preparations—Fluidextractum Cinchonæ; Tinctura Cinchonæ; Tinctura Cinchonæ Composita.

History—This drug derives its name from the Countess of Chinchon, through whose instrumentality it was introduced into European medical prac-

tice in 1640. It was also called *Jesuit's Bark* in recognition of the fact that it was used by the members of this ecclesiastical order in treating fever and ague. Its adoption as a valuable official remedy followed the purchase by Louis XIV, in 1680, of the secret of a proprietary remedy sold by an English apothecary's clerk named Robert Talbor, which contained cinchona as a basis. The romance of Cinchona has been published in various books and is well worth perusal.

About twenty alkaloids have been discovered in cinchona barks. Some of these are found in only one kind of bark, some are doubtless " split products " —that is, not existing naturally in the bark, but the result of the action of chemical agents upon it.

Quinine, Quinidine, Cinchonine, and *Cinchonidine* are the most important alkaloids found in cinchona barks, and they, or their important salts, will be considered in separate articles. The acids present are *kinic,* or *quinic, quinotannic,* and *kinovic,* or *quinovic.* The neutral principle is *kinovin,* or *quinovin,* while *cinchonic-red,* volatile oil, and red and yellow coloring matter are also present. The first four of the alkaloids in the following list are used in medicine. The list is as follows:

Natural Alkaloids—Quinine, $C_{20}H_{24}O_2N_2$; Quinidine, $C_{20}H_{24}O_2N_2$; Cinchonine, $C_{19}H_{22}ON_2$; Cinchonidine, $C_{19}H_{22}ON_2$; Quinamine, $C_{19}H_{24}O_2N_2$; Conquinamine, $C_{19}H_{24}O_2N_2$; Homoquinine, $C_{39}H_{46}O_4N_4$; Cinchonamine, $C_{19}H_{24}ON_2$; Paytine, $C_{21}H_{24}ON_2.H_2O$; Homocinchonidine, $C_{19}H_{22}ON_2$; Cusconine, $C_{23}H_{28}O_4N_2$; Cusconidine, $C_{23}H_{28}O_4N_2$; Concusconine, $C_{22}H_{26}O_4N_2$; Aricine, $C_{23}H_{28}O_4N_2$; Paricine, $C_{16}H_{18}ON_2$; Paytamine, $C_{21}H_{24}ON_2$; Hydroquinine, $C_{20}H_{26}O_2N_2$; Hydroquinidine, $C_{20}H_{26}O_2N_2$; Cinchotine, $C_{19}H_{24}ON_2$; Hydrocinchonine, $C_{19}H_{24}ON_2$; Hydrocinchonidine, $C_{19}H_{24}ON_2$; Diquinidine, $C_{40}H_{46}O_3N_4$; Cupreine, $C_{19}H_{22}O_2N_2$.

The Artificial Alkaloids are: Quinicine, $C_{20}H_{24}O_2N_2$; Cinchonicine, $C_{19}H_{22}ON_2$; Quinamicine, $C_{19}H_{24}O_2N_2$; Apoquinamine, $C_{19}H_{22}ON_2$. These are chiefly produced by the action of heat upon the natural alkaloids and usually in the presence of diluted acids. In addition there have been many others made which are not of pharmaceutical interest.

One of the principal difficulties in preserving galenical preparations of cinchona arises from the alteration and precipitation which the cinchotannic acid and its compounds undergo upon keeping. Glycerin has proved to be very useful by dissolving and holding these in solution, and hence it is present in nearly every one of the preparations.

Uses—Cinchona is a febrifuge and tonic in doses of fifteen grains (1 Gm.).

QUININA. U. S. Quinine

[Quin.]

An alkaloid [$C_{20}H_{24}O_2N_2.3H_2O = 378.36$] obtained from cinchona.

In 1820 Pelletier and Caventou, the famous French pharmacists, investigated the alkaloid *cinchonine* which had been announced in 1811 by Gomez of Lisbon, and found it to be a mixture of two alkaloids, the second of which they named *quinine. Quinidine* was discovered by Henry in 1833 and *cinchonidine* by Winckler in 1844. Pasteur gave the latter alkaloid its name and discovered the artificial cinchona alkaloids *quinicine* and *cinchonicine.*

This alkaloid, the most important one of cinchona, was obtained in an impure state by Fourcroy in 1792, but the importance of the discovery or the identity or properties of the substance were not realized.

Preparation—This alkaloid is usually made by adding to the cooled acid solution of the sulphate a quantity of ammonia water or solution of sodium

hydroxide just sufficient to precipitate the quinine, carefully avoiding an excess.

Quinine is soluble to varying degrees in the organic solvents (see U. S. P. text) and it has an $[a]_D$ $-158°$ at 15° C. in 99 per cent alcohol. The specific rotation of the alkaloid and its salts vary with the solvent.

Description and Physical Properties—A white, microcrystalline, odorless powder. It has a bitter taste, which is intense and persistent. It is efflorescent in dry air.

One Gm. of Quinine is soluble in 1560 cc. of water, 0.8 cc. of alcohol, 1.1 cc. of chloroform, 1.9 cc. of ether, and in 1890 cc. of ammonia water, at 25° C. One Gm. is soluble in 800 cc. of boiling water.

Tests for Identity—An alcoholic solution of Quinine (1 in 10) is alkaline to litmus paper, and is lævorotatory.

A solution of Quinine in diluted sulphuric acid shows a vivid blue fluorescence. Add 2 or 3 drops of bromine T.S. to 5 cc. of a saturated aqueous, solution of Quinine and add 1 cc. of ammonia T.S.: the liquid acquires an emerald-green color, due to the formation of thalleioquin.

Tests for Purity—Dried to constant weight at 100° C., Quinine loses not more than 15 per cent (*water*).

Ash: not more than 0.1 per cent.

A solution of 0.1 Gm. of Quinine in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

Heat 0.2 Gm. of Quinine with 2 cc. of sodium hydroxide T.S. on a water bath: the odor of ammonia is not evolved (*ammonium salts*).

Dry Quinine to constant weight at 100° C., dissolve 1.5 Gm. of the dried Quinine in 25 cc. of alcohol, dilute the solution with 50 cc. of hot water, add normal sulphuric acid (about 5 cc.) until the solution is acid, using 2 drops of methyl red T.S. as indicator, and neutralize the excess of acid with normal sodium hydroxide. Evaporate the liquid to dryness on a water bath, powder the residue, mix it in a test tube with 20 cc. of distilled water, and complete the test for *other alkaloids* as directed under *Quininæ Sulphas*.

Preserve in well-closed containers, protected from light.

N. F. Preparations—Liquor Hypophosphitum Compositus; Oleatum Quininæ; Syrupus Ferri, Quininæ et Strychninæ Phosphatum; Syrupus Hypophosphitum Compositus.

Uses—The alkaloid quinine is usually an ingredient of preparations in which it remains undissolved and therefore tasteless. The Pharmacopœia gives the following dose: tonic, one and one-half grains (0.1 Gm.); antimalarial, at least fifteen grains (1 Gm.) daily.

QUININÆ SULPHAS. U.S. Quinine Sulphate

[Quin. Sulph.]

$[(C_{20}H_{24}O_2N_2)_2.H_2SO_4 = 746.69$ (with 7 or $8H_2O$).]

Preparation—The processes which are used for making quinine sulphate, commercially, are regarded as valuable trade secrets, and the manufacturers carefully guard them. The following process, which was formerly official, illustrates one method of making the sulphate of the principal alkaloid from cinchona:

Take of yellow cinchona, in coarse powder, 48 oz. troy; hydrochloric acid, 3½ oz. troy; lime in fine powder, 5 oz. troy; animal charcoal, in fine powder, sulphuric acid, alcohol, water, distilled water, each, a sufficient quantity. Boil the cinchona in 13 pints of water mixed with one-third of the hydrochloric acid, and strain through muslin. Boil the residue twice successively with the same quantity of water and acid as before, and strain. Mix the decoctions, and, while the liquid is hot, gradually add the lime, previously mixed with 2 pints of water, stirring constantly, until the quinine is completely precipitated. Wash the precipitate with distilled water, and, having pressed, dried, and powdered it, digest it in boiling alcohol. Pour off the liquid, and repeat the digestion several times, until the alcohol is no longer rendered bitter. Mix the liquids, and distil off the alcohol until a brown viscid mass remains. Upon this, transferred to a suitable vessel, pour 4 pints of distilled water, and, having heated the mixture to the boiling point, add as much sulphuric acid as may be necessary to dissolve the quinine. Then add 1½ oz. troy of animal charcoal, boil the liquid for two minutes, filter while hot, and set it aside to crystallize. Should the liquid, before filtration, be entirely neutral, acidulate it very slightly with sulphuric acid; should it, on the contrary, change the color of litmus paper to a bright red, add more animal charcoal. Separate the crystals from the liquid, dissolve them in boiling distilled water slightly acidulated with sulphuric acid, add a little animal charcoal, filter the solution, and set it aside to crystallize. Lastly, dry the crystals on bibulous paper with a gentle heat, and keep them in a well-stoppered bottle. The mother-water may be made to yield an additional quantity of quinine sulphate by precipitating the quinine with ammonia water, and treating the precipitated alkaloid with distilled water, sulphuric acid, and animal charcoal, as before.

The hydrochloric acid forms with the alkaloids soluble hydrochlorides. The lime decomposes the salts by uniting with the acid, and the alkaloids are precipitated with the excess of lime. These are dissolved out with boiling alcohol, the solution evaporated, acidulated with sulphuric acid, decolorized with animal charcoal, and crystallized.

Sodium hydroxide is often used instead of lime to precipitate the alkaloids, because quinine is less soluble in a solution of sodium chloride than in calcium chloride, while several manufacturers prefer to use amyl alcohol for exhausting the lime precipitate of alkaloids. Oil of turpentine and refined petroleum have also been used as solvents to some extent.

At least three sulphates of quinine have been obtained, of which two are now official. The first of these, $(C_{20}H_{24}O_2N_2)_2.H_2SO_4 + 7H_2O$, "diquinic sulphate", is known and prescribed in Great Britain as *Quininæ Disulphas*, and is the official salt known as quinine sulphate, or *Quininæ Sulphas*, U. S.; the second, formed by dissolving the first in diluted sulphuric acid, has the formula $C_{20}H_{24}O_2N_2.H_2SO_4 + 7H_2O$, and is the official quinine bisulphate, or *Quininæ Bisulphas*, U. S.; while the third, which is not official, is the acid sulphate, $C_{20}H_{24}O_2N_2.2H_2SO_4 + 7H_2O$, and may be obtained from a solution of quinine in an excess of diluted sulphuric acid.

Description and Physical Properties—Hard, prismatic monoclinic needles or white, silky, light, flexible, glistening crystals, making a very light and easily compressible mass. It is odorless, and has a persistent, very bitter taste. It effloresces rapidly when exposed to dry air or when heated to 50° C., losing all but two molecules of its water of crystallization and becoming lusterless. When exposed to light, it acquires a brown tint.

One Gm. of Quinine Sulphate is soluble in 725 cc. of water, 107 cc. of alcohol, and in 30 cc. of glycerin, at 25° C. One Gm. is soluble in 47 cc. of water at 80° C. and in about 12 cc. of alcohol at 60° C. It is slightly soluble in chloroform and in ether, but is freely soluble in a mixture of 7 volumes of chloroform and in 4 volumes of dehydrated alcohol.

Tests for Identity—A saturated aqueous solution of Quinine Sulphate, when acidulated with diluted sulphuric acid, develops a vivid blue fluorescence.

Add 1 or 2 drops of bromine T.S. to 5 cc. of an aqueous solution of the salt (1 in 1000) and then add 1 cc. of ammonia T.S.: the liquid acquires an emerald-green color, due to the formation of thalleioquin.

Barium chloride T.S. produces in an aqueous solution of the salt a white precipitate, insoluble in hydrochloric acid.

Tests for Purity—A saturated aqueous solution of Quinine Sulphate is neutral or not more than slightly alkaline to litmus paper.

Quinine Sulphate loses not more than 16.2 per cent when dried to constant weight at 100° C. (*water*).

Ash: not more than 0.05 per cent.

A solution of 0.1 Gm. of the salt in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

One Gm. of the salt dissolves completely when heated to 50° C. in 7 cc. of a mixture of 2 volumes of chloroform and 1 volume of dehydrated alcohol, and the solution remains clear on cooling (*inorganic salts*).

Dry Quinine Sulphate (which must be neutral or slightly alkaline to litmus paper) at 50° C. for two hours, and then agitate 1.8 Gm. of the dried salt with 20 cc. of distilled water at 65° C. for half an hour. Allow the mixture to cool to 15° C., macerate it at this temperature for two hours with occasional shaking, and then filter it through a filter paper of a diameter from 8 to 10 cm. Transfer 5 cc. of this filtrate to a test tube and mix it gently (without shaking) with 6 cc. of ammonia T.S., which must contain not less than 10 per cent and not more than 10.2 per cent of NH_3, have a temperature of 15° C., and be added at once. A clear liquid is produced (*other cinchona alkaloids*).

Preserve in well-closed containers, protected from light.

N. F. Preparations—Elixir Cinchonæ Alkaloidorum and in other Elixirs containing Cinchona alkaloids in combination with Iron, Bismuth, etc.; Elixir Ferri Pyrophosphatis, Quininæ et Strychninæ; Pilulæ Antiperiodicæ; Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Fortiores; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Mites; Pilulæ Opii, Digitalis et Quininæ.

Uses—Quinine sulphate is used as an antiperiodic, tonic, and antipyretic. The tonic dose is one and one-half grains (0.1 Gm.), the anti-malarial dose, at least fifteen grains (1 Gm.) daily. It may be given in the form of pills or in solution. In the latter case it is better to suspend it in syrup without using acid, with the addition of a little fluidextract of glycyrrhiza and a small quantity of ammonia water.

QUININÆ BISULPHAS. U. S. Quinine Bisulphate

[**Quin. Bisulph.**—Quinine Acid Sulphate]

The acid sulphate $[C_{20}H_{24}O_2N_2.H_2SO_4.7H_2O = 548.50]$ of the alkaloid quinine.

Preparation—This salt is made by adding sulphuric acid to quinine sulphate suspended in water evaporating the solution, and crystallizing the bisulphate.

Description and Physical Properties—Colorless, transparent or whitish, orthorhombic crystals or small needles. It is odorless, and has a very bitter taste. It effloresces on exposure to air, and turns yellow on exposure to light.

One Gm. of Quinine Bisulphate is soluble in 9 cc. of water, 23 cc. of alcohol, 15 cc. of glycerin, 625 cc. of chloroform, and in 2500 cc. of ether, at 25° C. One Gm. is soluble in 0.7 cc. of boiling water and in 0.7 cc. of alcohol at 60° C.

Tests for Identity—An aqueous solution of Quinine Bisulphate (1 in 20) is strongly acid to litmus paper, and has a blue fluorescence.

Add 2 or 3 drops of bromine T.S. to 5 cc. of an aqueous solution of Quinine Bisulphate (1 in 1000), and then add 1 cc. of ammonia T.S.: the liquid acquires an emerald-green color, due to the formation of thalleioquin.

Barium chloride T.S. produces in an aqueous solution of the salt a white precipitate, insoluble in hydrochloric acid.

Tests for Purity—Quinine Bisulphate loses not more than 24 per cent when dried to constant weight at 100° C. (*water*).

Ash: not more than 0.05 per cent.

A solution of 0.1 Gm. of the salt in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

Heat 0.3 Gm. of the salt with 3 cc. of sodium hydroxide T.S. on a water bath: the odor of ammonia is not evolved (*ammonium salts*).

Dissolve 2.52 Gm. of Quinine Bisulphate in a mixture of 20 cc. of alcohol and 50 cc. of hot distilled water, and neutralize the solution with normal sodium hydroxide, using 2 drops of methyl red T.S. as indicator. Evaporate the solution to dryness on a water bath, powder the residue, mix it in a test tube with 20 cc. of distilled water, and complete the test for other *cinchona alkaloids* as directed under *Quininæ Sulphas*.

Preserve in well-closed containers, protected from light.

Uses—The bisulphate has been introduced into medicine in preference to the ordinary sulphate, because of its greater solubility. Being about eighty times more soluble, it is better adapted for making into pills than is the sulphate. It contains about 15 per cent less of the alkaloid than does the sulphate. The difference is to some extent compensated for by the greater solubility, and the dose given is usually the same as that of the sulphate.

QUININÆ HYDROCHLORIDUM. U.S. Quinine Hydrochloride

[Quin. Hydrochl.]

The hydrochloride [$C_{20}H_{24}O_2N_2.HCl.2H_2O = 396.81$] of the alkaloid quinine.

Preparation—Quinine hydrochloride may be made by double decomposition between quinine sulphate and barium chloride, or by dissolving the alkaloid quinine in diluted hydrochloric acid, evaporating, and crystallizing.

Description and Physical Properties—White, silky, glistening needles. It is odorless, and has a very bitter taste. The salt effloresces when exposed to warm air.

One Gm. of Quinine Hydrochloride is soluble in 16 cc. of water, 0.8 cc. of alcohol, 7 cc. of glycerin, 0.7 cc. of chloroform, and in 340 cc. of ether, at 25° C. One Gm. is soluble in 0.5 cc. of water at 80° C.

Tests for Identity—Add 2 or 3 drops of bromine T.S. to 5 cc. of an aqueous solution of Quinine Hydrochloride (1 in 1000), and then add 1 cc. of ammonia T.S.: an emerald-green color is produced, due to the formation of thalleioquin.

Silver nitrate T.S. produces in an aqueous solution of the salt (1 in 20) a white precipitate insoluble in nitric acid, but soluble in ammonia T.S.

Tests for Purity—An aqueous solution of Quinine Hydrochloride (1 in 25) is neutral or not more than slightly alkaline to litmus paper, and is not fluorescent, except when highly diluted or when diluted sulphuric acid is added to it.

Quinine Hydrochloride loses not more than 10 per cent when dried to constant weight at 120° C. (*water*).

Ash: not more than 0.05 per cent.

A solution of 0.1 Gm. of the salt in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

One Gm. of the salt dissolves completely in 7 cc. of a mixture of 2 volumes of chloroform and 1 volume of dehydrated alcohol (*inorganic salts*).

The addition of 5 drops of diluted sulphuric acid to 10 cc. of an aqueous solution of the salt (1 in 20) produces no turbidity (*barium*).

One Gm. of Quinine Hydrochloride shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1520.

Dissolve about 2.5 Gm. of Quinine Hydrochloride in 60 cc. of distilled water in a separator, add 10 cc. of ammonia T.S., shake out the mixture successively with 30 and 20 cc. of chloroform, and evaporate the combined chloroform solutions to dryness on a water bath. Dissolve 1.5 Gm. of this residue in 25 cc. of alcohol, dilute the solution with 50 cc. of hot distilled water, add normal

sulphuric acid (about 5 cc.) until the solution is acid, using 2 drops of methyl red T.S. as indicator, and neutralize the excess of acid with normal sodium hydroxide. Evaporate the liquid to dryness on a water bath, powder the residue, mix it in a test tube with 20 cc. of distilled water, and complete the test for *other cinchona alkaloids* as directed under *Quininæ Sulphas*.

Preserve in well-closed containers, protected from light.

N. F. Preparations—Elixir Ferri, Quininæ et Strychninæ; Elixir Glycerophosphatum Compositum; Syrupus Phosphatum cum Quinina et Strychnina; Tinctura Antiperiodica; Tinctura Antiperiodica sine Aloe.

Uses—This salt is used like the sulphate but it is much more soluble. The dose is the same as for the sulphate.

QUININÆ DIHYDROCHLORIDUM. U. S. Quinine Dihydrochloride

[Quin. Dihydrochl.]

The dihydrochloride [$C_{20}H_{24}O_2N_2.2HCl = 397.24$] of the alkaloid quinine.

Preparation—It may be prepared by dissolving 100 parts of quinine hydrochloride in 200 parts of distilled water and adding 37 parts of 25 per cent hydrochloric acid, the amount required to produce the dihydrochloride.

Description and Physical Properties—A white, odorless powder, having a very bitter taste.

One Gm. of Quinine Dihydrochloride is soluble in about 0.6 cc. of water and in 12 cc. of alcohol, at 25° C. It is slightly soluble in chloroform and very slightly soluble in ether.

Tests for Identity—An aqueous solution of Quinine Dihydrochloride is strongly acid to litmus paper.

Add 2 or 3 drops of bromine T.S. to 5 cc. of an aqueous solution of the salt (1 in 1000), and then add 1 cc. of ammonia T.S.: an emerald-green color is produced, due to the formation of thalleioquin.

Silver nitrate T.S. added to an aqueous solution of the salt (1 in 20) produces a white precipitate, insoluble in nitric acid but soluble in ammonia T.S.

Tests for Purity—Quinine Dihydrochloride loses not more than 3 per cent when dried to constant weight at 100° C. (*water*).

Ash: not more than 0.05 per cent.

A solution of 0.1 Gm. of Quinine Dihydrochloride in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

The addition of a few drops of diluted sulphuric acid to 10 cc. of an aqueous solution of the salt (1 in 20) produces no turbidity (*barium*).

One Gm. of Quinine Dihydrochloride shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1520.

Dissolve 1.8 Gm. of Quinine Dihydrochloride in 10 cc. of distilled water, add a slight excess of ammonia T.S., shake out the mixture successively with 20, 10 and 10 cc. of chloroform, and evaporate the combined chloroform solutions to dryness on a water bath. Dissolve the residue in 25 cc. of alcohol, dilute the solution with 50 cc. of hot distilled water, add normal sulphuric acid (about 5 cc.) until the solution is acid, using 2 drops of methyl red T.S. as indicator, and neutralize the excess of acid with normal sodium hydroxide. Evaporate the liquid to dryness on a water bath, powder the residue, mix it in a test tube with 20 cc. of distilled water, and complete the test for *other cinchona alkaloids* as directed under *Quininæ Sulphas*.

Preserve in well-closed containers, protected from light.

Uses—Its therapeutic effects are similar to the other quinine salts, but its great solubility makes it a favorite salt of quinine for hypodermic administration. The dose is the same as the sulphate.

QUININÆ HYDROBROMIDUM. U. S. Quinine Hydrobromide

[Quin. Hydrobr.—Quinine Bromide]

The hydrobromide [$C_{20}H_{24}O_2N_2.HBr.H_2O = 423.25$] of the alkaloid quinine.

Preparation—Quinine hydrobromide may be made by decomposing 40 parts of quinine sulphate, dissolved in 400 parts of hot alcohol, with 11 parts of potassium bromide dissolved in 30 parts of distilled water. Potassium sulphate crystallizes out, and the quinine hydrobromide in solution may be obtained by evaporation and crystallization. In drying the salt, care must be observed not to subject the crystals to heat sufficient to fuse them. A warm, dry atmosphere should be relied upon to effect the drying, and all unnecessary exposure to light should be avoided.

Quinine hydrobromide may also be made by double decomposition between quinine sulphate and barium bromide, both in hot alcoholic solution. It is sometimes made by dissolving the alkaloid quinine in hot diluted hydrobromic acid until the latter is no longer acid to litmus paper, evaporating, and crystallizing.

Description and Physical Properties—White, light, small needles, or scale-like crystals. It is odorless, has a very bitter taste, and effloresces on exposure to the air.

One Gm. of Quinine Hydrobromide is soluble in 40 cc. of water, 1 cc. of alcohol, 7 cc. of glycerin, 0.6 cc. of chloroform, and in 23 cc. of ether, at 25° C. One Gm. is soluble in 3.2 cc. of water at 80° C.

Tests for Identity—Add 2 or 3 drops of bromine T.S. to 5 cc. of an aqueous solution of Quinine Hydrobromide (1 in 1000), and then add 1 cc. of ammonia T.S.: an emerald-green color is produced, due to the formation of thalleioquin.

To 5 cc. of an aqueous solution of Quinine Hydrobromide (1 in 50) add 1 cc. of sodium hydroxide T.S., and warm the mixture for a few minutes. Cool well, filter, acidulate the filtrate with dilute hydrochloric acid, add 1 cc. of chloroform and a few drops of chlorine T.S., and shake gently: the chloroform acquires a reddish-brown color.

Tests for Purity—An aqueous solution of Quinine Hydrobromide (1 in 50) is neutral or only slightly alkaline to litmus paper and is not fluorescent except when mixed with an excess of diluted sulphuric acid.

Dried to constant weight at 100° C., Quinine Hydrobromide loses not more than 5 per cent (*water*).

Ash: not more than 0.05 per cent.

A solution of about 0.1 Gm. of the salt in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

One Gm. of Quinine Hydrobromide shows no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid, page 1520.

The addition of a few drops of diluted sulphuric acid to 10 cc. of a hot aqueous solution of the salt (1 in 20) produces no turbidity (*barium*).

One Gm. of Quinine Hydrobromide dissolves completely in 7 cc. of a mixture of 2 volumes of chloroform and 1 volume of dehydrated alcohol (*inorganic salts*).

Dissolve about 3 Gm. of Quinine Hydrobromide in 80 cc. of warm distilled water in a separator, add 10 cc. of ammonia T.S., shake out the mixture successively with 30 and 20 cc. of chloroform, and evaporate the combined chloroform solutions to dryness on a water bath. Dissolve 1.5 Gm. of this residue in 25 cc. of alcohol, dilute the solution with 50 cc. of hot distilled water, add normal sulphuric acid (about 5 cc.) until the solution is acid, using 2 drops of methyl red T.S. as indicator, and neutralize the excess of acid with normal sodium hydroxide. Evaporate the liquid to dryness on a water bath, powder the residue, mix it in a test tube with 20 cc. of distilled water, and complete the test for *other cinchona alkaloids* as directed under *Quininæ Sulphas*.

Preserve in well-closed containers, protected from light.

Uses—Quinine hydrobromide is sometimes used hypodermically. Its dose is the same as that of the sulphate.

QUININÆ TANNAS. U. S. Quinine Tannate
[Quin. Tann.]

Quinine Tannate is a compound of quinine with tannic acid, of somewhat varying composition, corresponding to not less than 30 per cent and not more than 35 per cent of anhydrous quinine [$C_{20}H_{24}O_2N_2 = 324.31$].

Preparation—It may be prepared by dissolving 12 Gm. of tannic acid in 75 cc. of distilled water and pouring the solution slowly and with constant stirring into a solution of 10 Gm. of quinine sulphate in a mixture of 15 cc. of diluted sulphuric acid and 150 cc. of water. Three Gm. of tannic acid and 3 Gm. of sodium bicarbonate are each dissolved in 50 cc. of distilled water, the solutions filtered and mixed, and the mixture added to the quinine-tannin mixture first prepared. The resulting precipitate is collected on a strainer, washed, heated on a water bath, in a porcelain dish, until it becomes resin-like, and is finally dried in the air and powdered.

Description and Physical Properties—A pale yellow or yellowish-white, amorphous powder. It is odorless and tasteless, or has not more than a slightly bitter, astringent taste.

Quinine Tannate is only slightly soluble in water, chloroform, and ether. It is somewhat more soluble in alcohol.

Tests for Identity—When heated, it melts to a purplish, viscous mass.

A saturated aqueous or alcoholic solution of Quinine Tannate is colored blue-black by ferric chloride T.S.

The alkaloid obtained in the assay responds to the identity tests under *Quinina*.

Tests for Purity—Quinine Tannate loses not more than 10 per cent when dried to constant weight at 100° C. (*water*).

Ash: not more than 0.3 per cent.

Shake 0.5 Gm. of Quinine Tannate with 50 cc. of distilled water and 1 cc. of nitric acid for five minutes, and filter: a 10 cc. portion of the filtrate is not colored by 1 cc. of hydrogen sulphide T.S. (*heavy metals*). Other 10 cc. portions of the filtrate show no more *chloride* than corresponds to 0.5 cc. of fiftieth-normal hydrochloric acid and no more *sulphate* than corresponds to 0.5 cc. of fiftieth-normal sulphuric acid.

Shake 1 Gm. of Quinine Tannate with 25 cc. of dehydrated ether for five minutes, filter, and wash the filter with 10 cc. of dehydrated ether. Evaporate the combined filtrate and washings and dry at 100° C.: the residue does not exceed 1 per cent (*uncombined quinine*).

Assay—Transfer to a separator about 0.5 Gm. of Quinine Tannate, accurately weighed, add 10 cc. of distilled water and 10 cc. of ammonia T.S., and shake at first with 20 cc. of ether, then with three successive 10 cc. portions of ether. Evaporate the combined ethereal liquids and dry the residue to constant weight at 100° C. The weight of the anhydrous quinine ($C_{20}H_{24}O_2N_2$) so obtained corresponds to not less than 30 and not more than 35 per cent of the weight of the Quinine Tannate taken.

Preserve in well-closed containers, protected from light.

Uses—This salt of quinine is almost insoluble in water and consequently almost tasteless. It is less certain in its action than the more soluble salts. Dose, three grains (0.2 Gm.).

QUININÆ ÆTHYLCARBONAS. U. S. Quinine Ethylcarbonate

[Quin. Æthylcarb.—Euquinine]

Quinine Ethylcarbonate [$C_2H_5O.CO.O.C_{20}H_{28}N_2O = 396.36$], the quinine ester of ethyl carbonic acid.

Description and Physical Properties—White, fine, soft needles, usually matted together in fleecy masses. Quinine Ethylcarbonate is odorless and practically tasteless, but when masticated it slowly develops a slightly bitter taste. It darkens on exposure to light.

Quinine Ethylcarbonate is only slightly soluble in water. One Gm. is soluble in 2 cc. of alcohol, 1 cc. of chloroform, and in about 10 cc. of ether, at 25° C. It is readily soluble in dilute acids.

Tests for Identity—Quinine Ethylcarbonate melts between 89° and 91° C.

Its saturated aqueous solution is slightly alkaline to litmus paper.

Its solution in diluted sulphuric acid exhibits a blue fluorescence.

To 5 cc. of an aqueous solution of Quinine Ethylcarbonate (1 in 1000), made with the aid of a slight excess of diluted sulphuric acid, add 2 or 3 drops of bromine T.S., and follow with 1 cc. of ammonia water: the liquid acquires a green color, due to the formation of thalleioquin.

To about 0.2 Gm. of Quinine Ethylcarbonate add 2 cc. of sodium hydroxide T.S. and 5 cc. of iodine T.S., and gently warm the mixture: the odor of iodoform is evolved.

Digest about 1 Gm. of Quinine Ethylcarbonate with 10 cc. of a 5 per cent solution of potassium hydroxide in dehydrated alcohol: a white precipitate is gradually formed which effervesces with acids.

Tests for Purity—Ash: not more than 0.2 per cent.

Dried over sulphuric acid for twenty-four hours, the loss in weight does not exceed 2 per cent (*water*).

Dissolve 0.3 Gm. of Quinine Ethylcarbonate in 10 cc. of diluted nitric acid and 20 cc. of distilled water: ten cc. portions of this solution are not rendered turbid at once by the addition of a few drops of silver nitrate T.S. (*chloride*) or of barium chloride T.S. (*sulphate*).

Preserve protected from light.

Uses—The action of quinine is essentially the same in all of its compounds. The soluble salts have the disadvantage of the bitter taste, and of producing a local action on the stomach and other tissues. To obviate these difficulties, insoluble compounds like the alkaloid, the tannate or the ethylcarbonate have been used, since these pass the mouth and stomach without offending the taste or disturbing the stomach. The same object is obtained more or less completely in a number of synthetic compounds in which the quinine radical is combined with other radicals, such as those of carbonic acid, to form insoluble, and therefore tasteless, esters. In the intestines these esters are broken up more or less rapidly into the alkaloid quinine and the other components. The rapidity with which this decomposition occurs will determine to a large extent the intensity of the therapeutic effect and the liability to produce cinchonism. This new official ester is of the latter character. The uses and dose are the same as for the other quinine salts.

QUININÆ ET UREÆ HYDROCHLORIDUM. U. S. Quinine and Urea Hydrochloride

[Quin. et Urea. Hydrochl.—Quinine and Urea Chloride]

A compound of the hydrochlorides of quinine and urea [$C_{20}H_{24}O_2N_2.HCl.CO(NH_2)_2.HCl.5H_2O = 547.38$] contains not less than 58 per cent of anhydrous quinine [$C_{20}H_{24}O_2N_2$].

Preparation—It may be prepared by dissolving 40 parts of quinine hydrochloride in 30 parts of diluted hydrochloric acid, specific gravity 1.061, adding 6 to 6.1 parts of pure urea, warming to form a solution filtering through glass wool, and crystallizing.

Description and Physical Properties—Colorless, translucent prisms, or a white, granular powder. It is odorless, and has a very bitter taste.

One Gm. of Quinine and Urea Hydrochloride is soluble in 0.9 cc. of water and in 2.4 cc. of alcohol, at 25° C.

Tests for Identity—An aqueous solution of Quinine and Urea Hydrochloride (1 in 20) is strongly acid to litmus paper.

A solution of the salt in diluted sulphuric acid (1 in 1000) shows a blue fluorescence. Add 2 or 3 drops of bromine T.S. to 5 cc. of an aqueous solution of the salt (1 in 1000), and then add 1 cc. of ammonia T.S.: the liquid acquires an emerald-green color, due to the formation of thalleioquin.

Add 2 cc. of colorless nitric acid to a cold solution of about 1 Gm. of the salt in 2 cc. of distilled water and cool the mixture at once to the temperature of melting ice: crystalline leaflets of urea nitrate are formed on standing. Collect the crystals in a funnel upon glass wool, wash them with about 5 cc. of a cold mixture of equal volumes of nitric acid and distilled water, and after draining, dissolve the crystals in a few cc. of distilled water: the addition of a few drops of mercuric nitrate T.S. to the urea nitrate solution, followed by sodium hydroxide T.S. to only a slightly acid reaction, produces a white precipitate.

Silver nitrate T.S. produces in an aqueous solution of the salt (1 in 20) a white precipitate, insoluble in nitric acid but soluble in ammonia T.S.

Tests for Purity—Ash: not more than 0.05 per cent.

A solution of 0.1 Gm. of the salt in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

Warm 10 cc. of an aqueous solution of the salt (1 in 20) with 5 cc. of sodium hydroxide T.S. to 50° C.: the odor of ammonia is not evolved at once (*ammonium compounds*).

Dissolve about 3 Gm. of Quinine and Urea Hydrochloride in 30 cc. of distilled water in a separator, add 10 cc. of ammonia water, shake out the mixture successively with 30 and 20 cc. of chloroform, and evaporate the combined chloroform solutions to dryness on a water bath. Dissolve 1.5 Gm. of this residue in 25 cc. of alcohol, dilute the solution with 50 cc. of hot distilled water, add normal sulphuric acid (about 5 cc.) until the solution is acid, using 2 drops of methyl red T.S. as indicator, and neutralize the excess of acid with normal sodium hydroxide. Evaporate the liquid to dryness on a water bath, powder the residue, mix it in a test tube with 20 cc. of distilled water, and complete the test for *other cinchona alkaloids* as directed under *Quininæ Sulphas*.

Assay—Dissolve about 0.5 Gm. of Quinine and Urea Hydrochloride, accurately weighed, in 5 cc. of distilled water in a separator, add 3 cc. of ammonia T.S., and shake the mixture with successive portions of 10, 5 and 5 cc., respectively, of chloroform or sufficient to completely extract the quinine. Evaporate the combined chloroform solutions on a water bath, dissolve the residue in 10 cc. of ether, evaporate to dryness and dry to constant weight at 100° C. The residue of anhydrous quinine ($C_{20}H_{24}O_2N_2$) so obtained corresponds to not less than 58 per cent of the weight of the Quinine and Urea Hydrochloride taken.

This assay is explained on page 1476.

Preserve in well-closed containers, protected from light.

Uses—It is used hypodermically in fifteen grain (1 Gm.) daily doses in the treatment of malaria and pneumonia. It is also much used as a local anesthetic as a substitute for cocaine.

Unofficial Salts of Quinine

Quininæ Hypophosphis, $C_{20}H_{24}O_2N_2HPH_2O_2.2H_2O$. (Quinine Hypophosphite (N. F. IV)	Fine, white, needles: odorless; very bitter. Soluble in about 35 parts of water and in 12.5 parts of alcohol. Dose, the same as other quinine salts
Quininæ Valeras, $C_{20}H_{24}O_2N_2HC_5H_9O_2.H_2O$. Quinine Valerate (N. F. IV)	White, lustrous crystals having an odor of valeric acid. Sparingly soluble in water but readily soluble in alcohol
Quininæ Glycerophosphas, $(C_{20}H_{24}O_2N_2)_2PO_4H_2(C_3H_7O_2).4H_2O$ Quinine Glycerophosphate, (N. F. IV)	White, crystalline needles or a powder. Soluble in about 850 parts of water and 75 parts of alcohol. Dose, the same as for quinine sulphate

Unofficial Salts of Quinine—*Continued*

Quininæ Salicylas, $C_{20}H_{24}O_2N_2.C_7H_6O_3.H_2O$. Quinine Salicylate (U. S. P. IX).	The salicylate of the alkaloid quinine. Colorless needles becoming pink on keeping. Soluble in 14 parts of alcohol, only slightly soluble in water. Dose, the same as the sulphate
Aristochin, Diquinine Carbonic Ester	The neutral carbonic ester of quinine. It is almost tasteless and insoluble
Saloquin, Quinine Salicylic Ester (Salochinin)	The salicylic acid ester of quinine. A tasteless salt of quinine

QUINIDINA. N. F. Quinidine

[Quinid.]

An alkaloid [$C_{20}H_{24}O_2N_2 = 324.31$], isomeric with quinine, obtained from the bark of various species of *Cinchona* (Fam. *Rubiaceæ*).

Quinidine (*conquinine*) is an isomer of quinine and occurs at least in small quantities in all of the cinchonas. It is probably present to the largest extent in Cinchona Calisaya which often contains 3 per cent.

It occurs in the mother liquors from the preparation of quinine sulphate. These liquors are precipitated with sodium hydroxide, whereby a mixture of alkaloids, known as "*quinoidine*" or "*chinoidin*", is obtained. This is similar to what is known as "*cinchona febrifuge*", which is prepared in India for native distribution. The quinoidine is extracted with ether, which removes the cinchonidine and quinidine. The ethereal solutions are evaporated, taken up in sulphuric acid, neutralized with ammonia, and the cinchonidine precipitated as the tartrate. Quinidine is a diacidic base, it produces fluorescence similar to quinine and gives the thalleioquin test. It is dextrorotatory $[\alpha]_D + 274.7°$ in a mixture of alcohol, 1 volume, chloroform, 2 volumes; quinine is lævorotatory.

Official Description—Quinidine occurs in acicular white crystals or as an amorphous white powder. When crystallized from alcohol it forms monoclinic prisms containing one molecule of alcohol, which it slowly loses on exposure to air, and rapidly loses when heated to 100° C. When precipitated by ammonia water from an aqueous solution of a salt of Quinidine, washed and dried, it forms an amorphous powder.

Odor, Taste—Odorless and having an intense and persistent bitter taste.

Solubility—When crystallized from an alcoholic solution, 1 Gm. dissolves at 25° C. in about 32 cc. of alcohol, 53 cc. of ether, and 1.5 cc. of chloroform; very slightly soluble in petroleum benzin and almost insoluble in water.

One gram of dried amorphous Quinidine dissolves at 25° C. in about 36 cc. of alcohol, 67 cc. of ether, and 1.7 cc. of chloroform; very slightly soluble in petroleum benzin and almost insoluble in water.

Tests for Identity—Quinidine melts at about 168° C. Incinerate 0.2 Gm. of Quinidine; no weighable residue remains.

Its alcoholic solution is dextrorotatory and its aqueous solution is alkaline to litmus.

A solution of Quinidine in diluted sulphuric acid (1 in 1000) shows a strong blue fluorescence.

Add a few drops of bromine T.S. to 10 cc. of an aqueous solution of Quinidine (1 in 1000), made with the aid of sufficient diluted sulphuric acid to produce complete solution, and then follow with ammonia water in slight excess; the liquid acquires an emerald-green color.

A solution of about 0.1 Gm. of Quinidine in 5 cc. of sulphuric acid is not darker than pale yellow.

Impurities and Tests for Impurities—Dissolve 0.5 Gm. of Quinidine in 10 cc. of distilled water at 80° C., with just enough sulphuric acid to form a solution neutral to litmus paper, and add a neutral solution of 0.5 Gm. of potassium iodide in 5 cc. of distilled water at 80° C. Agitate the mixture slightly, cool it to 15° C. and keep it at this temperature for one hour with occasional stirring. A white precipitate is formed (*difference from quinine*).

Filter out the precipitate and add 2 drops of ammonia water to the filtrate: it does not cause more than a slight turbidity (*other cinchona bases*).

Care must be taken to have the liquid perfectly neutral after the addition of the potassium iodide solution; if slightly acid, very dilute ammonia water must be added, drop by drop, with constant stirring, until exactly neutral to litmus paper.

Preserve in well closed containers, protected from light.

N. F. Preparation—Syrupus Quinidinæ.

Uses—Because of sparing solubility in water it is directed in the N. F. to prepare what has been sold as a "*Tasteless Syrup of Quinidine*". The dose is the same as quinine sulphate.

QUINIDINÆ SULPHAS. U. S. Quinidine Sulphate

[Quinidin. Sulph.]

The sulphate [$(C_{20}H_{24}O_2N_2)_2.H_2SO_4.2H_2O = 782.72$] of an alkaloid obtained from cinchona.

Preparation—Quinidine is obtained from cinchona bark as a by-product in the manufacture of quinine, to which it is closely related, being the stereoisomer of quinine.

Description and Physical Properties—Fine, needle-like, white crystals, frequently cohering in masses. It is odorless, has a very bitter taste, and darkens on exposure to light.

One Gm. of Quinidine Sulphate is soluble in about 90 cc. of water, and in 10 cc. of alcohol at 25° C. One Gm. is soluble in about 15 cc. of boiling water. It is soluble in chloroform but almost insoluble in ether.

Tests for Identity—An aqueous solution of Quinidine Sulphate (1 in 100) is neutral or slightly alkaline to litmus paper, and is dextrorotatory. (Quinine sulphate is lævorotatory.)

An aqueous solution of Quinidine Sulphate, when acidulated with diluted sulphuric acid, develops a vivid blue fluorescence. Add 1 or 2 drops of bromine T.S. to 5 cc. of an aqueous solution of the salt (1 in 1000) and follow with 1 cc. of ammonia T.S.: the liquid acquires an emerald-green color due to the formation of thalleioquin.

To 5 cc. of an aqueous solution of Quinidine Sulphate (1 in 100) add 1 cc. of silver nitrate T.S. and stir the mixture with a glass rod: a white precipitate forms after a short interval (*difference from many other alkaloids*).

Barium chloride produces in an aqueous solution of the salt a white precipitate which is insoluble in hydrochloric acid.

Tests for Purity—Dried to constant weight at 100° C., Quinidine Sulphate loses not more than 5 per cent (*water*).

Ash: not more than 0.1 per cent.

A solution of 0.1 Gm. of the salt in 2 cc. of sulphuric acid is not darker than light yellow (*readily carbonizable substances*).

One Gm. of Quinidine Sulphate dissolves in 5 cc. of a warm mixture of 2 volumes of chloroform and 1 volume of dehydrated alcohol with not more than a slight turbidity (*ammonium or other inorganic salts*).

Dissolve 0.5 Gm. of Quinidine Sulphate in 15 cc. of boiling water and add a solution of 0.5 Gm. of potassium iodide in 5 cc. of distilled water, which, if necessary, has previously been neutralized to litmus paper with tenth-normal sulphuric acid. A white precipitate is formed. Mix well, cool the mixture to 15° C., and keep it at this temperature for one hour with frequent agitation. Filter and add 2 drops of ammonia T.S. to the filtrate. No turbidity is produced within one minute (*other cinchona alkaloids*).

Preserve in well-closed containers, protected from light.

Uses—Quinidine, like quinine, is a protoplasm poison. It affects protozoa more than bacteria but less powerfully than quinine. At one time it was used, to some extent, as a substitute for quinine because it was then much the cheaper preparation.

Quinidine acts upon the heart in such a manner as to bring about cessation of fibrillation of the auricles in a certain proportion of instances. Quinidine and other cinchona alkaloids are the only drugs known to have this specific effect.

Dose—Commonly 3 grains (0.2 Gm.) of Quinidine Sulphate are given as a preliminary dose, and repeated after two hours to determine the patient's susceptibility to the drug. If there are no symptoms following this preliminary dose, therapeutic administration is begun on the following day when from 3 to 6 grains (0.2 to 0.4 Gm.) are given from three to five times daily, for one to three days. The maximum dose per day is from 15 to 30 grains (1 to 2 Gm.). If toxic symptoms occur, the administration of the drug should be discontinued.

CINCHONINÆ SULPHAS. N. F. Cinchonine Sulphate

(U. S. P. IX)

[Cinchonin. Sulph.]

The sulphate $[(C_{19}H_{22}ON_2)_2.H_2SO_4.2H_2O = 722.68]$ of an alkaloid obtained from the bark of several species of cinchona.

Cinchonine occurs in all of the varieties of cinchona, although it occurs in largest amounts in *Cinchona micrantha*. Due to the solubility of the sulphate it remains in the mother liquor after the crystallization of quinine sulphate. The liquor is precipitated with caustic soda producing, "quinoidine", a mixture of cinchonine, cinchonidine, and quinidine. The cinchonidine and quinidine are removed by washing with ether. The alkaloid is then crystallized from boiling alcohol.

Cinchonine is a diacidic base. It is not fluorescent in acid solution and does not give the thalleioquin reaction. It has an $[\alpha]_D$ of $+229°$ in alcoholic solution. It is isomeric with

cinchonidine but from which it differs by being nearly insoluble in ether and having a dextrorotatory power, whereas cinchonidine is lævorotatory.

Official Description—Cinchonine Sulphate occurs in white, lustrous prismatic crystals; odorless, and having a very bitter taste, permanent in the air.

Solubility—One Gm. of Cinchonine Sulphate dissolves in 60 cc. of water, 12.5 cc. of alcohol, 47 cc. of chloroform, and in 3230 cc. of ether at 25° C., also in 33 cc. of water at 80° C. and in 7 cc. of alcohol at 60° C.

Tests for Identity—A saturated aqueous solution of the salt is neutral or slightly alkaline to litmus and is dextrorotatory.

An aqueous solution of Cinchonine Sulphate (1 in 100) yields with barium chloride T.S. a white precipitate insoluble in hydrochloric acid.

Dried to constant weight at 100° C. Cinchonine Sulphate loses not more than 5 per cent of its weight.

Tests for Purity—Incinerate about 1 Gm. of Cinchonine Sulphate: not more than 0.1 per cent of ash remains.

Ten cc. of a solution of the salt (1 in 1000) in diluted sulphuric acid exhibits only a slight, blue fluorescence.

One-tenth Gm. of the powdered salt dissolves completely or nearly so when shaken with 10 cc. of chloroform at ordinary temperatures (*quinine or cinchonidine sulphate*).

Add 0.1 Gm. of the salt to 2 cc. of sulphuric acid; it imparts not more than a faint, yellow tinge to the acid (*readily carbonizable organic impurities*).

Preserve in well-closed containers, protected from light.

N. F. Preparations—Elixir Cinchonæ Alkaloidorum and in other elixirs containing cinchona alkaloids in combination with iron, bismuth, etc.

Uses—Cinchonine sulphate is used as a tonic and febrifuge. Its cheapness has led to its extensive employment as a substitute for quinine. The dose as an antiperiodic is, however, larger. The U. S. P. dose is two and one-half grains (0.15 Gm.), but fifteen to forty grains (1.0 to 2.6 Gm.) have been given.

CINCHONIDINÆ SULPHAS. U. S. Cinchonidine Sulphate

[Cinchonid. Sulph.]

The sulphate $[(C_{19}H_{22}ON_2)_2H_2SO_4.3H_2O = 740.70]$ of an alkaloid obtained from cinchona bark.

Preparation—The cinchonidine tartrate obtained in the manufacture of quinidine, is dissolved in dilute acid and then ammonia is added in excess. The precipitate is recrystallized from alcohol.

Cinchonidine behaves similarly to cinchonine in not being fluorescent and in not responding to the thalleioquin reaction. The base melts at 207° C. and has an $[a]_D$ of $-107.9°$ in 1 volume of alcohol, and in 2 volumes of chloroform.

Description and Physical Properties—White, glistening, silky needles or prisms. It is odorless, and has a very bitter taste.

One Gm. of Cinchonidine Sulphate is soluble in 65 cc. of water, 90 cc. of alcohol, and in 620 cc. of chloroform, at 25° C. One Gm. is soluble in 22 cc. of water at 80° C. and in 41 cc. of alcohol at 60° C. It is nearly insoluble in ether.

Tests for Identity—An aqueous solution of Cinchonidine Sulphate is lævorotatory.

The addition of ammonia T.S. to an aqueous solution of Cinchonidine Sulphate (1 in 100) produces a white precipitate of cinchonidine, which is but slightly soluble in ammonia T.S. or in ether. Sodium tartrate T.S. produces in an aqueous solution (1 in 100) a white precipitate of cinchonidine tartrate (*difference from cinchonine*).

An aqueous solution of Cinchonidine Sulphate yields with barium chloride T.S. a white precipitate, insoluble in hydrochloric acid.

Tests for Purity—A saturated aqueous solution of Cinchonidine Sulphate is neutral or faintly alkaline to litmus paper.

Dried to constant weight at 100° C., Cinchonidine Sulphate loses not more than 12 per cent (*water*).

Ash: not more than 0.1 per cent.

A solution of 0.1 Gm. of Cinchonidine Sulphate in 2 cc. of sulphuric acid is not darker than faint yellow (*readily carbonizable substances*).

A 10 cc. portion of a solution of the salt (1 in 1000) in diluted sulphuric acid exhibits only a faint, blue fluorescence (*quinine or quinidine*).

Macerate 0.5 Gm. of Cinchonidine Sulphate, with frequent agitation, at room temperature, with 20 cc. of distilled water, then add 0.5 Gm. of potassium and sodium tartrate, and continue the maceration with repeated agitation for one hour at 15° C., and filter the mixture. The addition of 1 drop of ammonia T.S. to the filtrate produces not more than a slight turbidity (*cinchonine or quinidine sulphate*).

Preserve in well-closed containers, protected from light.

N.F. Preparations—Elixir Cinchonæ Alkaloidorum and in other elixirs containing cinchona alkaloids in combination with iron, bismuth, etc.

Uses—This salt closely resembles quinine sulphate in its medicinal effects, and may be used for the same purposes but in somewhat larger doses. Dose, 2½ grains (0.15 Gm.).

CINCHOPHENUM. U.S. Cinchophen

[**Cinchophen.**—Acidum Phenylcinchoninicum U.S.P. IX, Phenyl-Quinoline-carboxylic Acid]

Cinchophen, when dried to constant weight over sulphuric acid, contains not less than 99 per cent of $C_6H_5.C_9H_5N.COOH = 249.18$.

Preparation—It may be prepared by heating a mixture of one molecule each of pyroracemic acid, benzaldehyde, and aniline in dehydrated alcohol.

Description and Physical Properties—Small, colorless, needle-like crystals, or a white to yellowish-white powder. It is odorless, has a slightly bitter taste, and is stable in the air.

Cinchophen is almost insoluble in cold water. One Gm. is soluble in about 400 cc. of chloroform, 100 cc. of ether, and in 120 cc. of alcohol, at 25° C. It is more readily soluble in hot than in cold alcohol.

Tests for Identity—Cinchophen melts at about 210° C. with partial decomposition.

A saturated solution of Cinchophen in hot diluted hydrochloric acid yields with platinic chloride T.S. a precipitate of yellowish-brown crystals.

Dissolve about 1 Gm. of Cinchophen in an excess of ammonia T.S., evaporate the solution to dryness on a water bath, or until free from the odor of ammonia, dilute to 20 cc. with distilled water, and filter: portions of the filtrate yield a white, flocculent precipitate with silver nitrate T.S., a yellowish, flocculent precipitate with lead acetate T.S., and a green, flocculent precipitate with copper sulphate T.S.

Tests for Purity—The ash from 0.2 Gm. is negligible.

A solution of 0.1 Gm. of Cinchophen in 5 cc. of sulphuric acid is not darker than yellow (*readily carbonizable substances*). On adding three drops of nitric acid to this solution, no reddish or brown color is produced.

Assay—Weigh accurately about 0.5 Gm. of Cinchophen, previously dried to constant weight over sulphuric acid, and dissolve it in 60 cc. of alcohol which has been neutralized with tenth-normal sodium hydroxide, using three drops of phenolphthalein T.S. as indicator, and warming gently to facilitate solution. Cool, and titrate the solution with tenth-normal sodium hydroxide until the pink color is restored. Each cc. of tenth-normal sodium hydroxide corresponds to 0.02492 Gm. of $C_6H_5.C_9H_5N.COOH$.

This assay is explained on page 1453.

Preserve in well-closed containers, protected from light.

Uses—This substance, commonly known as *atophan*, or phenylcinchoninic acid, is useful in acute gout; it relieves pain in this disease, acting more promptly than colchicum and without undesirable by-effects. In nonuratic joint affections, particularly acute articular rheumatism, favorable results are reported, while the chronic forms seem to yield to cinchophen only in isolated cases. It frequently relieves the pain of sciatica, but not invariably.

Dose—In gout the dose of cinchophen is from 8 grains (0.5 Gm.) four times a day to 15 grains (1 Gm.) three times a day suspended in large quantities of water. In order to prevent the precipitation of free uric acid from the urine with possibly resulting renal colic, it is necessary to administer simultaneously 225 grains (15 Gm.) of sodium bicarbonate in the course of the first day and from 75 to 150 grains (5 to 10 Gm.) on the following days. In articular rheumatism, Heller prescribes daily doses of from 45 to 75 grains (3 to 5 Gm.).

Unofficial Cinchophen Derivatives

Chloroxyl, N. N. R.—Phenylcinchoninic acid hydrochloride, $C_6H_5C_9H_5NCOOH.HCl$. The hydrochloride of 2-phenylquinolin-4-carboxylic acid.

Chloroxyl is a yellow crystalline powder with an astringent, slightly bitter taste. It is insoluble in water, ether or chloroform, but slightly soluble in alcohol.

Uses—The same as those of cinchophen.

Manufactured by Eli Lilly and Company.

Neocinchophen, N. N. R.—*Neocinchophenum.*—Ethyl-6-methyl-2-phenylquinolin-4-carboxylate, the ethyl ester of methyl-phenyl-quinolin-carboxylic acid.—$CH_3C_9H_4N.C_6H_5COOC_2H_5$, 6 : 2 : 4. Neocinchophen was first introduced as *novatophan*.

Uses and Doses—The same as those of cinchophen. It is practically tasteless.

Manufactured by The Abbott Laboratories.

NUX VOMICA. U. S. Nux Vomica

[Nux Vom.—Strychni Semen P. I.]

Nux Vomica is the dried ripe seed of *Strychnos Nux Vomica* Linné (Fam. *Loganiaceæ*).

Nux Vomica yields not less than 2.5 per cent of the alkaloids of Nux Vomica.

Description and Physical Properties—*Unground Nux Vomica*—Seed orbicular, nearly flat, occasionally somewhat bent, from 10 to 30 mm. in diameter, and from 4 to 5 mm. in thickness; externally grayish or greenish-gray, covered with appressed hairs, giving it a silky luster; hilum indicated by a circular scar at the center of one of the flattened sides, and connected with the micropyle by a ridge; very hard when dry; internally showing a thin and hairy seed-coat and a large grayish-white endosperm at one end of which is embedded a small embryo with two broadly ovate, 5- to 7-nerved cotyledons; inodorous; taste intensely and persistently bitter.

For further description see the U. S. P. X.

Assay—Place 10 Gm. of Nux Vomica, in fine powder, in a 250 cc. flask, add 100 cc. of ether-chloroform mixture, and proceed by Type Process A. Decant 50 cc. of the ethereal solution to complete the assay, using chloroform as the immiscible solvent in shaking out the alkaline liquid, and determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.0364 Gm. of the total alkaloids of Nux Vomica.

This assay is explained on page 1498.

U. S. P. Preparations—Extractum Nucis Vomicæ; Tinctura Nucis Vomicæ.

N. F. Preparations—Elixir Phosphori et Nucis Vomicæ (from Tincture); Fluidextractum Nucis Vomicæ; Pilulæ Aloes et Podophylli Compositæ (from Extract); Pilulæ Ferri, Quininæ, Aloes et Nucis Vomicæ (from Extract).

Nux Vomica contains *strychnine, brucine* ($C_{23}H_{26}O_4N_2$), probably *loganin, igasuric acid*, protein compounds, gum, fixed oil, sugar, etc. Of the total alkaloids from Nux Vomica, strychnine usually represents about one-third to one-half, most of the remainder being brucine. Strychnine is official in the N. F. and will be considered separately. Brucine is readily soluble in alcohol and in chloroform, but like strychnine it is only sparingly soluble in ether. It is colored bright red by nitric acid but this may be distinguished from the morphine reaction by adding stannous chloride, which changes the brucine reaction to a violet. Its solution acquires a rose-red coloration with chlorine water. Anhydrous brucine has a melting point of 178° C., and an $[a]_D$ −119° to 127° in chloroform. Igasurine, once thought to be a distinctive alkaloid, is now considered to be a mixture. The fixed oil is soluble in alcohol.

Uses—Nux Vomica is poisonous in large doses; in doses of one and one-half grains (0.1 Gm.) it is tonic.

STRYCHNINA. N. F. Strychnine

(U. S. P. IX)

[Strych.]

An alkaloid [$C_{21}H_{22}O_2N_2$ = 334.30] obtained from nux vomica, and also obtainable from other seeds of the *Loganiaceæ*.

This alkaloid was first discovered in Ignatia bean in 1818 by the French pharmacists, Pelletier and Caventou who gave it at that time the name which it still bears. They discovered *brucine* in 1819. It occurs in numerous plants belonging to the *Strychnos* species. In nux vomica seeds (*Strychnos Nux Vomica*) a little less than one half of the alkaloid is strychnine, while in ignatia beans (*Strychnos Ignatia*) about two-thirds is strychnine; each contains from 2 to 3 per cent of total alkaloids. Both brucine and strychnine are present in other portions of the plants. These species are mainly Asiatic, while a South American species furnishes the product Curare (see page 1533).

Strychnine, has a $[a]_D$ of −132.07°, in alcohol. It is distilled unchanged at 270° C. under 5 mm. pressure.

Preparation—Take of nux vomica, rasped, 48 oz. troy; lime, in fine powder, 6 oz. troy; hydrochloric acid, 3½ oz. troy; alcohol, diluted alcohol, diluted sulphuric acid, ammonia water, purified animal charcoal, water, each, a sufficient quantity. Macerate the nux vomica for twenty four hours in 16 pints of water, acidulated with one-third of the hydrochloric acid; then boil for two hours, and strain with expression through a strong muslin bag. Boil the

residue twice successively in the same quantity of acidulated water, each time straining as before. Mix the decoctions and evaporate to the consistence of thin syrup; then add the lime previously mixed with a pint of water, and boil for ten minutes, frequently stirring. Pour the whole into a double muslin bag, and, having thoroughly washed the precipitate, press, dry, and powder it. Treat the powder repeatedly with diluted alcohol, in order to remove the brucine, until the washings are but faintly reddened by nitric acid. Then boil it repeatedly with alcohol until deprived of its bitterness, mix the several tinctures, and distil off the alcohol by means of a water bath. Having washed the residue, mix it with a pint of water, and, applying a gentle heat, drop in enough diluted sulphuric acid to neutralize and dissolve the alkaloid. Then add purified animal charcoal, and, having boiled the mixture for a few minutes, filter, evaporate, and set aside to crystallize. Dissolve the crystals in water, and add sufficient ammonia water to precipitate the strychnine. Lastly, dry this on bibulous paper, and keep it in a well-stoppered bottle.

In this process strychnine hydrochloride and brucine hydrochloride are first formed. They are then removed from the exhausted drug by straining. The alkaloids are precipitated by lime, and the strychnine is dissolved out of the excess of lime with boiling alcohol (the brucine having been previously removed by treatment with diluted alcohol), the alcoholic solution is evaporated, and sulphuric acid added to dissolve the alkaloid; the solution is decolorized and evaporated to crystallize. The crystals of strychnine sulphate are dissolved and strychnine is precipitated by adding ammonia water.

Official Description—Strychnine occurs in colorless, transparent, prismatic crystals, or as a white crystalline powder; odorless; permanent in the air. *Great caution must be used in tasting it and then only in very dilute solutions* which are exceedingly bitter.

Solubility—One Gm. of Strychnine dissolves in 6420 cc. of water, 136 cc. of alcohol, 5 cc. of chloroform, and in 180 cc. of benzene at 25° C.; also in 3100 cc. of boiling water and 34 cc. of boiling alcohol: very slightly soluble in ether.

Tests for Identity and Purity—Its saturated solutions are alkaline to litmus and are lævorotatory. Sulphuric acid containing 1 per cent of ammonium vanadate produces with Strychnine a deep violet-blue color, changing to a deep purple, and finally to a cherry-red.

A solution of about 0.1 Gm. of Strychnine in 2 cc. of sulphuric acid is not more than pale yellow (*readily carbonizable organic impurities*), but on adding a fragment of potassium dichromate, a deep blue color is momentarily produced, changing to deep violet, then to purplish-red, cherry-red, and finally to orange or yellow. Incinerate about 1 Gm. of Strychnine: not more than 0.1 per cent of ash remains.

Brucine—One cc. of a mixture of equal volumes of nitric acid and distilled water, added to about 0.1 Gm. of Strychnine, may produce a yellow, but not a red or reddish color.

N. F. Preparations—Elixir Ferri Pyrophosphatis, Quininæ et Strychninæ; Elixir Pepsini, Bismuthi et Strychninæ; Liquor Hypophosphitum Compositus; Pilulæ Aloini, Strychninæ et Belladonnæ; Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Fortiores; Pilulæ Ferri, Quininæ, Strychninæ et Arseni Mites; Pilulæ Laxativæ Compositæ; Syrupus Ferri, Quininæ et Strychninæ Phosphatum; Syrupus Hypophosphitum Compositus.

Uses—Strychnine is a cardiac and nerve stimulant, and is given in doses of one-fortieth of a grain (0.0015 Gm.). It may sometimes be given in doses of one-twentieth of a grain (0.003 Gm.).

STRYCHNINÆ NITRAS. U.S. Strychnine Nitrate

[Strych. Nit.]

The nitrate [$C_{21}H_{22}O_2N_2.HNO_3 = 397.31$] of an alkaloid obtained chiefly from nux vomica.

Preparation—Strychnine Nitrate may be made by dissolving strychnine in warm diluted nitric acid, evaporating, and crystallizing.

Description and Physical Properties—Colorless, glistening needles or a white, crystalline powder. It is odorless and is stable in the air.

Caution—Strychnine Nitrate is extremely poisonous.

One Gm. of Strychnine Nitrate is soluble in 45 cc. of water, 150 cc. of alcohol, 50 cc. of glycerin, and in 105 cc. of chloroform, at 25° C. One Gm. is soluble in 10 cc. of boiling water and in 80 cc. of alcohol at 60° C. It is insoluble in ether.

Tests for Identity—An aqueous solution of Strychnine Nitrate is lævorotatory.

Dissolve about 0.05 Gm. of Strychnine Nitrate in 5 cc. of distilled water, add a few drops of ammonia T.S., and extract the liberated strychnine with 5 cc. of chloroform. Evaporate the chloroform to dryness on a water bath, cool, dissolve the residue in 2 cc. of sulphuric acid and add a fragment of potassium dichromate. On gently agitating the mixture, a blue color is momentarily produced, changing to violet, then to purplish-red, and finally to orange or yellow.

An aqueous solution of the salt, when superimposed in a test tube, upon diphenylamine T.S., develops a blue color at the zone of contact.

Strychnine Nitrate, heated with hydrochloric acid, produces a bright red color.

Tests for Purity—A solution of 0.5 Gm. of Strychnine Nitrate in 25 cc. of distilled water requires not more than 0.5 cc. of fiftieth-normal sodium hydroxide for neutralization, using one drop of methyl red T.S. as indicator.

Ash: not more than 0.1 per cent.

A solution of 0.1 Gm. of Strychnine Nitrate in 5 cc. of sulphuric acid is not darker than pale yellow (*readily carbonizable substances*).

The addition of 5 drops of silver nitrate T.S. to 20 cc. of an aqueous solution of Strychnine Nitrate (1 in 100), acidulated with 2 drops of diluted nitric acid, does not produce an opalescence at once (*chloride*), and no immediate turbidity is produced in 20 cc. of a similar solution by the addition of 5 drops of barium nitrate T.S. (*sulphate*).

One cc. of a mixture of equal volumes of nitric acid and distilled water, added to about 0.1 Gm. of Strychnine Nitrate, may produce a yellow, but not a red or reddish color (*brucine*).

Preserve in well-closed containers, protected from light.

N. F. Preparations—Elixir Glycerophosphatum Compositum; Syrupus Phosphatum cum Quinina et Strychnina.

Uses—Strychnine nitrate is a cardiac and nerve stimulant, and is given in the dose of one-thirtieth of a grain (0.002 Gm.).

STRYCHNINÆ SULPHAS. U. S. Strychnine Sulphate [Strych. Sulph.]

The sulphate $[(C_{21}H_{22}O_2N_2)_2.H_2SO_4.5H_2O = 856.75]$ of an alkaloid obtained chiefly from nux vomica.

Preparation—This salt is prepared during the process of making strychnine. (See Strychnina.)

Description and Physical Properties—Colorless or white crystals, or a white, crystalline powder. It is odorless and is efflorescent in dry air.

Caution—Strychnine Sulphate is extremely poisonous.

One Gm. of Strychnine Sulphate is soluble in 35 cc. of water, in 81 cc. of alcohol, and in 220 cc. of chloroform, at 25° C. One Gm. is soluble in 7 cc. of boiling water and in 26 cc. of alcohol at 60° C. It is freely soluble in glycerin but insoluble in ether.

Tests for Identity—An aqueous solution of Strychnine Sulphate is lævorotatory.

Add a fragment of potassium dichromate to a solution of 0.1 Gm. of Strychnine Sulphate in 2 cc. of sulphuric acid. A deep blue color is momentarily produced, changing to deep violet, then to purplish red, cherry-red, and finally to orange or yellow.

Sulphuric acid containing 1 per cent of ammonium vanadate produces with Strychnine Sulphate a deep violet-blue color, changing to a deep purple and finally to a cherry-red.

Barium chloride T.S. produces in an aqueous solution of the salt (1 in 50) a white precipitate, insoluble in hydrochloric acid.

Tests for Purity—A solution of 0.5 Gm. of Strychnine Sulphate in 20 cc. of distilled water requires not more than 0.5 cc. of fiftieth-normal sodium hydroxide for neutralization, using one drop of methyl red T.S. as indicator.

Dried to constant weight at 100° C., Strychnine Sulphate loses not more than 11 per cent.

Ash: not more than 0.1 per cent.

A solution of 0.1 Gm. of Strychnine Sulphate in 2 cc. of sulphuric acid is not darker than pale yellow (*readily carbonizable substances*).

One cc. of a mixture of equal volumes of nitric acid and distilled water, added to about 0.1 Gm. of Strychnine Sulphate, may produce a yellow, but not a red or reddish color (*brucine*).

Preserve in well-closed containers, protected from light.

N. F. Preparations—Elixir Cinchonæ Alkaloidorum, Ferri, Bismuthi et Strychninæ; Elixir Ferri, Quininæ et Strychninæ.

Uses—Strychnine sulphate is more useful, medicinally, than strychnine, only because it is much more soluble. The dose is one-thirtieth of a grain (0.002 Gm.).

Unofficial Strychnine Alkaloids and Preparations

STRYCHNINÆ GLYCEROPHOSPHAS

[Strychnine Glycerophosphate (N. F. IV)]

The glycerophosphate $[(C_{21}H_{22}O_2N_2)_2PO_4H_2(C_3H_7O_2).6H_2O]$ of the alkaloid strychnine.

White, rhombic crystals or as a white powder. Soluble in about 350 parts of water, also in about 310 parts of alcohol.

STRYCHNINÆ VALERAS

[Strychnine Valerate (N. F. IV)]

The valerate $[C_{21}H_{22}O_2N_2.HC_5H_9O_2]$ of the alkaloid strychnine.

A white, crystalline powder. Sparingly soluble in water, becoming less soluble on keeping, through the loss of valeric acid.

LIQUOR STRYCHNINÆ ACETATIS

[Solution of Strychnine Acetate (N. F. IV)—Hall's Solution of Strychnine]

	Metric	Alternative
Strychnine	**0.178 Gm**	3 gr.
Diluted Acetic Acid	**3.500 cc.**	67 min.
Alcohol	**25.000 cc.**	1 fl. oz.
Compound Tincture of Cardamom	**1.000 cc.**	19 min.
Distilled Water, a sufficient quantity, To make	**100 cc.**	4 fl. oz.

Dissolve the strychnine in the diluted acetic acid, add about 50 cc. [2 fl. oz.] of distilled water, then the alcohol, compound tincture of cardamom, and sufficient distilled water to make the product measure 100 cc. [4 fl. oz.] and filter. Dose, ten minims (0.6 cc.).

ERGOTA. U. S. Ergot

[Ergot.—Ergot of Rye, Secale Cornutum P. I., Spurred Rye]

Ergot is the dried sclerotium of *Claviceps purpurea* (Fries) Tulasne (Fam. *Hypocreaceæ*), developed on rye plants.

Ergot, in the form of the fluidextract, administered by intramuscular injection to single-comb, white Leghorn cocks, in doses not exceeding 0.5 cc. for each kilogram of body weight of cock, produces a darkening of the comb, corresponding in intensity to that caused by the same dose of a standard fluidextract of ergot, prepared as directed below. It contains not more than 5 per cent of seeds, fruits, or other foreign organic matter.

Ergot should be dried at a low temperature. It deteriorates with age and should not be kept longer than one year.

Description—Cylindraceous, obscurely 3-angled, tapering towards both ends, obtuse, somewhat curved, from 1 to 4.5 cm. in length and from 3 to 5 mm. thick, longitudinally furrowed; externally dark purple or dark reddish-brown; fracture short; internally white, tinged with purple or gray; odor characteristic but free from mustiness or rancidity; taste oily, somewhat acrid, disagreeable.

For further description see the U. S. P. X.

Test for Purity—When crushed or powdered, Ergot does not develop a rancid or ammoniacal odor upon the addition of hot water.

Assay—This drug is assayed biologically. The details of the official method will be found on page 1508.

U. S. P. Preparation—Fluidextractum Ergotæ.

N. F. Preparation—Extractum Ergotæ Aquosum.

Ergot preparations rapidly deteriorate, especially during the first few months after manufacture, hence the requirement that the "standard fluidextract" should be aged for six months before adjusting its activity.

Although the Pharmacopœia does not specifically require the aging of the fluidextract before standardizing, in practice, it becomes a necessity as a fresh product, though standardized, would soon fall below the official requirement for activity.

Experience has demonstrated that Ergot and its preparations retain their activity much longer if stored in vacuum containers.

The following abstract from the N. N. R. discussion of the active principles of Ergot sets forth the present day knowledge:

It has been shown that ergot contains at least two alkaloids and a series of active amines. The numerous names applied to these principles and to impure mixtures render the literature confusing. The chief constituents are these:

Ergotoxine or *hydroergotinine*, $C_{35}H_{41}O_6N_5$, is an amorphous alkaloid occurring in alcoholic extracts. It is responsible for the characteristic action on the cock's comb, and is concerned in uterine and vascular effects. It is rather unstable and by loss of water changes into its lactone. *Ergotinine*, $C_{35}H_{39}O_5N_5$, is a crystalline alkaloid, with very weak actions.

Both of these alkaloids exist ready formed in ergot, but can be easily converted into each other by chemical means. Both are insoluble in water and petroleum benzin, sparingly soluble in ether, and readily soluble in almost all other organic solvents. Ergotoxine is easily soluble in cold alcohol; ergotinine is sparingly soluble.

Ergotoxine has a melting point of 162° C. and the specific rotation is variable; *ergotinine* melts at 229° C. and has an $[a]_D$ +338° in alcohol.

Para-hydroxyphenylethamine, $OH.C_6H_4.CH_2.CH_2.NH_2$. This is closely related to epinephrine in structure and action. It is mainly responsible for the pressor effect, and is not materially concerned in the uterine action.

Beta-iminazolylethylamine, *4-meta-aminoethylglyoxaline* $C_3H_3N_2.CH_2.CH_2.NH_2$. This amine lowers the blood pressure, and stimulates the excised uterus powerfully.

A number of other aromatic amines occur, such as *agmatine*, *guanidobutylamine* and *isoamylamine*. *Acetyl-choline* is frequently present, and lowers the blood pressure by a cardiac action.

Ergotine is a name applied to a variety of pharmaceutical extracts such as the aqueous extract of the N. F. They are generally prepared in such a way that they contain mainly the amines, and relatively little of the alkaloids.

It will be seen that several of the constituents exert uterine actions, and it is not yet known which of these is the most important in the effects of the crude drug. The galenic preparations must vary in composition according to the solvent. The alcoholic fluidextract probably owes its activity mainly to ergotoxine; the aqueous preparations, including the solid extracts and "ergotines", owe theirs probably to the amines, particularly to *histamine*. The isolated principles have not been used sufficiently to decide whether or not they can take the place of the natural mixture.

All ergot preparations, especially those containing water, deteriorate with age. It is, therefore, of advantage to standardize the ergot preparations, as is now required by the Pharmacopœia. Because of the complex composition, no satisfactory chemical assay has been devised. Different methods of bioassay have been proposed; but because of its varied physiologic activities it is not certain how perfectly these tests reflect the therapeutic efficiency of the drug; however, the cock's comb method of assay is, in general, considered to be satisfactory for the purpose and has been adopted by the U. S. P. X.

Uses—It is used as a parturient and hemostatic. Dose, thirty grains (2 Gm.). Sclerotic acid has been used in medicine in doses of one-half to three-fourths of a grain (0.03 to 0.048 Gm.).

Unofficial Ergot Preparations

Ergot Aseptic, N. N. R.—A liquid extract of ergot is standardized by the cock's comb method of assay so that 1 cc. represents 2 Gm. of ergot.

Uses—The same as those of ergot. Ergot aseptic is intended for intramuscular injection and is marketed in ampuls only. The date of manufacture appears on each package and the product is not guaranteed to possess its full potency for more than one year from time of manufacture. Dose, fifteen to thirty minims (1 to 2 cc.).

Manufactured by Parke, Davis and Company, Detroit.

Ergotinine Citrate, N. N. R.—*Ergotininæ Citras*—The citrate of ergotinine, a crystalline alkaloid, probably $C_{35}H_{39}O_5N_5$, derived from ergot. A grayish-white, amorphous powder, slowly soluble in water. It gives an acid reaction to litmus paper. One part of ergotinine dissolves at 18° C. in 292 parts of alcohol. It is insoluble in water.

Uses—According to the investigations of Barger and Dale, ergotinine has very slight physiologic activity when it enters the system unchanged, but it is likely to be converted to a certain extent into ergotoxine which possesses marked physiologic activity and appears to represent the pharmacologic actions of ergot. The action of ergotinine, when given by mouth or when injected hypodermically, is variable in intensity but represents the action of ergot.

Used in the treatment of headaches and uterine hemorrhage.

Dose—$\frac{1}{200}$ to $\frac{1}{100}$ grain (0.00032 to 0.00064 Gm.).

Manufactured by Burroughs, Wellcome and Company, and F. Hoffmann-LaRoche and Company.

Ergotinine is obtained by extracting the residue left on evaporation of an a coholic tincture of ergot with light petroleum to remove oily matter, dissolving the residue in ethyl acetate and shaking with citric acid solution. Sodium bromide or hydrobromic acid is then added and the precipitated hydrobromides of the alkaloids, ergotinine and ergotoxine are collected. The mixed hydrobromides are dissolved in caustic soda and shaken with ether; in this way ergotinine is removed first. Finally, the ergotinine is crystallized from alcohol, leaving ergotoxine and impurities in the mother liquor. By interaction of ergotinine with citric acid, ergotinine citrate is obtained.

Ergotole, N. N. R.—*Extractum Ergotæ Liquidum*—A liquid extract of ergot containing 19 per cent of alcohol. It is standardized on the uterus of the virgin guinea-pig so that a 1 : 2500 dilution of ergotole has the same activity as a 1 : 20,000,000 dilution of beta-iminazolylethylamine hydrochloride.

Ergotole is a brownish red liquid having the odor and taste of ergot.

Uses—The same as those of ergot.

Dose—Orally, from 15 to 60 minims (1 to 4 cc.); hypodermically, from 5 to 20 minims (0.3 to 1.2 cc.).

Manufactured by Sharp and Dohme, Baltimore.

Extract of Ergot, Purified, N. N. R.—*Extractum Ergotæ Purificatum.—Ergotin Bonjean.—Extractum Secalis Cornuti.—Extractum Ergoti.*—An aqueous extract of ergot purified by alcohol, corresponding to the aqueous extract of the N. F. (see page 465).

Actions and Uses—The same as those of ergot.

Dose—From 3 to 8 grains (0.2 to 0.5 Gm.).

This preparation should not be confused with these:

Ergotin Wernich (Pure Dried), a purified and dialyzed dried aqueous extract of ergot.

Ergotin Wernich (Liquid), a dialyzed extract of ergot, in the form of a reddish-brown liquid.

Ergotin Wernich (Soft), a purified and dialyzed soft extract of ergot; a reddish-brown syrupy liquid.

Ergotin Wiggers (Pure Dried), a dried, alcohol-purified extract of ergot.

Ergotin Yvon, a fluidextract of ergot prepared by extracting with dilute solution of tartaric acid.

Ergotin-Merck, N. N. R.—A brand of extract of ergot, purified.

Distributed by Merck and Company.

Liquor Ergot-Mulford N. N. R.—*Cornutol.*—A biologically tested liquid extract of ergot, containing the water-soluble constituents of ergot and about 10 per cent of alcohol.

It is a brownish-red liquid, having a characteristic, not unpleasant, odor and disagreeable taste.

Uses—The same as those of ergot.

Dose—Hypodermically, from 10 to 30 minims (0.6 to 2 cc.); by the mouth, from 10 to 60 minims (0.6 to 4 cc.) repeated as often as may be necessary. On account of the deterioration liable to occur in this preparation, the date when it was tested appears on each package. The air has been removed from the vacules before sealing to prevent deterioration.

Manufactured by H. K. Mulford Company, Philadelphia.

Secacornin, N. N. R.—*Ergotin-Roche.*—A solution of the active principles of ergot in a menstruum consisting of distilled water, glycerin and 7.5 per cent of alcohol. One cubic centimeter of secacornin corresponds to 4 Gm. of ergot, U. S. P., and is said to be standardized according to the method of Kehrer.

Secacornin is a dark brown solution, said to be sterile. It is claimed that it does not deteriorate on keeping.

Uses—The same as those of ergot.

Dose—8 minims (five-tenths cc.) is equivalent to 30 minims (2 cc.) of fluidextract of ergot, U. S. P. It may be given by intramuscular injection in doses of from 8 to 15 minims (0.5 to 1 cc.).

Manufactured by F. Hoffmann-LaRoche and Company.

Tyramine Hydrochloride, N. N. R.—See Epinephrine, page 1195.

PHYSOSTIGMA. (U. S. P. IX) Physostigma

[Calabar Bean, Ordeal Bean]

The dried ripe seeds of *Physostigma venenosum* Balfour (Fam. *Leguminosæ*), yielding not less than 0.15 per cent of the alkaloids of Physostigma.

Physostigmine ($C_{15}H_{21}O_2N_3$) (or *eserine*) is the most important constituent. Several other alkaloids are also present, mainly *eseridine, eseramine* and *geneserine.*

The melting point of *physostigmine* varies according to the form of crystal. One, a stable form, melts at 105° C., another form melts at 86° C. Solutions of the alkaloid are strongly alkaline and will precipitate ferric hydroxide from a solution of ferric chloride. It has an $[\alpha]_D$ of —75.8°, in chloroform. On exposure to air or in the presence of alkali the alkaloid oxidizes to *rubreserine* ($C_{13}H_{16}O_2N_2.H_2O$) which crystallizes from water in red needles.

Description—Oblong or ellipsoidal, somewhat compressed reniform, from 15 to 30 mm. in length and from 10 to 15 mm. in thickness; externally reddish or chocolate brown, smooth, somewhat wrinkled near the brownish-black groove, the latter being about 2 mm. in width and extending almost the entire length of the convex edge and in which are found frequently the remains of the white membranous funiculus, the margins of the seed-coat on both sides of the groove somewhat elevated, of a yellowish-red or brownish-red color and somewhat thickened; embryos large, white, with short hypocotyl and two concavo-convex cotyledons. Taste at first starchy, afterwards acrid.

Assay—Introduce 15 Gm. of Physostigma in No. 60 powder, into a flask of about 250 cc. capacity, and add 150 cc. of ether. Stopper the flask, shake it well and allow it to stand ten minutes, then add 10 cc. of an aqueous solution of sodium bicarbonate (1 in 20) and shake the mixture vigorously at intervals during four hours. Now add 15 cc. of distilled water, again shake the flask well, and, when the drug has settled, decant 100 cc. of the ether solution, representing 10 Gm. of Physostigma. Filter the solution through a pledget of purified cotton into a beaker and rinse the graduate and cotton with ether. Add 20 cc. of tenth-normal sulphuric acid and evaporate off the ether, stirring during the evaporation with a rubber-tipped glass rod. After the resinous and fatty matter has agglutinated, pour off the acid solution through a wetted filter into a separator. Redissolve the residue in the beaker in about 15 cc. of ether, add 2 cc. of tenth-normal sulphuric acid, evaporate off the ether with continued stirring as before and pour the acid solution on the filter. Repeat this operation until all of the alkaloid is extracted and then wash the filter with distilled water until it is free from alkaloids. Collect the solution and washings in a separator, add sufficient sodium bicarbonate to make the solution decidedly alkaline to litmus and completely extract the alkaloids by shaking it out repeatedly with ether. Wash the combined ether solutions with 10 cc. of distilled water, separate the water completely, and filter the ether solution, washing the container and filter with ether. Evaporate the ether solution to dryness, dissolve the alkaloids from the residue in exactly 5 cc. of tenth-normal sulphuric acid and titrate the excess of acid with fiftieth-normal potassium hydroxide, using cochineal T.S. as indicator.

Each cc. of tenth-normal sulphuric acid consumed corresponds to 27.52 milligrams of the alkaloids of Physostigma.

Uses.—This drug is no longer official as the alkaloid offers a more satisfactory therapeutic agent. The drug is sedative, and acts as a powerful poison, contracting the pupil of the eye. Dose, one to three grains (0.06 to 0.2 Gm.).

PHYSOSTIGMINÆ SALICYLAS. U.S. Physostigmine Salicylate

[Physostig. Salicyl.—Eserine Salicylate]

The salicylate [$C_{15}H_{21}O_2N_3.C_7H_6O_3 = 413.35$] of an alkaloid obtained from the dried ripe seed of *Physostigma venenosum* Balfour (Fam. *Leguminosæ*).

Preparation—This salt may be made by adding 2 parts of physostigmine to a solution of 1 part of salicylic acid in 35 parts of boiling distilled water, and allowing the salt to crystallize on cooling.

Description and Physical Properties—Colorless or faintly yellow, shining, odorless crystals. It acquires a red tint when long exposed to light and air.

Caution—Physostigmine Salicylate is extremely poisonous.

One Gm. of Physostigmine Salicylate is soluble in 75 cc. of water, 16 cc. of alcohol, 6 cc. of chloroform, and in 250 cc. of ether, at 25° C. One Gm. is soluble in 16 cc. of water at 80° C., and in 5 cc. of boiling alcohol.

Tests for Identity—A cold, saturated aqueous solution of Physostigmine Salicylate is neutral, or only faintly acid to litmus paper. Upon standing, the solution usually acquires a pink color.

Evaporate on a water bath about 0.005 Gm. of Physostigmine Salicylate with a few drops of ammonia T.S.: a blue residue is produced which, when dissolved in alcohol, yields a red, fluorescent solution upon the addition of an excess of acetic acid. On adding a few drops of sodium hydroxide T.S. to 5 cc. of a cold-saturated aqueous solution of the salt, a pink color rapidly develops.

Ferric chloride T.S. produces a deep violet color in an aqueous solution of Physostigmine Salicylate.

Tests for Purity—The ash from 0.1 Gm. is negligible.

A solution of 0.1 Gm. of Physostigmine Salicylate in 2 cc. of sulphuric acid does not become darker than yellow within five minutes (*readily carbonizable substances*).

Precipitate the salicylic acid from 10 cc. of a cold, saturated aqueous solution of the salt with a slight excess of diluted hydrochloric acid, and filter: the filtrate is not rendered turbid at once by the addition of 5 drops of barium chloride T.S. (*sulphate*).

Preserve in small, well-closed containers, protected from light.

Uses—The salts of physostigmine, or eserine, are used to contract the pupil of the eye. The advantage possessed by the salicylate is that it is more permanent and less liable to deliquesce. The addition of a few grains of boric acid to a solution of the salt is said to inhibit the formation of the red decomposition product which is produced by alkalies and which frequently occurs in solutions of physostigmine salts which have been dispensed upon prescriptions. A red or discolored solution should not be used. The dose for internal administration should not be more than one-thirtieth of a grain (0.002 Gm.).

Solanaceous Drugs

Belladonna, hyocyamus, and stramonium all yield alkaloids belonging to the solanaceous group. There are also many other plants of this group which are commercially valuable, being used largely in the manufacture of the various alkaloids.

The alkaloids of the most important plants and their distribution are as follows:

Plant	Part yielding alkaloid	Per cent of total alkaloid	Most important alkaloids
Atropa Belladonna	leaves	0.15–0.60	hyoscyamine
	root	0.10–0.70	hyoscyamine
	seeds	about 0.80	hyoscyamine
Datura Metel	leaves	0.25–0.55	hyoscine (scopolamine)
Datura Stramonium	leaves	0.20–0.45	hyoscyamine
	seeds	0.20–0.48	hyoscyamine
Hyoscyamus muticus	leaves	about 1.4	hyoscyamine
Hyoscyamus niger	leaves	0.045–0.080	hyoscyamine
	tops	0.070–0.100	hyoscine

It is said that atropine rarely occurs, as such, in any of the plants, but is always the product of the racemisation of the lævo-isomeride, hyoscyamine. Commercial atropine is therefore entirely obtained from plants rich in hyoscyamine and practically free from the other solanaceous alkaloids. The separated hyoscyamine is converted into atropine by the action of weak alkalies. Stramonium furnishes in this country a large amount of the hyoscyamine for the manufacture of atropine.

Scopolamine (*hyoscine*) is produced to a large extent from *Datura Metel* as well as from the mother liquors after crystallization of hyoscyamine.

Numerous other alkaloids of lesser importance are present in various members of the family, as *belladonnine*, *meteloidine*, and numerous synthetic alkaloids.

BELLADONNÆ FOLIA. U. S. Belladonna Leaves

[**Bellad. Fol.**—Deadly Nightshade Leaves, Belladonnæ Folium P. I.]

Belladonna Leaves consist of the dried leaves and tops of *Atropa Belladonna* Linné (Fam. *Solanaceæ*).

Belladonna Leaves yield not less than 0.3 per cent of the alkaloids of Belladonna Leaves, and contain not more than 3 per cent of their stems over 10 mm. in diameter, and yield not more than 3 per cent of acid-insoluble ash.

Description—Usually matted together, crumpled or broken; leaves mostly light green, from 5 to 20 cm. in length, and from 4 to 12 cm. in width, broadly ovate, apex acute, margin entire, narrowed into the petiole, with few hairs, the latter more abundant along the veins, and numerous whitish dots (crystal cells) visible with a lens; stems more or less hollow and flattened, finely hairy when young; flowers with campanulate corolla, yellowish-purple, becoming faded, usually subtended by the calyx; fruits nearly globular, green to brown or purplish-black with numerous, flattened somewhat reniform seeds, up to 2 mm. in width; odor slight, somewhat tobacco-like when moistened; taste somewhat bitter and acrid.

For further description see the U. S. P. X.

Assay—Proceed by Type Process B, using 10 Gm. of Belladonna Leaves in fine powder, ether-chloroform mixture for percolating the drug, and chloroform as the immiscible solvent for extracting the alkaloid from the aqueous liquid. Determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.02893 Gm. of the alkaloids of Belladonna Leaves.

This assay is explained on page 1496.

U. S. P. Preparations—Emplastrum Belladonnæ (from Extract); Extractum Belladonnæ (Pilular and Powdered); Fluidextractum Belladonnæ Foliorum; Tinctura Belladonnæ; Unguentum Belladonnæ (from Pilular Extract).

N. F. Preparations—Pilulæ Aloes et Podophylli Compositæ (from Pilular Extract); Pilulæ Aloini Compositæ (from Pilular Extract); Pilulæ Aloini, Strychninæ et Belladonnæ (from Pilular Extract); Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ (from Pilular Extract); Pilulæ Laxativæ Compositæ (from Pilular Extract).

BELLADONNÆ RADIX. U. S. Belladonna Root

[**Bellad. Rad.**—Deadly Nightshade Root]

Belladonna Root is the dried root of *Atropa Belladonna* Linné (Fam. *Solanaceæ*).

Belladonna Root yields not less than 0.45 per cent of the alkaloids of Belladonna Root, and contains not more than 10 per cent of its stem bases and woody crowns, and not more than 2 per cent of other foreign organic matter, and yields not more than 4 per cent of acid-insoluble ash.

Description and Physical Properties—*Unground Belladonna Root*—Cylindrical or tapering, sparingly branched, often split longitudinally or broken transversely; from 0.5 to 4 cm. in thickness; light grayish-brown externally, nearly white internally; somewhat wrinkled longitudinally and the soft periderm frequently abraded; fracture short, mealy and emitting a puff of dust consisting chiefly of starch grains; nearly odorless when dry, but characteristic when moistened; taste sweetish, then bitterish and acrid.

For further description see the U. S. P. X.

Assay—Proceed by Type Process B, using 10 Gm. of Belladonna Root in fine powder, ether-chloroform mixture for percolating the drug, and chloroform as the immiscible solvent for extracting the alkaloids from the aqueous liquid. Determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.02893 Gm. of the alkaloids of Belladonna Root
This assay is explained on page 1497.

U. S. P. Preparation—Fluidextractum Belladonnæ Radicis.
N. F. Preparation—Linimentum Belladonnæ (from Fluidextract).

Uses—Belladonna is narcotic and poisonous. It dilates the pupil of the eye. Dose, three-fourths to two grains (0.045 to 0.125 Gm.).

ATROPINA. U. S. Atropine

[Atrop.]

An alkaloid [$C_{17}H_{23}O_3N$ = 289.28] chiefly obtained from belladonna.

Atropine was discovered by Mein, a German pharmacist, in 1833, simultaneously with its preparation by Geiger and Hess, two German chemists.

It sublimes unchanged when heated rapidly, and is optically inactive if pure. It exerts its mydriatic effect in a dilution of 1 in 130,000, when applied to the eye of a cat.

Preparation—This alkaloid may be prepared by adding sulphuric acid to a concentrated alcoholic tincture of the root to convert the atropine into the sulphate, distilling off the alcohol, adding water to the residuary liquid, filtering to separate oil and resin, and treating the filtrate with potassium hydroxide and chloroform. By separating and evaporating the latter, atropine is obtained. This is purified by redissolving the crystals and filtering the solution, decolorizing with animal charcoal and recrystallization.

Description and Physical Properties—White, odorless crystals.
Caution—Atropine is extremely poisonous.

One Gm. of Atropine is soluble in 455 cc. of water, 2 cc. of alcohol, about 27 cc. of glycerin, 1 cc. of chloroform, and in 25 cc. of ether, at 25° C. One Gm. is soluble in 90 cc. of water at 80° C., and in 1.2 cc. of alcohol at 60° C.

Tests for Identity—Atropine melts between 114° and 116° C.

Atropine is optically inactive.

Its saturated aqueous solution is alkaline to litmus paper and to phenolphthalein T.S.

Add a few drops of nitric acid to about 0.01 Gm. of Atropine contained in a porcelain dish, and evaporate the mixture to dryness on a water bath: a yellow residue is obtained. Add to the cooled residue a few drops of alcoholic potassium hydroxide T.S. and a fragment of potassium hydroxide: an intensely violet color is produced. (*Hyoscyamine* and *hyoscine* produce the same color as Atropine, but the presence of *other alkaloids* masks the reaction.)

Gold chloride T.S. produces in a solution of Atropine (1 in 50) in diluted hydrochloric acid, a lusterless precipitate. (*Hyoscyamine* yields a lustrous precipitate.)

Tests for Purity—Five cc. portions of a solution made by dissolving 0.2 Gm. of Atropine in 1 cc. of normal sulphuric acid and 14 cc. of distilled water, do not respond to the platinic chloride test for *most other alkaloids* or the test for *apoatropine* or *belladonnine* described under *Atropinæ Sulphas*. Atropine complies with the tests for *ash* and *readily carbonizable substances* under *Atropinæ Sulphas*.

Uses—Atropine is chiefly used to dilate the pupil of the eye. It is employed preferably as a solution in sterile olive oil or in an ointment vehicle. The sulphate, however, is preferred on account of its greater solubility in water. It has the properties of belladonna when given internally, and is narcotic. Dose, one one-hundred-and-sixtieth to one-sixtieth of a grain (0.0004 to 0.001 Gm.).

ATROPINÆ SULPHAS. U. S. Atropine Sulphate

[Atrop. Sulph.]

The sulphate [$(C_{17}H_{23}O_3N)_2H_2SO_4H_2O$ = 694.65] of the alkaloid atropine.

Preparation—Atropine sulphate may be prepared by suspending 120 grains of atropine in 4 fl. dr. of distilled water and adding very dilute sulphuric acid

until the alkaloid is dissolved and the solution is neutral. The latter is then evaporated to dryness at a temperature not exceeding 37.7° C. (100° F.).

Description and Physical Properties—A white, odorless, crystalline powder. It is efflorescent in dry air.

Caution—Atropine Sulphate is extremely poisonous.

One Gm. of Atropine Sulphate is soluble in 0.4 cc. of water, 5 cc. of alcohol, 2.5 cc. of glycerin, 420 cc. of chloroform, and in 3000 cc. of ether, at 25° C. One Gm. is soluble in 2.5 cc. of boiling alcohol.

Tests for Identity—Melting point: not below 188° C.

Add a few drops of nitric acid to about 0.01 Gm. of Atropine Sulphate, contained in a porcelain dish, and evaporate the mixture to dryness on a water bath: a yellow residue is obtained. Add to the cooled residue a few drops of alcoholic potassium hydroxide T.S. and a fragment of potassium hydroxide: an intensely violet color is produced. (*Hyoscyamine* and *hyoscine* produce the same color as Atropine, but the presence of *other alkaloids* masks the reaction.)

Gold chloride T.S. produces in an aqueous solution of Atropine Sulphate (1 in 50) a lusterless precipitate. (*Hyoscyamine* yields a lustrous precipitate.)

Barium chloride T.S. produces in an aqueous solution of Atropine Sulphate a white precipitate which is insoluble in hydrochloric acid.

Tests for Purity—An aqueous solution of Atropine Sulphate (1 in 20) is neutral to litmus paper.

The ash from 0.1 Gm. is negligible.

One-tenth Gm. of Atropine Sulphate dissolves in 2 cc. of concentrated sulphuric acid without producing more than a slightly yellow coloration (*readily carbonizable substances*), and the solution becomes only light yellow upon the addition of 0.1 cc. of nitric acid (*many other alkaloids*).

In an aqueous solution of Atropine Sulphate (1 in 50), mixed with a few drops of hydrochloric acid, platinic chloride T.S. produces no precipitate (*most other alkaloids*).

An aqueous solution of the salt (1 in 60) is rendered turbid by sodium hydroxide, but no turbidity is produced immediately upon the addition of 2 cc. of ammonia T.S. to 5 cc. of the solution (*apoatropine* or *belladonnine*).

Uses—Atropine sulphate is preferred to the alkaloid for use as a mydriatic. An aqueous solution is generally employed for this purpose. The internal dose is from one one-hundred-and-sixtieth to one-sixtieth of a grain (0.0004 to 0.001 Gm.).

Unofficial Atropine Derivatives

SYNTHETIC MYDRIATICS

The usefulness of atropine is somewhat diminished by the fact that it affects, simultaneously, so many organs; on the eye its effects continue much longer than is, in many cases, desirable. Many attempts have been made to secure drugs of the atropine type with more specific actions or such as have a more transitory effect upon the eye. One of these drugs (homatropine) is a synthetic alkaloid analogous to atropine, the only difference being that it contains mandelic acid instead of tropic acid in combination with tropine; eucatropine is a combination of mandelic acid and a base similar to that contained in beta-eucaine.

Eucatropine, N. N. R.—Euphthalmine.—Phenyl-glycolyl-methyl-vinyl-diacetonalkamine Hydrochloride.—C_5H_6N-$(CH_3)_4(C_6H_5CHOH.COO)HCl$ = the 1,2,6,6-tetra-methyl-4-mandeloxy-piperidine hydrochloride. Eucatropine was first introduced as euphthalmine.

A white, granular, odorless powder; permanent in the air. It is very soluble in water; freely soluble in alcohol and chloroform; insoluble in ether.

Uses—Eucatropine produces prompt mydriasis free from anesthetic action, pain, corneal irritation, or increase in intra-ocular tension. It has little or no effect on accommodation, and such effect as it has disappears more rapidly than with atropine, cocaine, homatropine, etc. It is useful as an aid in ophthalmoscopic examinations in place of atropine, homatropine, etc.

Dose—From 2 to 3 drops of from a 5 to a 10 per cent solution, according to the age of the patient and the nature of the case, are instilled into the eye.

Manufactured by the Werner Drug and Chemical Company.

Homatropine Hydrochloride, N. N. R.—Homatropinæ Hydrochloridum.—$C_{16}H_{21}O_3NHCl$.—The hydrochloride of the alkaloid homatropine, obtained by the condensation of tropine and mandelic acid.

Small white crystals, soluble in water and alcohol.

Uses—Homatropine hydrochloride is given for the same indications as the hydrobromide.

Dose—It is applied to the eye in 1 per cent solution.

HOMATROPINÆ HYDROBROMIDUM. U.S. Homatropine Hydrobromide

[**Homatrop. Hydrobr.**—Homatropine Bromide]

The hydrobromide [$C_{16}H_{21}O_3N.HBr$ = 356.18] of homatropine, an alkaloid obtained by the condensation of tropine and mandelic acid. Preserve it in well-closed containers, protected from light.

Preparation—It is made by heating *tropine*, $C_8H_{15}ON$, with *mandelic (phenyl glycolic) acid*, in the presence of hydrochloric acid; ammonia is added, and the homatropine which is liberated is dissolved out by chloroform; the solution is evaporated, hydrobromic acid added, and the crystals of Homatropine Hydrobromide purified by recrystallization.

Description and Physical Properties—White crystals or a white, crystalline powder. It is odorless.

Caution—Homatropine Hydrobromide is extremely poisonous.

One Gm. of Homatropine Hydrobromide is soluble in 6 cc. of water, 40 cc. of alcohol, and in 420 cc. of chloroform, at 25° C. One Gm. is soluble in 12 cc. of alcohol at 60° C. It is insoluble in ether.

Tests for Identity—It melts at about 212° C. with partial decomposition.

Iodine T.S. produces in an aqueous solution of Homatropine Hydrobromide a brown precipitate; silver nitrate T.S. produces a yellowish-white precipitate, insoluble in nitric acid.

Shake 2 cc. of chloroform with 1 cc. of an aqueous solution of the salt (1 in 10) to which a few drops of chlorine T.S. have been added: the chloroform acquires a brownish color.

Add a slight excess of ammonia T.S. to 1 cc. of an aqueous solution of the salt (1 in 100), shake it with chloroform, and evaporate the chloroform solution to dryness on a water bath: the residue becomes yellow and finally brick-red when warmed with about 1.5 cc. of a solution made by dissolving 1 Gm. of mercuric chloride in 50 cc. of a mixture of 5 volumes of alcohol and 3 volumes of distilled water (*difference from most other alkaloids except atropine and hyoscyamine*).

Tests for Purity—Its aqueous solution (1 in 20) is neutral to litmus paper.

The ash from 0.1 Gm. is negligible.

One cc. of an aqueous solution of the salt (1 in 20) is not precipitated by tannic acid T.S. Another 1 cc. portion acidulated with hydrochloric acid yields no precipitate with platinic chloride T.S. (*difference from most other alkaloids*).

Add 5 drops of nitric acid to about 0.01 Gm. of Homatropine Hydrobromide, and evaporate to dryness in a porcelain dish on a water bath: the residue does not become violet on the addition of a few drops of alcoholic potassium hydroxide T.S. (*atropine, hyoscyamine, or scopolamine*).

Uses—Homatropine Hydrobromide is usually preferred to atropine as a mydriatic, because it is less toxic, and the effects subside far more rapidly. Dose, one one-hundred-and-twentieth of a grain (0.0005 Gm.).

SCOPOLAMINÆ HYDROBROMIDUM. U. S. Scopolamine Hydrobromide

[Scopolamin. Hydrobrom.—Hyoscine Hydrobromide, Scopolamine Bromide]

The hydrobromide [$C_{17}H_{21}O_4N.HBr.3H_2O$ = 438.24] of lævorotatory scopolamine, also known as hyoscine, obtained from various plants of the *Solanaceæ*. Preserve it in well-closed containers, protected from light.

Preparation—It is produced largely from the mother liquors remaining after the crystallization of hyoscyamine. It has an $[a]_D$ of $-18°$, in alcohol.

The U. S. P. scopolamine (or hyoscine) consists of the lævorotatory compound. The optically inactive compound has the same effect on the central nervous system as has the official or lævorotatory compound; it has but one-half the activity on peripheral organs (eye, heart, secreting glands). The absence of the latter action may in some cases be desirable, and in such cases there may be advantages in using the optically inactive compound; this has been introduced under the name "euscopol".

Description and Physical Properties—Colorless, transparent, rhombic crystals, sometimes of large size. It is odorless, and slightly efflorescent.

Caution—Scopolamine Hydrobromide is extremely poisonous.

One Gm. of Scopolamine Hydrobromide is soluble in 1.5 cc. of water and in 20 cc. of alcohol, at 25° C. It is slightly soluble in chloroform, but insoluble in ether.

Tests for Identity and Purity—(See the U. S. P. X.).

Preserve in well-closed containers, protected from light.

Uses—Scopolamine Hydrobromide is a powerful mydriatic and cerebral and spinal sedative. It is also known as *hyoscine hydrobromide*, and this title was recognized in the U. S. P. VIII in a separate article. Dose, one one-hundred-and-twentieth grain (0.0005 Gm.).

Unofficial Preparation of Scopolamine

Scopolamine Stable-Roche, N. N. R.—*Scopomannit*—An aqueous solution of pure scopolamine hydrobromide, protected against decomposition by the addition of 10 per cent of mannite, supplied in ampuls, each containing 1.2 cc. (1 cc. contains 0.0003 Gm. of scopolamine hydrobromide).

Uses and Dose—The same as those of scopolamine hydrobromide, U. S. P.

Manufactured by F. Hoffmann-LaRoche and Company.

HYOSCYAMUS. U. S. Hyoscyamus

[Hyosc.—Henbane, Hyoscyami Folium P. I.]

Hyoscyamus is the dried leaf, with or without the tops, of *Hyoscyamus niger* Linné (Fam. *Solanaceæ*).

Hyoscyamus yields not less than 0.065 per cent of the alkaloids of Hyoscyamus and contains not more than 25 per cent of its stems, none of which is more than 7 mm. in thickness. It yields not more than 12 per cent of acid-insoluble ash.

Description—Usually much wrinkled, matted and broken, frequently consisting of leaves, stems, and flowering and fruiting tops. Leaves ovate or ovate-lanceolate, inequilateral, with petioles up to one-third the length of the blade, or sessile; apex acute, margin coarsely and angularly 1- to 4-toothed or lobed; hairy, densely so on the lower surface; upper surface dark green, lower surface light gray-green; stems from 2 to 7 mm. in thickness, cylindrical or somewhat compressed, longitudinally wrinkled, hairy, gray-green; flowers nearly sessile, with an urn-shaped, hairy, unequally 5-toothed calyx and a campanulate corolla, yellowish with purplish veins; fruit, a 2-locular pyxis enclosed in the calyx; odor distinctive; taste bitter and acrid.

For further description see the U. S. P. X.

Assay—Proceed by Type Process B, taking 25 Gm. of Hyoscyamus, in fine powder, using ether-chloroform mixture for percolating the drug and chloroform for the final extraction of the alkaloids. Determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.02893 Gm. of the alkaloids of Hyoscyamus.

This assay is explained on page 1498.

U. S. P. Preparations—Extractum Hyoscyami; Fluidextractum Hyoscyami; Tinctura Hyoscyami.

N. F. Preparation—Pilulæ Catharticæ Vegetabiles (from Extract).

Hyoscyamus contains *hyoscyamine*, $C_{17}H_{23}O_3N$, *hyoscine*, $C_{17}H_{21}ON_4$, *hyoscypicrin*, $C_{27}H_{52}O_{14}$, chlorophyll, mucilage, extractive, etc.

Uses—Hyoscyamus is narcotic, hypnotic, and slightly laxative. Dose, three grains (0.2 Gm.).

HYOSCYAMINÆ HYDROBROMIDUM. U. S. Hyoscyamine Hydrobromide

[Hyoscyamin. Hydrobr.—Hyoscyamine Bromide]

The hydrobromide [$C_{17}H_{23}O_3N.HBr = 370.21$] of hyoscyamine, an alkaloid obtained from hyoscyamus and other plants of the *Solanaceæ*.

Preparation—It is made by dissolving hyoscyamine in diluted hydrobromic acid, evaporating and crystallizing. This salt is somewhat more stable than the sulphate which was formerly official.

Hyoscyamine, the base melts at 108° C. and has an $[a]_D$ −22°, in 50 per cent alcohol. It is only sparingly soluble in ether and in cold water. The base is readily converted into atropine by any alkali.

Description and Physical Properties—White, odorless, deliquescent crystals.

Caution—Hyoscyamine Hydrobromide is extremely poisonous.

Hyoscyamine Hydrobromide is very soluble in water. One Gm. is soluble in 2.5 cc. of alcohol, 1.7 cc. of chloroform, and in 2260 cc. of ether, at 25° C.

Tests for Identity—It melts at about 152° C.

An aqueous solution of Hyoscyamine Hydrobromide is lævorotatory.

Add 5 drops of nitric acid to about 0.01 Gm. of the salt, and evaporate to dryness in a porcelain dish on a water bath: the residue becomes violet upon the addition of alcoholic potassium hydroxide T.S.

Gold chloride T.S. added to about 1 cc. of an aqueous solution of the salt (1 in 20) produces a precipitate which, when recrystallized from a small quantity of boiling distilled water acidulated with hydrochloric acid, is deposited, on cooling, in minute, lustrous, golden-yellow scales (*difference from atropine and scopolamine*).

Silver nitrate T.S. added to an aqueous solution of Hyoscyamine Hydrobromide produces a yellowish-white precipitate which is insoluble in nitric acid.

Shake 2 cc. of chloroform with 1 cc. of an aqueous solution of the salt (1 in 10) to which a few drops of chlorine T.S. have been added: the chloroform acquires a brownish color.

Tests for Purity—An aqueous solution of Hyoscyamine Hydrobromide (1 in 20) is neutral to litmus paper.

The ash from 0.1 Gm. is negligible.

Platinic chloride T.S. does not form a precipitate in an aqueous solution of the salt (1 in 20) (*difference from most other alkaloids*).

Dissolve about 0.05 Gm. of the salt in 1 cc. of sulphuric acid: the solution is not darker than faint yellow (*readily carbonizable substances*).

Preserve in well-closed containers, protected from light.

Uses—Hyoscyamine Hydrobromide is used as a narcotic and sedative. The dose is one one-hundredth grain (0.0006 Gm.).

STRAMONIUM. U.S. Stramonium

[**Stramon.**—Jamestown Weed, Jimson Weed]

Stramonium consists of the dried leaves and flowering tops of *Datura Stramonium* Linné (Fam. *Solanaceæ*).

Stramonium yields not less than 0.25 per cent of the alkaloids of Stramonium, contains not more than 3 per cent of stems over 8 mm. in diameter, and yields not more than 4 per cent of acid-insoluble ash.

Description—More or less matted, wrinkled and crushed; leaves petiolate, ovate; apex acuminate, base unequal; margin sinuate, toothed or angled, the teeth few, acute and with rounded sinuses; the lamina usually shows small, circular perforations, surrounded by cork or sometimes filled with cork, surfaces usually sparsely hairy, the hairs mostly upon the veins; upper surface dark green, lower surface light green. Stems often flattened, longitudinally wrinkled, occasionally with one or more deep furrows: light greenish-brown to purplish-brown. Odor distinct, heavy and narcotic; taste unpleasant and nauseous.

For further description see the U. S. P. X.

Assay—Proceed by Type Process B, using 10 Gm. of Stramonium in fine powder, ether-chloroform mixture for percolating the drug, and chloroform as the immiscible solvent for extracting the alkaloids from the aqueous liquid. Determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.02893 Gm. of the alkaloids of Stramonium.

This assay is explained on page 1499.

U. S. P. Preparations—Extractum Stramonii (Pilular and Powdered); Tinctura Stramonii.

N. F. Preparations—Fluidextractum Stramonii; Unguentum Stramonii.

Stramonium contains *hyoscyamine*, *hyoscine*, and *atropine*; the mixed alkaloids were formerly called *daturine*. The leaves contain albumin, mucilage, malic acid, and potassium nitrate. In the seeds, which are no longer official, there is found about 25 per cent of fixed oil, with resins, mucilage, etc.

History—*Stramonium* was probably known to the ancients as a poison. It certainly has been known and used in India for many centuries. Dioscorides confused it with henbane.

Uses—Stramonium is narcotic and poisonous. Dose, one to three grains (0.06 to 0.2 Gm.).

PILOCARPUS. (U. S. P. IX) Pilocarpus

[Jaborandi]

The dried leaflets of *Pilocarpus Jaborandi* Holmes, known in commerce as Pernambuco Jaborandi, or of *Pilocarpus microphyllus* Stapf, known in commerce as Maranham Jaborandi (Fam. *Rutaceæ*), without the presence or admixture of more than 5 per cent of the stalks bearing the leaflets and stems of the same plant, or other matter, and yielding not less than 0.6 per cent of the alkaloids of Pilocarpus.

Pilocarpus leaves were first employed medicinally about 1874. Since 1900 very little *Pilocarpus jaborandi* has been obtainable, most of the supply now coming from *Pilocarpus microphyllus*.

Description—*Pernambuco Jaborandi*—Leaflets when entire, oval oblong, or elliptical, from 4 to 10.5 cm. in length and from 2 to 4 cm. in breadth and with short, stout petiolules; summits more or less rounded or acute and emarginate; bases rounded or acute and mostly unequal; margins entire and narrowly revolute; very smooth, shiny, coriaceous and glandular-punctate; upper surfaces grayish to brownish-green, midribs mostly depressed, under surfaces yellowish- or greenish-brown and slightly pubescent on the prominent midvein.

Maranham Jaborandi—Leaflets rhomboidally oval to obovate or elliptical, from 1.5 to 5 cm. in length and from 1 to 3 cm. in breadth, the lateral ones nearly sessile, the terminal ones on margined petiolules, from 0.5 to 1.5 cm. in length; of a nearly uniform grayish or yellowish-green color, rather thin but otherwise resembling Pernambuco Jaborandi.

For a further description and assay, see the U. S. P. IX.

Pilocarpus contains *pilocarpine*, $C_{11}H_{16}O_2N_2$, and *isopilocarpine*. *Jaborane*, which was believed to be a definite principle, has been shown to be a mixture of other alkaloids. Several other unimportant alkaloids have been separated from various species of pilocarpus. It also contains a colorless, viscid oil. The leaves are coriaceous and difficult to powder.

Assay—Proceed by Type Process A, taking 15 Gm. of Pilocarpus in fine powder, using 150 cc. of chloroform as the solvent and decanting an aliquot portion of 100 cc. representing 10 Gm. of pilocarpus. Determine the alkaloids volumetrically. Each cc. of tenth-normal sulphuric acid corresponds to 0.0208 Gm. of the alkaloids of Pilocarpus.

Uses—It is used as a diaphoretic and sialogogue. Dose, thirty grains (2 Gm.).

PILOCARPINÆ HYDROCHLORIDUM. U.S. Pilocarpine Hydrochloride

[Pilocarpin. Hydrochl.—Pilocarpine Chloride]

The hydrochloride [$C_{11}H_{16}O_2N_2.HCl = 244.67$] of an alkaloid obtained from the dried leaflets of *Pilocarpus Jaborandi* Holmes, or of *Pilocarpus microphyllus* Stapf (Fam. *Rutaceæ*).

Preparation—The total alkaloids are extracted with alcohol containing a small amount of hydrochloric acid. The solvent is distilled off and the aqueous residue filtered, and the filtrate neutralized with ammonia. This is allowed to stand until the resins are all deposited. It is then filtered, and the filtrate evaporated to a small bulk. Ammonia is then added in excess and the free alkaloids removed with chloroform. This solvent is removed by distillation and the residue dissolved in a small quantity of water and nitric acid. The crystals which form are a mixture of pilocarpine and isopilocarpine nitrates and these are separated by recrystallization from alcohol. Other salts are derived from the purified nitrate.

Pilocarpine is in the form of a colorless, oily liquid which boils at 260° C. under 5 mm. It has an $[\alpha]_D$ of +100°. It is soluble in water, alcohol, or in chloroform but practically insoluble in ether.

Description and Physical Properties—Colorless, odorless, translucent crystals. It is hygroscopic.

One Gm. of Pilocarpine Hydrochloride is soluble in 0.3 cc. of water, 3 cc. of alcohol, and in 366 cc. of chloroform, at 25° C. One Gm. is soluble in 1.5 cc. of alcohol at 60° C. It is insoluble in ether.

Tests for Identity—When dried to constant weight at 100° C., Pilocarpine Hydrochloride melts between 195° and 198° C.

Its aqueous solution (1 in 20) is slightly acid to litmus paper.

Dissolve 0.01 to 0.02 Gm. of Pilocarpine Hydrochloride in 2 cc. of distilled water in a test tube, add 2 cc. of a faintly acid hydrogen dioxide T.S., and cover the mixture with about 1 cc. of benzene. Add 3 or 4 drops of a solution of potassium dichromate (1 in 300) and shake the mixture gently: the benzene layer acquires a violet color, while the aqueous layer remains yellow (*distinction from other alkaloids*). (If more than 0.02 Gm. of the salt is used, the benzene turns blue and the reaction is no longer characteristic.)

Silver nitrate T.S. produces in an aqueous solution of the salt, a white precipitate, insoluble in nitric acid.

Tests for Purity—The ash from 0.1 Gm. is negligible.

A solution of 0.1 Gm. of Pilocarpine Hydrochloride in 2 cc. of sulphuric acid is colorless or at most faintly yellow (*readily carbonizable substances*).

The addition of ammonia T.S. or of potassium dichromate T.S. to 10 cc. of an aqueous solution of the salt (1 in 100) produces no turbidity (*various foreign alkaloids*).

Preserve in well-closed containers, protected from light.

Uses—Pilocarpine Hydrochloride is a diaphoretic and sialogogue. Dose, by mouth, one-sixth of a grain (0.01 Gm.) but preferably given hypodermically in doses of one-twelfth grain (0.005 Gm.).

PILOCARPINÆ NITRAS. U.S. Pilocarpine Nitrate

[Pilocarpin. Nit.]

The nitrate [$C_{11}H_{16}O_2N_2.HNO_3$] of an alkaloid obtained from the dried leaflets of *Pilocarpus Jaborandi* Holmes, or of *Pilocarpus microphyllus* Stapf (Fam. *Rutaceæ*).

Preparation—See *Pilocarpinæ Hydrochloridum*, above.

Description and Physical Properties—Shining, colorless crystals. It is stable in the air.

One Gm. of Pilocarpine Nitrate is soluble in 4 cc. of water and in 75 cc. of alcohol, at 25° C. One Gm. is soluble in 21 cc. of alcohol at 60° C. It is insoluble in chloroform and in ether.

Tests for Identity—Pilocarpine Nitrate melts between 170° and 173° C.

Its aqueous solution (1 in 20) is slightly acid to litmus paper.

Dissolve from 0.01 to 0.02 Gm. of Pilocarpine Nitrate in 2 cc. of distilled water in a test tube, add 2 cc. of a faintly acid hydrogen dioxide T.S., and cover the mixture with about 1 cc. of benzene. Add 3 or 4 drops of a solution of potassium dichromate (1 in 300) and shake the mixture gently: the benzene layer acquires a violet color, while the aqueous layer remains yellow (*distinction from other alkaloids*). (If more than 0.02 Gm. of the salt is used, the benzene turns blue and the reaction is no longer characteristic.)

Mix an aqueous solution of the salt with an equal volume of ferrous sulphate T.S., and superimpose the mixture upon 5 cc. of sulphuric acid, contained in a test tube: the line of contact becomes brown.

Tests for Purity—The ash from 0.1 Gm. is negligible.

A solution of 0.1 Gm. of Pilocarpine Nitrate in 2 cc. of sulphuric acid is colorless or at most only faintly yellow (*readily carbonizable substances*).

The addition of a few drops of silver nitrate T.S. to 5 cc. of an aqueous solution of the salt (1 in 50), acidulated with nitric acid, does not at once produce an opalescence (*chloride*).

The addition of ammonia T.S. or of potassium dichromate T.S. to 10 cc. of an aqueous solution of Pilocarpine Nitrate (1 in 100) produces no turbidity (*various foreign alkaloids*).

Preserve in well-closed containers, protected from light.

Uses—Pilocarpine Nitrate is used as a diaphoretic and sialogogue. The dose is the same as for the hydrochloride.

COLCHICI CORMUS. U. S. Colchicum Corm

[**Colch. Corm.**—COLCHICUM ROOT]

The dried corm of *Colchicum autumnale* Linné (Fam. *Liliaceæ*), yielding not less than 0.35 per cent of colchicine.

Description—Usually in reniform transverse slices or in ovate longitudinal slices from 2 to 5 mm. in thickness; flat surfaces whitish, slightly roughened, and of a crystalline appearance under a hand lens; epidermal surface light brown and finely wrinkled; fracture short and mealy; odor slight; taste bitter and acrid.

For further description see the U. S. P. X.

Powdered Colchicum Corm—Light brown or grayish-brown; starch grains numerous, single or 2- to 6-compound, the individual grains varying from spherical or ovoid to polygonal, from 0.003 to 0.030 mm. in diameter and marked with a triangular or star-shaped central cleft; tracheæ few and with spiral or scalariform thickenings; occasional fragments of epidermal cells with thin, reddish-brown walls.

Assay—Proceed as directed under *Colchici Semen.*

U. S. P. Preparation—Extractum Colchici Cormi.

N. F. Preparations—Fluidextractum Colchici Cormi; Tinctura Colchici Cormi Fortior.

Uses—For uses see Colchicum Seed.

COLCHICI SEMEN. U. S. Colchicum Seed

[**Colch. Sem.**—COLCHICI SEMEN P. I.]

Colchicum Seed is the dried ripe seed of *Colchicum autumnale* Linné (Fam. *Liliaceæ*).

Colchicum Seed yields not less than 0.45 per cent of colchicine.

Description—Ovoid or irregularly globular, minutely pointed at the hilum, and with a distinct beak or caruncle approximately opposite to the hilum; from 2 to 3 mm. in diameter and, when fresh, with a tendency to cohere in small clumps; externally dark brown, finely pitted; tough and of bony hardness; internally whitish or light brown; nearly inodorous; taste bitter and acrid.

For further description see the U. S. P. X.

Assay—Place 15 Gm. of Colchicum Seed, in fine powder, in a 500 cc. flask, and add 290 cc. of distilled water and 10 cc. of solution of lead subacetate. Weigh the flask and contents, and digest the mixture at from 60° to 70° C. for three hours with occasional agitation. Cool, add distilled water to restore the original weight, and filter off 200 cc. Add 2 Gm. of sodium phosphate to the clear filtrate, or sufficient to completely precipitate the lead, shake the mixture frequently during half an hour, and filter off 100 cc., representing 5 Gm. of Colchicum Seed. Shake out the alkaloid from the filtrate with chloroform until completely extracted, as shown by testing with iodine T.S., and evaporate the chloroform solution. Add about 1 cc. of alcohol, and again evaporate. Repeat this operation once more, and dry the residue to constant weight at 100° C. To this weighed residue contained in a flask add 5 cc. of tenth-normal sulphuric acid and 5 cc. of distilled water, adding a few drops of chloroform, and heat the mixture for ten minutes at 70° C. Filter the liquid through a pledget of purified cotton, wash the flask and cotton with distilled water, reject the filtrate and washings, and remove as much of the water from the cotton as possible. Dissolve any insoluble residue that may remain on the cotton by

washing it first with a little alcohol and then with ether; collect the alcohol-ether washings in the flask, evaporate, and dry the residue to constant weight at 100° C. Deduct this weight from the weight of residue previously obtained. The difference will be the weight of colchicine obtained from 5 Gm. of Colchicum Seed (Proximate Assays, page 1497).

U. S. P. Preparations—Fluidextractum Colchici Seminis; Tinctura Colchici Seminis.

The alkaloid *colchicine*, $C_{22}H_{25}O_6N$, is found in both the corm and seed of colchicum. It is the active principle. There has been extracted a second alkaloid *colchiceine*, $C_{21}H_{23}O_6N.\frac{1}{2}H_2O$, the actual presence of which is doubtful as colchicine can be readily converted into it by heating with dilute sulphuric acid. There are present in the corm, starch, fat, sugar, resin, etc. In the seed, a fixed oil is found in addition to the other principles. The toughness of the seeds is due to their composition and structure, being composed chiefly of horny albumin made up of cells having very thick walls and surrounded by a closely adherent testa. The seeds may be exhausted of their active principle by digesting them in hot alcohol without bruising or powdering them.

Uses—Colchicum is used in gout and rheumatism. Dose of the seeds, three grains (0.2 Gm.); of the corm, four grains (0.25 Gm.).

COLCHICINA. U. S. Colchicine

An alkaloid [$C_{22}H_{25}O_6N = 399.32$] obtained from the seed or corm of colchicum.

Preparation—Colchicine may be made by percolating colchicum with alcohol, evaporating the percolate, diluting with water, filtering, precipitating the coloring matter with lead subacetate, treating the liquid with sodium phosphate to remove lead compounds, and precipitating the colchicine with tannic acid; the tannate is then digested with lead oxide, dried, and the colchicine dissolved out with alcohol. Colchicine forms with chloroform an additive product. It is soluble in water, dilute alcohol, and in chloroform. When crystallized from ethyl acetate, it has a melting point of 155° to 157° C. and has an $[a]_D$ of −120°, in chloroform.

Description and Physical Properties—Pale yellow, amorphous scales, or powder, turning darker on exposure to light. It is odorless, or nearly so.

Caution—Colchicine is extremely poisonous.

One Gm. of Colchicine is soluble in 22 cc. of water, 220 cc. of ether, and in 100 cc. of benzene, at 25° C. It is freely soluble in alcohol and in chloroform, and is insoluble in petroleum benzin.

Tests for Identity—Colchicine melts between 142° and 146° C.

Its aqueous solution (1 in 30) is neutral to litmus paper, and is lævorotatory.

An aqueous solution of Colchicine (1 in 30) is yellow, its color becoming intensified by the addition of inorganic acids.

Mix about 0.001 Gm. of Colchicine with a few drops of sulphuric acid: a lemon-yellow color is produced, which, on the addition of a drop of nitric acid, changes to greenish-blue, rapidly becoming reddish and finally yellow, or almost colorless. On adding an excess of sodium hydroxide T.S., the color is changed to red.

Tests for Purity—The addition of 2 drops of ferric chloride T.S. to 5 cc. of an aqueous solution of Colchicine (1 in 100) produces no color (*colchiceine*), but on heating, a brownish-red color is developed, which changes to brownish-black. One drop of ferric chloride T.S. added to 1 cc. of an alcoholic solution of Colchicine (1 in 20) at once produces a garnet-red color.

The ash from 0.1 Gm. is negligible.

Heat the mixture of about 0.01 Gm. of Colchicine, 2 cc. of sodium hydroxide T.S., and one drop of aniline: no odor of phenylisocyanide is developed (*chloroform*).

Preserve in well-closed containers, protected from light.

History—This drug is referred to by Dioscorides who simply knew it as a poison. It was called *Hermodactylus* by several writers in the sixth and seventh centuries and was recommended at that time in the treatment of gout. It was the basis of a celebrated proprietary remedy in the latter part of the eighteenth century, which was put up in 2 drachm bottles (containing

two doses) which sold for the equivalent of $4.00 a bottle. The preparation was called Hasson's *Eau Medicinale*. Its composition was exposed shortly after the beginning of the nineteenth century.

Uses—Colchicine is used in the treatment of gout and rheumatism. Dose, one one-hundred-and-twentieth of a grain (0.0005 Gm.).

VERATRUM VIRIDE. U. S. Veratrum Viride

[Verat. Vir.—Green Hellebore, American Hellebore]

Veratrum Viride consists of the dried rhizome and roots of *Veratrum viride* Aiton (Fam. *Liliaceæ*).

Veratrum Viride contains not more than 5 per cent of its stems or other foreign organic matter, and yields not more than 4 per cent of acid-insoluble ash.

Description—Rhizome more or less conical, from 2 to 7 cm. in length, from 1.5 to 3 cm. in diameter, externally light to dark brown or brownish-black; frequently bearing at the summit numerous, thin, closely-arranged leaf bases, otherwise rough and wrinkled and somewhat annulate from scars of bud scales; inodorous; taste bitter and acrid. Roots numerous, nearly cylindrical, from 3 to 8 cm. in length and from 1 to 4 mm. in diameter, usually brittle, whitish and more or less starchy.

For further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Veratri Viridis.

The U. S. P. formerly included under the name of Veratrum both *Veratrum album* and *Veratrum viride*, but, as the two drugs do not possess identical therapeutic value recent pharmacopœias have recognized only the latter.

Veratrum viride contains the alkaloids *jervine*, *pseudojervine*, *rubijervine*, and *cevadine*. The most active of these appears to be *cevadine*, which is very poisonous and sternutatory. It contains also a bitter glucoside, *veratramarin*, and *jervic acid*. It is claimed that *cevadine* is not present in *Veratrum album*, while the other constituents are present in both. Cevadine is also known as *crystallized veratrine* to distinguish it from the mixture of alkaloids known as *veratrine*.

Veratrum album contains *protoveratrine* which is similar to cevadine in its action, though even more toxic. There are also present resins, starch, coloring matter, etc.

Uses—It is a cardiac sedative, poisonous, with emetic and diaphoretic properties. Dose, one to two grains (0.06 to 0.125 Gm.).

VERATRINA. N. F. Veratrine

(U. S. P. IX)

[Veratrin.—Veratria]

A mixture of alkaloids obtained from the seed of *Asagræa officinalis* (Chamisso and Schlechtendal) Lindley (Fam. *Liliaceæ*). Preserve it in well-closed containers, protected from light.

Preparation—The seeds are exhausted with alcohol, and the alcohol recovered by distillation. The residuary liquid contains veratrine in its natural combination with veratric acid; this is diluted with water (which precipitates the resins) and filtered; potassium hydroxide or ammonia is added to the filtrate, when veratrine is precipitated. It is then redissolved, decolorized, and reprecipitated.

The official *Veratrine* consists of a mixture of *cevadine*, *cevadilline*, *sabadine*, *sabadinine* and *veratridine*. It is entirely different from *crystallized veratrine*, which is another name for pure *cevadine*.

Official Description—It is a white, or grayish-white, amorphous powder. It is slightly hygroscopic.

Odor, Taste, and Reaction—Odorless, but causing intense irritation and sneezing when even a minute quantity reaches the nasal mucous membrane. *Great caution must be used in tasting it.* Its alcoholic solution is alkaline to moistened litmus paper.

Solubility—One Gm. of Veratrine dissolves in 1760 cc. of water, 2.8 cc. of alcohol, 0.7 cc. of chloroform, and in 4.2 cc. of ether at 25° C. (77° F.); also in 1345 cc. of water at 80° C. (176° F.); insoluble in petroleum benzin.

Tests for Identity—Triturate about 0.05 Gm. of Veratrine with 2 cc. of sulphuric acid in a glass mortar; the yellow or orange-red solution exhibits by reflected light a greenish fluorescence, which becomes more intense upon the addition of an equal volume of sulphuric acid. Upon standing, the solution gradually assumes a deep red color.

Sulphuric acid, when heated with Veratrine, gives a cherry-red color. Sulphuric acid added to a mixture of one part of Veratrine and six parts of sucrose produces a green color, which changes to blue, and finally the mixture becomes colorless.

No weighable ash remains on incinerating 0.1 Gm. of Veratrine.

Impurities and Test for Impurities—An alcoholic solution of Veratrine (1 in 20) remains clear after the addition of platinic chloride T.S. (*various foreign alkaloids*).

N. F. Preparations—Oleatum Veratrinæ; Unguentum Veratrinæ.

Uses—Veratrine is used externally in neuralgia, rheumatism, etc. It is sternutatory and very poisonous.

ACONITUM. U. S. Aconite

[**Aconit.**—Monkshood, Aconite Root, Aconiti tuber P. I.]

Aconite, in the form of the tincture, administered subcutaneously to guinea pigs, has a minimum lethal dose not exceeding 0.0004 cc. of tincture for each gram of body weight of guinea pig. Aconite contains not more than 5 per cent of its stems or 2 per cent of other foreign organic matter.

Description—More or less conical or fusiform, from 4 to 10 cm. in length, and from 1 to 3.5 cm. in diameter at the crown; externally dark brown or grayish-brown, smooth or longitudinally wrinkled, the upper end with a bud, or remains of bud-scales and a stem-scar, the other portions with numerous root-scars or short rootlets; fracture short, horny or somewhat mealy; internally whitish, light brown or dark brown; bark, 1 to 2 mm. in thickness, cambium zone usually 5- to 8-angled; odor very slight, taste sweetish, soon becoming acrid and developing a tingling sensation, followed by numbness. (*Taste cautiously.*)

Assay—The details of this assay will be found on page 1506 with explanations.

For further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Aconiti.

N. F. Preparations—Linimentum Aconiti et Chloroformi (from Fluidextract); Fluidextractum Aconiti.

Aconite is found both on the European and American continents. It has been used medicinally since medieval times and is said to have been used as an arrow poison by the Chinese.

The drug contains aconitine, $C_{34}H_{47}O_{11}N$, as its principal alkaloid. Several others are present namely, *benzaconine*, (*benzolaconine*), *aconine*, and *methyl benzolaconine*. These are all decomposition products. The physiologic action of the other alkaloids is antagonistic to aconitine. Aconitine is readily decomposed into the other alkaloids which are inert or less active and for this reason the U. S. P. X has a biological standard for the drug and its preparations to indicate the minimum activity. *Aconitic acid*, $H_6C_6O_6$, is also present, together with resins, sugar, fat, coloring matter, etc. Aconitic acid may be produced by heating citric acid to 155° C. (311° F.). Alcohol is the best menstruum for preparations of aconite.

Uses—Aconite is a cardiac and nerve sedative, producing numbness and tingling when applied to the tongue or lips. It is very poisonous. Dose, one-half grain (0.03 Gm.).

ACONITINA. U. S. Aconitine

[**Aconitin.**]

An alkaloid [$C_{34}H_{47}O_{11}N$ = 645.55] obtained from aconite. Aconitine, administered subcutaneously to guinea pigs, has a minimum lethal dose of not less than 0.00,000,005,5 Gm. and not more than 0.00,000,006,5 Gm. for each gram of body weight of guinea pig.

Preparation—Aconitine may be made by acidifying an alcoholic tincture of aconite with tartaric acid to remove resin and fatty matter, precipitating the filtrate with sodium bicarbonate, dissolving the precipitate in ether, and crystallizing.

The base has an $[a]_D$ of $+14.6°$ in chloroform. Aconitine salts, when heated to 120° to 130° C., in aqueous solution under pressure, yield, first acetic acid and benzoylaconine and finally benzoic acid and aconine.

Description and Physical Properties—Colorless or white crystals. It is odorless and is stable in the air.

Caution—Aconitine is extremely poisonous.

Aconitine is very slightly soluble in water. One Gm. dissolves in 28 cc. of alcohol, in about 65 cc. of ether, and in 7 cc. of benzene, at 25° C. It is almost insoluble in petroleum benzin.

Tests for Identity—Aconitine melts at about 195° C. when heated rapidly.

Solutions of Aconitine in neutral solvents are slightly alkaline to litmus paper.

About 0.001 Gm. of Aconitine mixed with 2 or 3 drops of nitric or sulphuric acid on a white porcelain surface dissolves without coloration. Under the same conditions, 0.001 Gm. of Aconitine mixed with 2 drops of sulphuric acid containing 0.005 Gm. of ammonium vanadate in each cc. produces an orange color.

Dilute solutions of Aconitine salts yield precipitates with mercuric potassium iodide T.S., tannic acid T.S., and gold chloride T.S., but only concentrated solutions yield precipitates with platinic chloride T.S., mercuric chloride T.S., and trinitrophenol T.S.

Tests for Purity—The ash from 0.05 Gm. is negligible.

Evaporate to dryness on a water bath about 0.01 Gm. of Aconitine with 5 drops of fuming nitric acid, cool and treat the resulting yellow residue with alcoholic potassium hydroxide T.S.: no violet color develops (*pseudaconitine or atropine*).

Assay—The details of this assay will be found on page 1506 with explanations.

Preserve in well-closed containers, protected from light.

Uses—*Crystallized* aconitine is a *very powerful poison.* It is given in the dose of one four-hundredth of a grain (0.00015 Gm.). Amorphous or commercial aconitine is usually an impure product. It is a cardiac and nerve sedative.

HYDRASTIS, U. S. Hydrastis

[Golden Seal]

Hydrastis consists of the dried rhizome and roots of *Hydrastis canadensis* Linné (Fam. *Ranunculaceæ*).

Hydrastis yields not less than 2.5 per cent of the ether-soluble alkaloids of Hydrastis and contains not more than 2 per cent of its stems and leaves, or more than 2 per cent of other foreign organic matter, and yields not more than 3 per cent of acid-insoluble ash.

Description—Rhizome subcylindrical, flexuous, from 1 to 5 cm. in length and from 2 to 10 mm. in thickness; more or less annulate and wrinkled longitudinally; yellowish-brown to dark grayish-brown; marked by numerous stem scars or occasional stem- or leaf-bases and numerous roots, frequently broken, leaving circular yellowish scars or short protuberances; fracture short and waxy; internally deep yellow or greenish-yellow; odor distinctive; taste bitter.

Roots numerous, filiform, up to 35 cm. in length and 1 mm. in diameter; yellowish; brittle; curved, twisted and matted together or broken into pieces.

Assay—Proceed by Type Process A, taking 10 Gm. of Hydrastis, in fine powder, using 100 cc. of ether and decanting an aliquot portion of 50 cc., representing 5 Gm. of Hydrastis. Use ether for the final extraction, and determine the alkaloids gravimetrically.

This assay is explained on page 1498.

U. S. P. Preparation—Fluidextractum Hydrastis.

N. F. Preparations—Extractum Hydrastis; Mistura Rhei Alkalina (from Fluidextract); Tinctura Hydrastis.

Hydrastis contains *hydrastine*, $C_{21}H_{21}O_6N$, *berberine*, $C_{20}H_{17}O_4N$, and *canadine*, $C_{20}H_{21}O_4N$, sugar, starch, resin, coloring matter, etc. Hydrastis usually contains at least 1.5 per cent of hydrastine and 2.5 per cent of berberine. The ether-soluble alkaloids upon which the value of the drug is based are

hydrastine and canadine. The salts of hydrastine are white; those of berberine are bright yellow.

Uses—Hydrastis is used as an alterative and tonic, in doses of twenty to forty grains (1.3 to 2.6 Gm.).

HYDRASTINÆ HYDROCHLORIDUM. N. F. Hydrastine Hydrochloride

[**Hydrastin. Hydrochl.**—HYDRASTINE CHLORIDE]

The hydrochloride [$C_{21}H_{21}O_6N.HCl = 419.75$] of the alkaloid hydrastine.

Preparation—It may be made by adding hydrochloric acid carefully to hydrastine in aqueous mixture until a neutral solution results, then concentrating and crystallizing.

Official Description—It occurs as a white to creamy-white powder; hygroscopic.

Odor and Reaction—Odorless. An aqueous solution of the salt (1 in 20) is neutral or only slightly acid to litmus.

Solubility—Hydrastine Hydrochloride is very soluble in water and in alcohol; slightly soluble in chloroform; very slightly soluble in ether.

Tests for Identity—An aqueous solution of the salt yields with silver nitrate T.S. a white precipitate insoluble in nitric acid, but soluble in ammonia water. Sulphuric acid, when added to Hydrastine Hydrochloride, produces a yellow color which turns to purple on heating. Sulphuric acid containing 0.005 Gm. of molybdic acid in each cc. produces with hydrastine salts a green color, changing to olive-green, then to brown; nitric acid produces a reddish-yellow color; sulphuric acid containing 0.005 Gm. of selenous acid in each cc. gives a light green color changing to brown.

Tests for Purity—No weighable ash remains on incinerating 0.1 Gm. of Hydrastine Hydrochloride. A solution of about 0.1 Gm. of Hydrastine Hydrochloride in 10 cc. of diluted sulphuric acid shows no blue fluorescence (*hydrastine*) but on the gradual addition of potassium permanganate T.S., avoiding excess, a blue fluorescence develops.

An aqueous solution of Hydrastine Hydrochloride (1 in 20) is not reddened by chlorine water (*berberine*).

Preserve it in well-closed containers, protected from light.

N. F. Preparation—Liquor Hydrastinæ Compositus.

Uses—Same uses and dose as hydrastine.

LIQUOR HYDRASTINÆ COMPOSITUS. N. F. Compound Solution of Hydrastine

[**Liq. Hydrastin. Co.**—COLORLESS HYDRASTINE SOLUTION]

	Metric	Alternative
Hydrastine Hydrochloride	**3 Gm.**	22 gr.
Aluminum Chloride	**3 Gm.**	22 gr.
Calcium Chloride	**3 Gm.**	22 gr.
Magnesium Chloride	**3 Gm.**	22 gr.
Potassium Chloride	**1 Gm.**	7 gr.
Glycerin	**500 cc.**	8 fl. oz.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	16 fl. oz.

Dissolve the salts in 450 cc. [7 fl. 96 min.] of distilled water, add the glycerin, filter, and add sufficient distilled water to make the product measure 1000 cc. [16 fl. oz.].

Compound Solution of Hydrastine is a straw-colored liquid with a saline taste. It is acid to litmus paper.

Specific gravity: about 1.127 at 25° C.

Evaporate 10 cc. of the solution at a temperature not exceeding 100° C.: it leaves a thick, viscous residue not exceeding 5.714 Gm.

Incinerate the residue from 10 cc. of the solution: it leaves not more than 0.038 Gm. of ash.

A solution of sodium carbonate added to the Solution produces a white gelatinous precipitate.

Uses—It is used as an alterative, astringent, and antiseptic in a dose of one fluidrachm (4 cc.)

Average dose—1 fluidrachm (4 cc.).

GRANATUM. U. S. Pomegranate

[Granat.—Pomegranate Bark]

Pomegranate is the dried bark of the stem or root of *Punica Granatum* Linné (Fam. *Granaceæ*).

Pomegranate contains not more than 2 per cent of wood or other foreign organic matter.

Description—Stem bark in pieces from 2 to 8 cm. in length; bark from 0.5 to 3.5 mm. in thickness; outer surface yellowish to grayish-brown, with patches of grayish lichens, broadly elliptical lenticels and yellow-brown furrows or abraded patches of cork; longitudinally wrinkled; inner surface light yellow or yellowish-brown, finely striate; fracture short; phelloderm dark green; inner bark yellowish-green.

Root bark in transversely curved pieces; externally brownish-yellow with conchoidal depressions and dark brown irregular patches in the cork; internally dark yellow, the medullary rays extending nearly to the outer surface.

In either root or stem bark, odor slight, taste astringent, somewhat bitter and nauseous.

For further description see the U. S. P. X.

Preserve in tightly-closed containers.

U. S. P. Preparation—Fluidextractum Granati.

Pomegranate contains four alkaloids, *pelletierine*, $C_8H_{15}ON$, *isopelletierine*, *pseudopelletierine* and *methylisopelletierine*. The first named is sometimes called *punicine*; the mixed alkaloids are official in the form of pelletierine tannate; pseudopelletierine is solid and crystallizable; the others are liquid. The total alkaloidal content of the bark is about 2.5 per cent. Of this about 0.5 per cent is pelletierine which is said to be toxic to the tapeworm. It also contains punicotannic acid, $C_{20}H_{16}O_{13}$, sugar, mannite, pectin, gum, etc.

Uses—Pomegranate is anthelmintic, in doses of thirty grains (2 Gm.).

PELLETIERINÆ TANNAS. U. S. Pelletierine Tannate

[Pellet. Tann.]

A mixture in varying proportions of the tannates of four alkaloids (pelletierine, iso-pelletierine, methyl-iso-pelletierine, and pseudo-pelletierine), obtained from pomegranate.

Preparation—Pelletierine tannate may be made by precipitating a solution of a sulphate of the alkaloids from pomegranate bark with a solution of tannic acid containing ammonia, washing and drying the precipitate.

Description and Physical Properties—A light yellow, odorless, amorphous powder, having an astringent taste.

One Gm. of Pelletierine Tannate is soluble in about 250 cc. of water at 25° C.

It is soluble in alcohol, slightly soluble in ether, and insoluble in chloroform.

It is dissolved by warm dilute acids.

Test for Identity—Its saturated, aqueous solution is acid to litmus paper. A saturated aqueous solution of the salt is colored blue-black by ferric chloride T.S.

Tests for Purity—The ash from 0.2 Gm. is negligible.

Platinic chloride T.S. produces no precipitate in a cold solution of about 0.1 Gm. of Pelletierine Tannate in a mixture of 4 cc. of distilled water and 1 cc. of diluted hydrochloric acid (*many foreign alkaloids*).

Dissolve about 0.5 Gm. of Pelletierine Tannate, accurately weighed, in 5 cc. of sodium hydroxide T.S., and shake the solution with four successive portions of 10, 5, 5, and 5 cc. of chloroform. Acidulate the combined chloroform solutions with 0.1 cc. of hydrochloric acid, evaporate to apparent dryness on a water bath, dissolve the residue in 5 cc. of alcohol, again evaporate and dry for one hour at 60° C. The weight of the residue is not less than 20 per cent of the weight taken.

Stir about 0.001 Gm. of the residue obtained in the preceding test on a white, porcelain surface with 2 drops of sulphuric or nitric acid: no other than a light yellow or slightly brown color is produced.

Preserve in small, well-closed containers, protected from light.

Uses—Pelletierine tannate is used as a tænifuge. Dose, four grains (0.25 Gm.).

IPECACUANHA. U. S. Ipecac

[Ipecac.—Ipecachuanhæ Radix P. I.]

Ipecac consists of the dried rhizome and roots of *Cephaëlis Ipecacuanha* (Brotero) A. Richard, known in commerce as Rio or Brazilian Ipecac, or of *Cephaëlis acuminata* Karsten, known in commerce as Cartagena or Panama Ipecac (Fam. *Rubiaceæ*).

Ipecac yields not less than 1.75 per cent of the ether-soluble alkaloids of ipecac and contains not more than 5 per cent of its over-ground stems, or more than 2 per cent of other foreign organic matter.

Description—Roots in cylindrical pieces, mostly curved and sharply flexuous, occasionally branched, from 3 to 15 cm. in length, from 1 to 4 mm. in thickness, reddish-brown to dark brown, either smooth or closely annulated, with thickened, incomplete rings and usually exhibiting transverse fissures with vertical sides; bark of smooth root thin, approximately one-ninth of the diameter of the root, that of the annulated root approximately two-thirds of the entire diameter. Fracture of bark short, easily separable from the tough, fibrous wood; odor distinctive, the dust sternutatory; taste bitter, nauseous and acrid. Rhizomes cylindrical, attaining a length of 10 cm. and a thickness of 2 mm., finely longitudinally wrinkled, with a few elliptical scars and a distinct pith approximately one-sixth of the entire diameter.

For further description see the U. S. P. X.

Assay—Proceed by Type Process A, taking 10 Gm. of Ipecac, using 100 cc. of ether and decanting an aliquot portion of 50 cc., representing 5 Gm. of Ipecac. Use ether for the final extraction and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.024 Gm. of the ether-soluble alkaloids of Ipecac.

This assay is explained on page 1498.

U. S. P. Preparations—Fluidextractum Ipecacuanhæ; Pulvis Ipecacuanhæ et Opii; Syrupus Ipecacuanhæ (from Fluidextract).

N. F. Preparations—Mistura Rhei Composita (from Fluidextract): Pilulæ Laxativæ Compositæ; Syrupus Asari Compositus (from Fluidextract); Syrupus Ipecacuanhæ et Opii (from Tincture); Tinctura Ipecacuanhæ et Opii (from Fluidextract).

Ipecac contains *emetine* (*methyl-cephaëline*), $C_{15}H_{22}O_2N$, *cephaëline*, $C_{14}H_{19}O_2N$, *psychotrine*, *emetamine*, also *ipecacuanhic acid*, pectin, starch, resin, sugar, etc. All of the alkaloids are interrelated and may be synthesized from each other. Brazilian roots yield as much as 2.5 per cent of total alkaloids and Cartagena root 2.0 per cent. The apothegmatic matter, which is dissolved by hydroalcoholic liquids when percolating it, is slowly precipitated when added to water or syrup. It may be separated by allowing the aqueous liquid to stand until the separation is completed and then filtering.

History—The first mention of this Brazilian drug is by *Purchas*, a famous traveler, in 1625. Its first introduction into European medicine was in 1686 when Louis XIV purchased from a quack named *Helvetius* the secret of a nostrum used successfully in the treatment of diarrhea and dysentery, and ipecac was found to be the essential ingredient.

Uses—Ipecac is an emetic, in doses of fifteen grains (1 Gm.), and an expectorant, in doses of one grain (0.06 Gm.).

EMETINÆ HYDROCHLORIDUM. U. S. Emetine Hydrochloride

[Emet. Hydroch.]

The hydrochloride [$C_{30}H_{44}O_4N_2.2HCl = 569.46$] of an alkaloid obtained from ipecac or prepared synthetically. It contains variable amounts of water of crystallization. Pelletier and Magendie, the celebrated French scientists, discovered this alkaloid in 1817.

Preparation—The total alkaloids are prepared by extracting the roots with alcohol, evaporating the solution, and shaking out with ether to remove fat and resin. The purified aqueous solution is now made alkaline with ammonia and the alkaloids removed with ether. Cephaëline, which is a phenolic base

is removed with sodium hydroxide, leaving the emetine in the ethereal solution. The salt may be prepared by adding just sufficient diluted hydrochloric acid to emetine, concentrating the solution, and setting it aside to crystallize.

Description and Physical Properties—A white or very slightly yellowish, odorless, crystalline powder.

Emetine Hydrochloride is freely soluble in water and in alcohol.

Tests for Identity—An aqueous solution of the salt (1 in 100) yields precipitates with iodine T.S., with mercuric potassium iodide T.S., or with platinic chloride T.S.

Sulphuric acid, containing in each cc. about 0.005 Gm. of molybdic acid, when added to Emetine Hydrochloride produces a bright green color.

Silver nitrate T.S. produces in an aqueous solution of the salt (1 in 2) a white precipitate insoluble in nitric acid.

Tests for Purity—The ash from 0.2 Gm. is negligible.

Emetine Hydrochloride dried to constant weight at 100° C. loses not more than 19 per cent (*water*).

A solution of 0.1 Gm. of Emetine Hydrochloride in 10 cc. of distilled water requires for neutralization not more than 0.5 cc. of fiftieth-normal sodium hydroxide, using 1 drop of methyl red T.S. as indicator.

One-tenth of 1 Gm. of the salt dissolves in 2 cc. of sulphuric acid without producing more than a faint yellow color (*readily carbonizable substances*).

Dissolve 0.2 Gm. of Emetine Hydrochloride in 10 cc. of water, add 5 cc. of sodium hydroxide T.S. and shake, successively, with 20 cc. of ether, and then with 10 cc. portions of ether, until the residue obtained by evaporating 2 cc. of the last ether extraction, when dissolved in 1 drop of diluted hydrochloric acid and 1 cc. of water, no longer yields a distinct turbidity with iodine T.S. Discard the ether solutions, acidulate the aqueous liquid with diluted sulphuric acid, add ammonia T.S. until alkaline, and shake with four successive 10 cc. portions of ether. Evaporate the combined ether solutions to dryness on a water bath, and dry the residue at 100° C. Its weight does not exceed 0.004 Gm. (*cephaëline*).

Preserve in dark amber-colored vials, protected from light.

Uses—It is used as a specific agent against the various forms of ameba that cause dysentery and pyorrhea alveolaris. It is usually administered hypodermically. Dose, one-third to one grain (0.02 to 0.06 Gm.).

Unofficial Ipecac Preparations

Emetine Bismuth Iodide, N. N. R.—Emetinæ Bismutho-Iodidum—*Emetine Bismuthous Iodide*—*Bismuth Emetine Iodide*—A complex iodide of emetine and bismuth containing from 17 to 23 per cent of anhydrous emetine and from 15 to 20 per cent of bismuth.

Emetine bismuth iodide is an odorless, orange-red powder having a slightly bitter taste.

It is but slightly soluble (with decomposition and liberation of emetine) in water, and dilute acids. It is decomposed by alkaline liquids and by strong acids.

Uses—Emetine bismuth iodide has the action of emetine; but when taken by the mouth, on account of its limited solubility, it is less likely to cause vomiting than the soluble salts of emetine administered by mouth.

It has been used with apparently good results in the treatment of chronic cases and carriers of amebic dysentery, even when the hypodermic administration of emetine had failed.

Dose—The commonly used dose has been 3 grains (0.2 Gm.) daily for four days, either in a single dose at the midday meal, or in divided doses. The drug should be given as dry powder, enclosed in capsules or cachets as desired, or in the form of pills or capsules which resist disintegration in the stomach.

Alcresta Ipecac—A form of ipecac alkaloids adsorbed with Lloyd's reagent, rendering the drug insoluble in the stomach but soluble in the intestinal secretions. It is especially useful in the treatment of endomebic dysentery. Dose, 1 to 3 tablets. Manufactured by Eli Lilly and Company.

COCAINA. U. S. Cocaine

[**Cocain.**]

An alkaloid [$C_{17}H_{21}O_4N = 303.26$] obtained from the leaves of *Erythroxylon Coca* Lamarck and other species of *Erythroxylon* (Fam. *Erythroxylaceæ*).

Preparation—It may be made by moistening ground coca leaves with solution of sodium hydroxide, percolating with petroleum benzin, shaking the liquid with diluted sulphuric acid, and adding to the separated acid solution an excess of sodium hydroxide. The precipitated cocaine is purified by recrystallization. Cocaine can be made synthetically by treating benzoylecgonine, obtained naturally or by synthesis from cinnamyl cocaine, with hydrochloric or sulphuric acids in the presence of methyl alcohol. The greater part of the alkaloid manufactured in Germany is prepared from cinnamyl cocaine which is obtained from Java coca leaves. The alkaloid has an $[a]_D$ of $-15.8°$.

Description and Physical Properties—Colorless crystals, or a white, crystalline powder. It is odorless, and is stable in the air.

One Gm. of Cocaine is soluble in about 600 cc. of water, 6.5 cc. of alcohol, 0.7 cc. of chloroform, 3.5 cc. of ether, 12 cc. of olive oil, and in 30 to 50 cc. of liquid petrolatum, at 25° C. One Gm. is soluble in 270 cc. of water at 80° C. It is very soluble in warm alcohol.

Tests for Identity—Cocaine melts between 96° and 98° C.

Its saturated aqueous solution is alkaline to litmus paper.

Its solution in diluted acids is lævorotatory.

Heat about 0.1 Gm. of powdered Cocaine with 1 cc. of sulphuric acid for five minutes at 100° C., then cautiously mix with 2 cc. of distilled water: the aromatic odor of methyl benzoate is noticeable and on cooling crystals of benzoic acid separate.

Tests for Purity—The ash from 0.5 Gm. is negligible.

Dissolve 0.1 Gm. of finely powdered Cocaine in 1 cc. of sulphuric acid: not more than a slightly yellow tint is produced (*readily carbonizable substances*).

Dissolve 0.3 Gm. of finely powdered Cocaine in 1 cc. of normal hydrochloric acid, gently warming, if necessary, to aid solution, and dilute with distilled water to 15 cc.: 5 cc. portions of this solution do not respond to the tests for *cinnamyl-cocaine* and for *isoatropyl-cocaine* under *Cocainæ Hydrochloridum*.

N. F. Preparation—Oleatum Cocainæ.

Uses—The alkaloid is required when a solution of cocaine in oil, liquid petrolatum, or fatty substances is prescribed, or in making a fatty ointment, otherwise cocaine hydrochloride is preferred. It is a cerebral stimulant and local anesthetic. Dose, one-fourth to one grain (0.015 to 0.06 Gm.). It can only be sold or dispensed under the rigid regulations of the Harrison Act (see Part VII).

COCAINÆ HYDROCHLORIDUM. U. S. Cocaine Hydrochloride

[**Cocain. Hydrochl.**—Cocaine Chloride, Cocainum Hydrochloricum P. I.]

The hydrochloride [$C_{17}H_{21}O_4N.HCl = 339.73$] of the alkaloid cocaine.

Preparation—It may be made by adding cocaine to an alcoholic solution of hydrochloric acid and crystallizing.

Description and Physical Properties—Colorless, transparent crystals, lustrous leaflets, or a white, crystalline powder. It is odorless and is stable in the air.

One Gm. of Cocaine Hydrochloride is soluble in 0.4 cc. of water, 3.2 cc. of alcohol, and in 12.5 cc. of chloroform, at 25° C. One Gm. is soluble in 2 cc. of alcohol at 60° C. It is soluble in glycerin and insoluble in ether.

Tests for Identity—Melting point not below 183° C.

Add five drops of a solution of chromium trioxide (1 in 20) to 5 cc. of a solution of Cocaine Hydrochloride (1 in 50): a yellow precipitate is produced which redissolves on shaking the mixture. On the addition of 1 cc. of hydrochloric acid, a permanent, orange-colored, crystalline precipitate is formed.

A solution of about 0.01 Gm. of Cocaine Hydrochloride in 1 cc. of distilled water yields on the addition of 2 cc. of tenth-normal potassium permanganate a violet, crystalline precipitate which appears brownish-violet when collected on a filter, and shows characteristic, crystalline aggregates under the low power of a microscope.

Heat about 0.1 Gm. of powdered Cocaine Hydrochloride with 1 cc. of sulphuric acid for five minutes then cautiously mix with 2 cc. of distilled water; the aromatic odor of methyl benzoate is noticeable and on cooling crystals of benzoic acid separate.

Silver nitrate T.S. produces in an aqueous solution of the salt (1 in 20) a white precipitate insoluble in nitric acid.

Tests for Purity—The ash from 0.5 Gm. is negligible.

Dissolve 0.5 Gm. of Cocaine Hydrochloride in 1 cc. of sulphuric acid: not more than a slightly yellow tint is produced (*readily carbonizable substances*).

A solution of 0.5 Gm. of Cocaine Hydrochloride in 10 cc. of distilled water requires for neutralization not more than 0.5 cc. of fiftieth-normal sodium hydroxide, using one drop of methyl red T.S. as indicator.

Mix 5 cc. of an aqueous solution of the salt (1 in 50) with 0.3 cc. of normal sulphuric acid and 0.1 cc. of tenth-normal potassium permanganate: the violet color does not disappear entirely within a half hour (*cinnamyl-cocaine*).

Dilute 5 cc. of an aqueous solution of the salt (1 in 50) in a beaker with 80 cc. of distilled water, add 0.2 cc. of ammonia T.S., and stir the solution vigorously during five minutes, occasionally rubbing the sides of the beaker with a stirring rod; a crystalline precipitate of cocaine is formed and the supernatant liquid is clear (*isoatropyl-cocaine*). The presence of 0.5 per cent of isoatropyl-cocaine will prevent the formation of nearly all of the precipitate, and will cause the supernatant liquid to be milky.

Uses—Cocaine hydrochloride is used as a local anesthetic when applied to the mucous membrane or injected hypodermically; it is also a cerebral stimu-

lant. The dose is from one-fourth to one grain (0.015 to 0.06 Gm.). Because of the habit-forming character of this drug the sale of cocaine or cocaine hydrochloride is forbidden by the Harrison Act and most State laws, except upon physicians' prescriptions, and these must not be renewed, nor may they be filled for habitués. (For full details see Part VII.)

EUCAINÆ HYDROCHLORIDUM. U. S. Eucaine Hydrochloride

[**Eucain. Hydrochl.**—BETAEUCAINÆ HYDROCHLORIDUM U. S. P. IX]

Eucaine Hydrochloride, when dried to constant weight at 100° C., contains not less than 99 per cent of $C_5H_7N(CH_3)_3O(C_6H_5CO).HCl$ (283.72).

Preparation—Eucaine is a synthetic derivative of piperidine. It is prepared by treating diacetonamine with paraldehyde, reducing the product with metallic sodium to vinyl-di-acetone-alkamine and then treating this with benzoyl chloride to produce betaeucaine. This is afterwards neutralized with hydrochloric acid to produce the official salt. While this salt is similar to cocaine in its action as a local anesthetic, it is not related chemically and it is claimed that it is not habit-forming, and, according to a ruling, is not subject to the restrictions of the Harrison Act.

Description and Physical Properties—A white, odorless, crystalline powder. It is stable in the air.

One Gm. of Eucaine Hydrochloride is soluble in 30 cc. of water, 35 cc. of alcohol, and in 6 cc. of chloroform, at 25° C. It is more soluble in boiling water and in boiling alcohol.

Tests for Identity—Dissolve about 0.1 Gm. of the salt in 1 cc. of sulphuric acid. Keep the solution at 100° C. for five minutes, and then mix it cautiously with 2 cc. of water: the aromatic odor of methyl benzoate becomes noticeable and on cooling crystals of benzoic acid form.

Ten cc. portions of its saturated aqueous solution yield a white, curdy precipitate on the addition of mercuric chloride T.S., and a yellowish, curdy precipitate with a few drops of a mixture of equal volumes of potassium chromate T.S. and diluted sulphuric acid.

Silver nitrate T.S. produces in an aqueous solution of the salt (1 in 100) a white precipitate which is insoluble in nitric acid.

Tests for Purity—An aqueous solution of Eucaine Hydrochloride (1 in 50) is neutral to litmus paper.

The ash from 0.5 Gm. is negligible.

A solution of 0.1 Gm. of Eucaine Hydrochloride in 1 cc. of sulphuric acid is colorless (*readily carbonizable substances*).

Triturate about 0.05 Gm. of the salt with about five times its weight of mild mercurous chloride and moisten the mixture with a few drops of water: no black color is produced (*difference from cocaine hydrochloride*).

No permanent precipitate is produced by the addition of 5 cc. of mercuric chloride T.S. to 5 cc. of an aqueous solution of the salt (1 in 100) (*cocaine and alphaeucaine*).

Assay—Dissolve about 0.5 Gm. of Eucaine Hydrochloride, previously dried to constant weight at 100° C. and accurately weighed, in 100 cc. of neutral alcohol. Titrate this alcoholic solution with tenth-normal sodium hydroxide, using phenolphthalein T.S. as indicator. Each cc. of tenth-normal sodium hydroxide corresponds to 0.02837 Gm. of $C_5H_7N(CH_3)_3O(C_6H_5CO).HCl$.

This assay is explained on page 1453.

Uses—Eucaine Hydrochloride is a local anesthetic like cocaine, but weaker. It is used in ophthalmology in 2 to 3 per cent solutions; in 5 to 10 per cent solutions, for the nose and throat; in a 5 to 10 per cent ointment in the treatment of hemorrhoids. Other synthetic anesthetics, such as benzocaine, procaine, etc., will be found under benzoic acid derivatives, page 834.

CAFFEINA. U. S. Caffeine

[**Caff.**—THEINE]

Trimethyl-xanthine, a feebly basic substance [$C_8H_{10}O_2N_4+H_2O$ or $C_5H(CH_3)_3O_2N_4+H_2O=212.17$] obtained from the leaves of *Thea sinensis* Linné (Fam. *Ternstrœmiaceæ*), or from the seeds of *Coffea arabica* Linné (Fam. *Rubiaceæ*); also occurring in some other plants or prepared synthetically.

This alkaloid was discovered by Robiquet in coffee in 1821 while searching for quinine which he believed to be present. In 1827 Oudry found an alkaloid

in tea and called it *theine*. In 1838 Jobst and Mulder proved the identical character of the two principles.

Preparation—Caffeine occurs in the following per cent: in tea, 1 to 4.8; in kola nuts, 2.7 to 3.6; in coffee, 1 to 1.5; in maté, 1.25 to 2; in guarana, 3 to 5. Being a weak base, caffeine does not form stable salts and is often classed among the uric acid derivatives instead of the alkaloids. It is soluble in water in the presence of certain salts, as sodium salicylate or benzoate, and advantage is taken of this to form the several official compounds which follow.

Caffeine may be prepared from tea or coffee by precipitating a decoction with lead acetate, removing the excess of lead from the filtrate by hydrogen sulphide, adding ammonia water, evaporating, and recrystallizing. The source of the commercial supply is largely tea dust or sweepings. It may also be made synthetically by the further methylation of theobromine or theophylline, which are isomeric compounds chemically known as dimethylxanthine.

Description and Physical Properties—White, flexible, silky, glistening needles, usually matted together in fleecy masses. It is odorless, has a bitter taste, and is efflorescent in dry air.

One Gm. of Caffeine is soluble in 46 cc. of water, 66 cc. of alcohol, 50 cc. of acetone, 5.5 cc. of chloroform, 530 cc. of ether, and in 100 cc. of benzene, at 25° C. One Gm. is soluble in 5.5 cc. of water at 80° C., in 22 cc. of alcohol at 60° C., and in 22 cc. of boiling benzene.

Tests for Identity—Caffeine rendered anhydrous by drying at about 100° C. melts between 235° and 237° C.

A saturated aqueous solution of Caffeine is neutral to litmus paper.

Dissolve about 0.01 Gm. of Caffeine in 1 cc. of hydrochloric acid in a porcelain dish, add 0.1 Gm. of potassium chlorate, and evaporate to dryness on a water bath. On inverting the dish over a vessel containing a few drops of ammonia T.S., the residue acquires a purple color which disappears upon the addition of solutions of fixed alkalies (*murexide reaction*)

A saturated aqueous solution of Caffeine yields with tannic acid T.S., a precipitate which is soluble in an excess of the reagent, but no precipitate is produced by tenth-normal iodine unless the solution is first acidulated with hydrochloric or sulphuric acid.

Tests for Purity—Caffeine loses not more than 9 per cent when dried to constant weight at 80° C.

Ash: not more than 0.05 per cent.

The solution of 0.5 Gm. of Caffeine in 5 cc. of sulphuric or nitric acid is colorless or only faintly yellow (*readily carbonizable substances*).

No precipitate is produced by mercuric potassium iodide T.S. in an aqueous solution of Caffeine (1 in 50) (*alkaloids*).

U. S. P. Preparations—Caffeina Citrata; Caffeinæ Sodio-Benzoas.

N. F. Preparations—Caffeinæ Sodio-Salicylas; Pulvis Acetanilidi Compositus; Sal Potassii Bromidi Effervescens Compositus.

Uses—Caffeine is a nerve stimulant. It is chiefly used in nervous headaches of a certain type. The dose is from one to three grains (0.06 to 0.2 Gm.).

CAFFEINA CITRATA. U.S. Citrated Caffeine

[Caff. Cit.]

Citrated Caffeine, when dried to constant weight at 80° C., contains not less than 48 per cent and not more than 52 per cent of anhydrous caffeine [$C_8H_{10}O_2N_4$ = 194.15].

The formula of the U. S. P. IX is as follows:

	Metric	Alternative
Caffeine	50 Gm.	1 oz. av.
Citric Acid	50 Gm.	1 oz. av.
Distilled Water, hot	100 cc.	2 fl. oz.

Dissolve the citric acid in the hot distilled water, add the caffeine, and evaporate the resulting solution to dryness on a water bath, constantly stirring toward the end of the operation. Reduce the product to a fine powder and transfer it to well-closed containers.

This is not a definite chemical salt, but a mixture of caffeine and citric acid. The common name *citrate of caffeine* is therefore improper.

Description and Physical Properties—A white, odorless powder, having a slightly bitter, acid taste.

One Gm. of Citrated Caffeine is soluble in about 4 cc. of warm water. On diluting the solution with an equal volume of water, a portion of the caffeine gradually separates, but redissolves on the further addition of water.

Tests for Identity—The residue obtained in the assay when recrystallized from hot water and dried to constant weight at 80° C. has the melting point given under *Caffeina*.

An aqueous solution of Citrated Caffeine (1 in 30) is acid to litmus paper.

Dissolve about 0.02 Gm. of Citrated Caffeine in 1 cc. of hydrochloric acid in a porcelain dish, add 0.1 Gm. of potassium chlorate, and evaporate to dryness on a water bath. On inverting the dish over a vessel, containing a few drops of ammonia T.S., the residue acquires a purple color, which disappears upon the addition of solutions of fixed alkalies (*murexide reaction*).

About 2 cc. of a filtered aqueous solution of Citrated Caffeine (1 in 10) mixed with 50 cc. of lime water remains clear in the cold but becomes turbid when heated to boiling. Add 1 cc. of mercuric sulphate T.S. to 5 cc. of an aqueous solution of Citrated Caffeine (1 in 100), heat the mixture to boiling, and add 1 cc. of potassium permanganate T.S.: a white precipitate is formed.

Tests for Purity—Dried to constant weight at 80° C., Citrated Caffeine loses not more than 5 per cent (*water*).

Ash: not more than 0.1 per cent.

Heat a mixture of 0.25 Gm. of Citrated Caffeine and 5 cc. of sulphuric acid in a porcelain dish on a water bath for fifteen minutes, protecting it from dust; it may become yellow but not brown or black (*tartrate*).

An aqueous solution of Citrated Caffeine meets the requirements of the test for *heavy metals*, page 1519.

The addition of a few drops of barium chloride T.S. to 10 cc. of an aqueous solution of Citrated Caffeine (1 in 100), previously treated with a few drops of hydrochloric acid, produces no turbidity (*sulphate*).

Assay for Caffeine—Dissolve about 0.5 Gm. of Citrated Caffeine, previously dried to constant weight at 80° C. and accurately weighed, in 10 cc. of hot distilled water, add 10 cc. of sodium hydroxide T.S., cool the solution, and shake it on a separator with three successive portions of 20 cc., 10 cc., and 5 cc., respectively, of chloroform, or more if necessary to complete the extraction. Evaporate the combined chloroform solutions on a water bath, dry the residue to constant weight at 80° C., and weigh.

Preserve in well-closed containers.

Uses—It is used as a cerebral stimulant in doses of three to eight grains (0.2 to 0.5 Gm.).

CAFFEINÆ SODIO-BENZOAS. U. S. Caffeine Sodio-Benzoate

[Caff. Sod. Benz.]

A mixture of caffeine and sodium benzoate, which contains, when dried to constant weight at 80° C., not less than 47 per cent and not more than 50 per cent of anhydrous caffeine [$C_8H_{10}O_2N_4 = 194.15$], and not less than 50 and not more than 53 per cent of sodium benzoate [$NaC_7H_5O_2 = 144.08$].

Preparation—It may be prepared by triturating together equal parts of caffeine and sodium benzoate, in a mortar, with enough alcohol to form a smooth paste, drying at a moderate heat, and powdering.

Description and Physical Properties—A white, odorless powder, having a slightly bitter taste.

One Gm. of Caffeine Sodio-Benzoate is soluble in 1.1 cc. of water, a portion of the caffeine usually separating on standing and in 30 cc. of alcohol, at 25° C. It is partly soluble in chloroform.

Tests for Identity—On heating, it is decomposed with the evolution of white vapors of caffeine, leaving a residue which effervesces with acids and colors a non-luminous flame intensely yellow.

Ferric chloride T.S. produces a salmon-colored precipitate, and diluted hydrochloric acid produces a white precipitate in an aqueous solution of Caffeine Sodio-Benzoate.

The residue obtained in the assay for caffeine when recrystallized from hot water, and dried to constant weight at 80° C., has the melting point of Caffeine, and responds to the other tests for identity under *Caffeina*.

Tests for Purity—Its aqueous solution (1 in 20) may be neutral, slightly acid, or slightly alkaline to litmus paper, but is not reddened by phenolphthalein T.S.

When dried to constant weight at 80° C., Caffeine Sodio-Benzoate loses not more than 5 per cent of its weight (*water*).

The solution of 0.1 Gm. of Caffeine Sodio-Benzoate in 2 cc. of sulphuric acid is colorless or only faintly yellow (*readily carbonizable substances*).

Dissolve about 2 Gm. of Caffeine Sodio-Benzoate in 40 cc. of distilled water in a separator, add 10 cc. of diluted sulphuric acid, extract the liberated benzoic acid with two successive 10 cc. portions of ether, and allow the ether solution to evaporate to dryness at room temperature: one-half Gm. of the benzoic acid so obtained complies with the test for *chlorinated compounds* under *Acidum Benzoicum*.

Its aqueous solution (1 in 50) acidulated with hydrochloric acid and filtered, meets the requirements of the test for *heavy metals*, page 1519.

Assay for Caffeine—Dissolve about 1 Gm. of Caffeine Sodio-Benzoate, previously dried to constant weight at 80° C. and accurately weighed, in 5 cc. of distilled water in a separator, add 5 cc. of sodium hydroxide T.S. and shake the mixture with four successive portions of 20 cc., 10 cc., 10 cc., and 5 cc., respectively, of chloroform. Pass the chloroform solutions through a filter which has been previously moistened with chloroform, and wash the stem of the funnel and filter with a few cc. of hot chloroform to remove any adhering caffeine. Evaporate the combined chloroform solutions on a water bath, and dry the residue, consisting of anhydrous caffeine, to constant weight at 80° C.

This assay is explained on page 1476.

Assay for Sodium Benzoate—To the aqueous liquid from which the caffeine has been removed in the above assay for caffeine, add 10 cc. of diluted sulphuric acid, and extract the liberated benzoic acid with four successive portions of 20 cc., 10 cc., 10 cc., and 5 cc., respectively, of chloroform. Pass the chloroform solutions through a filter which has been previously moistened with chloroform, and wash the stem of the funnel and the filter with a few cc. of hot chloroform. Evaporate the combined chloroform solutions to about 5 cc. at a temperature not exceeding 40° C., add 25 cc. of diluted alcohol previously neutralized with tenth-normal sodium hydroxide, using 3 drops of phenolphthalein T.S. as indicator, and titrate with tenth-normal barium hydroxide to the restoration of the pink color. Each cc. of tenth-normal barium hydroxide corresponds to 0.01441 Gm. of sodium benzoate ($NaC_7H_5O_2$).

This assay is explained on page 1456.

Uses—Its solubility renders it especially adaptable for the hypodermic injection of caffeine. It is a diuretic and cardiac stimulant. Dose, by the mouth, five grains (0.32 Gm.); hypodermically, three grains (0.2 Gm.).

CAFFEINÆ SODIO-SALICYLAS. N. F. Caffeine Sodio-Salicylate

[Caff. Sod.-Sal.]

	Metric	Alternative
Caffeine	**50 Gm.**	2 oz. av.
Sodium Salicylate	**50 Gm.**	2 oz. av.
Alcohol, a sufficient quantity,		
To make about	**100 Gm.**	4 oz. av.

Triturate the caffeine with the sodium salicylate and a sufficient quantity of alcohol to produce a smooth paste and dry this by exposure to air in a moderately warm place. Reduce the dry mass to powder and keep it in well-stoppered bottles.

Assay for Caffeine—Dissolve 1 Gm. of Caffeine Sodio-Salicylate, previously dried to constant weight at 80° C. and accurately weighed, in about 5 cc. of distilled water in a separator, add 5 cc. of sodium hydroxide T.S. and extract the caffeine with successive portions of chloroform until the chloroformic residue gives no test for alkaloid with iodine T.S. Evaporate the combined chloroform solutions to dryness on a water bath, moisten the residue with alcohol and again evaporate to dryness. Dry the residue to constant weight at 80° C. and weigh. The weight of anhydrous caffeine corresponds to not less than 46 per cent and not more than 50 per cent of the Caffeine Sodio-Salicylate taken.

This assay is explained on page 1476.

Uses—This compound has the same therapeutic activity as caffeine and has the advantage of being water soluble. The dose is three grains (0.2 Gm.).

Unofficial Preparation of Caffeine

Effervescent Citrated Caffeine, U. S. P. IX—It contains not less than 1.9 per cent of anhydrous caffeine.

Powder 195 Gm. [3 oz. av. 394 gr.] of citric acid and mix it intimately with 40 Gm. [350 gr.] of citrated caffeine and 300 Gm. [6 oz. av.] of tartaric acid, then thoroughly incorporate 570 Gm. [11 oz. av. 175 gr.] of sodium bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. Manipulate the mixture carefully with a wooden spatula, and, when it has become moist, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. Immediately transfer the product to suitable containers and seal them tightly. Care must be used to prevent the preparation from coming in contact with air containing moisture.

Assay—Dissolve about 5 Gm. of Effervescent Citrated Caffeine, accurately weighed, in 10 cc. of hot distilled water. When effervescence has ceased, add an excess of sodium hydroxide T. S., cool the mixture and shake it in a separator with three successive portions of 20 cc., 10 cc., and 5 cc., respectively, of chloroform, or more if necessary to complete the extraction. Evaporate the combined chloroform solutions on a water bath and dry the residue to constant weight at 80° C. The weight of anhydrous caffeine, ($C_8H_{10}O_2N_4$) so obtained corresponds to not less than 1.9 per cent of the weight of Effervescent Citrated Caffeine taken. This residue, when recrystallized from hot water, responds to the tests for identity, and, when dried to constant weight at 80° C., has the melting point given under *Caffeina*.

Uses—This effervescent salt is used for preparing a pleasant stimulating draught by adding a teaspoonful (4 Gm.) to four fluidounces of water.

THEOPHYLLINA. U. S. Theophylline

[Theophyll.—Dimethylxanthine theocin]

An organic base, dimethylxanthine [$C_7H_8O_2N_4 + H_2O$ or $1:3\ C_5H_2(CH_3)_2.O_2N_4 + H_2O = 198.15$], isomeric with theobromine. It is found in small amounts in the leaves of *Thea sinensis* Linné (Fam. *Ternstræmiaceæ*) and is also prepared synthetically.

Preparation—This alkaloid is isomeric with theobromine and is found as a natural alkaloid in tea in small amounts, but it was made synthetically by a complicated process involving the methylation of uric acid and now more generally from carbamide or dimethyl carbamide. This is the first alkaloid to be made artificially on a commercial scale. It is similar in its chemical properties to caffeine and theobromine, and, with them, is often, classed with the derivatives of uric acid.

Description and Physical Properties—A white, crystalline, odorless powder having a bitter taste. It is stable in the air.

One Gm. of Theophylline is soluble in 120 cc. of water and in 80 cc. of alcohol, at 25° C. It is more readily soluble in hot water; sparingly soluble in ether. It is readily soluble in solutions of potassium hydroxide and in ammonia water.

Tests for Identity—Theophylline melts between 269° and 272° C.

To about 0.01 Gm. of Theophylline, contained in a porcelain dish, add 1 cc. of hydrochloric acid and 0.1 Gm. of potassium chlorate, and evaporate to dryness on a water bath: on inverting the dish over a vessel containing a few drops of ammonia T.S., the residue acquires a purple color which is destroyed by fixed alkalies.

An aqueous solution of Theophylline yields with tannic acid T.S. a precipitate which is soluble in an excesss of the reagent.

Tests for Purity—A saturated aqueous solution of Theophylline is neutral to litmus paper.

Theophylline loses not more than 9.5 per cent when dried to constant weight at 100° C. (*water*).

The ash from 0.1 Gm. is negligible.

Two-tenths Gm. of Theophylline dissolves in 5 cc. of sulphuric acid without producing more than a faint yellow color (*readily carbonizable substances*).

A clear solution is produced when 0.2 Gm. of Theophylline is dissolved in 5 cc. of potassium hydroxide T.S. or in 5 cc. of ammonia T.S. (*difference from caffeine, theobromine, or paraxanthine*).

Uses—It is used as a stimulating diuretic, similar to caffeine. Dose, four grains (0.25 Gm.).

THEOBROMINÆ SODIO-SALICYLAS. U. S. Theobromine Sodio-Salicylate

[Theobrom. Sodio-Sal.]

A mixture of sodium theobromine [$C_7H_7O_2N_4Na = 202.12$] and sodium salicylate [$NaC_7H_5O_3$] in approximately molecular proportions. It yields, when dried to constant weight at 110° C., not less than 46.5 per cent of theobromine [$C_7H_8O_2N_4 = 180.13$] and not less than 35 per cent of salicylic acid [$HC_7H_5O_3 = 138.08$].

Preparation—*Theobromine*, which is obtained from the seed of *Theobroma Cacao*, is said to be absent in the unfermented seeds, but is developed in the curing process, through the splitting up of a glucoside. It is also present in kola nuts and tea. It may be prepared by boiling the powdered beans with water, filtering, precipitating the tannins and coloring matter with lead acetate, removing the lead with sulphuric acid, filtering, concentrating, adding magnesia, evaporating to dryness, extracting the residue with alcohol, and purifying the product by recrystallization. Theobromine has been also synthesized from methylcarbamide. Theobromine is a uric acid derivative and is often so classed instead of under alkaloids.

The official salt, commonly known as *diuretin*, is made by preparing an alcoholic solution of sodium hydroxide, adding an amount equal to 20 parts of the hydroxide to 100 parts of water and 90 parts of theobromine, and warming the mixture until solution results. This is then added to 80 parts of sodium

salicylate in 75 parts of water and the solution quickly evaporated to dryness and powdered.

Description and Physical Properties—A white, odorless powder, having a sweetish, saline and somewhat alkaline taste. It gradually absorbs carbon dioxide from the air with the liberation of theobromine, becoming incompletely soluble in water. It also frequently develops a characteristic odor.

One Gm. of Theobromine Sodio-Salicylate is soluble in 1 cc. of water at 25° C. It is slightly soluble in alcohol.

Tests for Identity and Purity—(See U. S. P. X.).

Assay for Theobromine—(See U. S. P. X.). This assay is explained on page 1477.

Assay for Salicylic Acid—(See U S. P. X.). This assay is explained on page 1456.

Preserve in well-closed containers.

Uses—It is used as a diuretic in cardiac dropsy and chronic Bright's disease. The dose is fifteen grains (1 Gm.).

Unofficial Theobromine and Theobromine Compounds

Theobromine—Theobromina, N. N. R.—3.7-Dimethyl-Xanthine—$C_5H_2(CH_3)_2.O_2N_4$. A base occurring in *Theobroma cacao;* also made synthetically.

Colorless, rhombic needles or a white crystalline powder, odorless, bitter, and permanent in the air. Theobromine is slightly soluble in water, alcohol, ethyl acetate and chloroform, and insoluble in petroleum ether. It is soluble in aqueous solutions of the alkalis.

Uses—The uses of theobromine are similar to those of caffeine, but its action is said to be relatively greater on the heart and muscles and also as a diuretic. It does not act so powerfully on the central nervous system.

It is used as a diuretic. The great obstacle to its use has been its insolubility and the consequent uncertainty of the degree of its absorption. It is liable to produce gastric disturbances.

Dose—From 5 to 8 grains (0.35 to 0.5 Gm.).

Theobromine Sodium Acetate—Theobrominæ Sodio-Acetas, N. N. R.—A hydrated double salt of theobromine-sodium and sodium acetate, containing not less than 63 per cent of theobromine, corresponding to about 80 per cent of the anhydrous double salt—$NaC_7H_7O_2N_4+NaC_2H_3O_2$.

A white, finely crystalline powder, odorless and bitter. It is soluble in cold water; slightly soluble in cold alcohol; more so in hot alcohol. Its aqueous solutions are strongly alkaline toward phenolphthalein and litmus. It is quite hygroscopic, and in aqueous solution when exposed to air it gradually splits up into its components through absorption of carbon dioxide and becomes incompletely soluble.

Uses—Theobromine sodium acetate acts like theobromine, over which it has the advantages of greater solubility and of being well tolerated by the stomach. While inferior in diuretic power to theophylline (page 1154), it is said to have greater power in sustaining the diuresis produced.

Dose—From 8 to 15 grains (0.5 to 1 Gm.), preferably in wafers or capsules. If in solution, this should be freshly prepared (with peppermint water), without sugar or mucilage.

Agurin—A brand of the theobromine sodium acetate, distributed by the Winthrop Chemical Company.

Theobromine and Sodium Acetate is also manufactured by the Powers-Weightman-Rosengarten Company, and Hoffman-LaRoche Chemical Works.

Theocalcin N. N. R.—A double salt or mixture of calcium theobromine $([C_7H_7O_2N_4]_2Ca)$ and calcium salicylate $([C_7H_5O_3]_2Ca)$. It contains not less than 44 per cent of theobromine.

A white, amorphous powder having a saline taste. It is partly soluble in water.

Uses—Theocalcin acts like theobromine. It is claimed to be less likely to produce gastric irritation than the official theobromine sodio-salicylate.

Dose—Average dose, from 7 to 15 grains (0.5 to 1 Gm.), three times a day.

Manufactured by E. Bilhuber, Incorporated.

Unofficial Theophyllin Compounds

Theophyllin Sodio-Acetate—Theophyllinæ Sodio-Acetas, N. N. R.—$NaC_7H_7O_2N_4+NaC_2H_3O_2+H_2O$.—A double salt of sodium acetate and 1.3-dimethylxanthine-sodium (theophyllinsodium).

A white crystalline powder, containing about 60 per cent of anhydrous theophyllin. It dissolves in about 20 parts of water at 25° C., but is insoluble in alcohol or ether.

Dose—From 3 to 5 grains (0.2 to 0.35 Gm.), best given after meals.

Theocin Sodium Acetate—A brand of theophyllin sodio-acetate, distributed by the Winthrop Chemical Company.

LOBELIA. U. S. Lobelia

[**Lobel.**—INDIAN TOBACCO]

Lobelia consists of the dried leaves and tops of *Lobelia inflata* Linné (Fam. *Lobeliaceæ*).

Lobelia contains not more than 10 per cent of stems or more than 2 per cent of other foreign organic matter, and yields not more than 5 per cent of acid-insoluble ash.

Description—Leaves alternate, sessile or narrowing into a short petiole, usually more or less broken; when entire, blades ovate or oblong, from 2 to 9 cm. in length, obtusely toothed or irregularly serrate-denticulate, each tooth with a yellow-brown, gland-like apex; pale green and with

scattered bristly hairs; stem cylindrical, coarsely and irregularly furrowed, yellowish-green, occasionally purplish and with numerous spreading hairs; flowers pale blue, in a long, loose raceme with short pedicels, calyx tubes ovoid, with 2 subulate teeth, corollas tubular, from 3 to 4 mm. in length, 5-parted, the upper 2-lobed portion cleft nearly to the base; stamens with anthers united above into a curved tube enclosing the bifid stigma; capsule ovoid or ellipsoidal, from 5 to 8 mm. in length, light brown, wholly inferior and enclosing numerous brownish, oblong and coarsely reticulate seeds; odor slight and irritating; taste strongly acrid.

For further description see the U. S. P. X.

U. S. P. Preparation—Tinctura Lobeliæ.

Lobelia contains *lobeline*, $C_{23}H_{29}O_2N_2$, *lobelic acid*, *lobelacrin*, *inflatin*, and *lobelianin*, a volatile oil, wax, resin, gum, etc. Lobeline at one time was believed to be a liquid alkaloid but recent work has demonstrated its crystalline form. It melts at 130° C. and has an $[a]_D$ of -42.8, in alcohol. Lobeline is a violent emetic.

Uses—Lobelia is used as an expectorant in 2 grain (0.125 Gm.) doses or as an emetic in 40 grain (2.6 Gm.) doses.

Average dose—1½ grains (0.1 Gm.).

BAPTISIA. N. F. Baptisia

[**Baptis.**—Wild Indigo]

Baptisia is the dried root of *Baptisia tinctoria* (Linné) R. Brown (Fam. *Leguminosæ*). Baptisia contains not more than 10 per cent of its stem bases, over-ground parts, or more than 2 per cent of other foreign organic matter.

It contains *cytisine* or *baptitoxine*, which is found in several other plants, also several other glucosides: *baptisin*, *baptigenin*, *pseudobaptisin*, and *baptin*, also resin. Cytisine melts at 153° C. and has an $[a]_D$ of -119 in water at 17° C. It is soluble in water, alcohol, or in chloroform, and insoluble in ether.

Description—Fleshy, from 0.5 to 4 cm. in thickness, usually cut into elongated cylindrical pieces; the crown from 5 to 8 cm. in thickness, more or less warty and marked by stem scars; outer surface dark brown; usually longitudinally wrinkled, the thicker pieces covered with a soft and friable corky layer bearing few branching rootlets; fracture tough, the fractured surface whitish; bark-section radially striate, wood-section inconspicuously radiate, porous. Nearly odorless; the bark bitter and acrid, the wood nearly tasteless.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Baptisiæ.

Uses—It is a cathartic and hepatic stimulant, also employed as a nerve stimulant and antipyretic. It is also used in pharmacy to produce a yellow color in such preparations as the antiseptic solutions. Dose, fifteen grains (1 Gm.).

BERBERIS. N. F. Berberis

[**Berber.**—Oregon Grape Root]

Berberis consists of the dried rhizome and roots of species of the section *Mahonia* (Nuttall) De Candolle of the genus *Berberis* Linné (Fam. *Berberidaceæ*).

Berberis contains not more than 5 per cent of the overground parts of the plant or other foreign organic matter. Reject pieces of the rhizome or root over 45 mm. in diameter or with the bark removed.

Berberis contains a yellow alkaloid, *berberine*, $C_{20}H_{17}O_4N$, and *oxyacanthine* (*berbine* or *vinetine*), $C_{18}H_{19}O_3N$, and *berbamine*, $C_{18}H_{19}O_3N$.

Description—Cylindrical more or less knotty, strongly branched, usually cut into pieces of varying length and up to 45 mm. in diameter; usually splitting somewhat on drying; externally light yellowish-brown, longitudinally wrinkled and short, scaly; fracture hard and tough; bark 1 mm. in thickness, easily separable into layers; wood yellow, the color more pronounced upon wetting, distinctly radiate, and showing rings of growth; pith of rhizome small, sometimes excentral. Odor slight; taste distinctive, very bitter; on chewing it tinges the saliva yellow.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Berberidis.

Uses—It is used as a tonic, hepatic stimulant, antiperiodic, and febrifuge. Dose, thirty grains (2 Gm.).

CACTUS GRANDIFLORUS. N. F. Cactus Grandiflorus

[Cact. Grand.—Night Blooming Cereus]

Cactus Grandiflorus is the fresh succulent stem of the wild growing *Selenicereus grandiflorus* (Linné) Britton et Rose (Fam. *Cactaceæ*).

As found in commerce, Cactus Grandiflorus is usually preserved in alcohol and the amount of alcohol present should be stated on the label.

Its constituents have not been well studied; it contains a small amount of alkaloid, glucosidal bodies, acid, fat, etc. The preserved fresh stems only are recognized by the N. F., never the dried plant.

Description—In pieces of varying length, from 1.5 to 4 cm. in diameter, and from five- to nine-angled. The angles at intervals of about 2 cm. with tufts of from nine to twelve acicular spines about 5 mm. in length together with about the same number of bristles about 1 cm. in length; at irregular intervals branched roots are sometimes present; a strong, herby odor; taste acidulous and mucilaginous.

For further description see the N. F. V.

N. F. Preparation—Tinctura Cacti Grandiflori.

Uses—It is employed as a substitute for digitalis in cardiac weakness. The dose of the tincture is fifteen minims (1 cc.).

COCCULUS. N. F. Cocculus

[Fish Berry, Indian Berry]

Cocculus is the dried ripe fruit of *Anamirta Cocculus* (Linné) Wight et Arnott (Fam. *Menispermaceæ*).

Cocculus contains not more than 2 per cent of foreign organic matter.

It contains the alkaloids *menispermine*, $C_{18}H_{24}O_2N_2$, and *paramenispermine*, and *hydropicrotoxic acid*, also *picrotoxin*, the poisonous principle.

Description—Reniform, 8 to 13.5 mm. in length and 7 to 11 mm. in breadth and 7 to 10 mm. in thickness, blackish-brown or reddish-brown, wrinkled; hilum and micropyle close together, separated by a shallow sinus and connected by an obscure ridge running around the convex side; distinct circular stalk-scar. Pericarp tough, about 1 mm. thick, outer layer brownish, inner layer light yellow, enclosing a single seed. Seed whitish-yellow, urn-shaped, its longitudinal and transverse sections crescent-shaped. Taste slightly bitter; the seed intensely bitter.

For further description see the N. F. V.

N. F. Preparation—Tinctura Cocculi.

Uses—The tincture is used externally as a parasiticide.

COFFEA TOSTA. N. F. Coffee

[Coff. Tost.—Roasted Coffee]

Coffee is the dried ripe seed of *Coffea arabica* Linné or *Coffea liberica* Bulliard (Fam. *Rubiaceæ*), deprived of most of the seed coat and roasted until a dark brown color and a characteristic aroma are developed.

Coffee yields not less than 1 per cent of caffeine, not less than 3 per cent and not more than 5 per cent of total ash and not less than 10 per cent of fat.

Its chief constituent is *caffeine*, although it contains tannic acid and *caffeic* and *quinic acids*.

Description—Oval, of variable size, having one side strongly convex, the other flat with a longitudinal groove, and showing traces of the papery seed coat in the cleft. It has a characteristic aroma and a pleasantly bitter taste.

For further description see N. F. V.

Assay—Place 6 Gm. of Coffee, in fine powder, in a suitable flask or bottle, add 120 cc. of chloroform and shake. Allow to stand five minutes, then add 6 cc. of ammonia water and shake the mixture continuously during one hour, or intermittently (see Proximate Assays, Type Process A, page 1494), during two hours. Allow the mixture to stand overnight, again shake intermittently during one-half hour, then allow the drug to settle. Decant, or filter off through a pledget of purified cotton, 100 cc. of the chloroformic liquid, representing 5 Gm. of Coffee, and evaporate it to dryness. Treat the residue with 10 cc. of weak (about 1 per cent) sulphuric acid with the aid of a gentle heat, allow to cool, filter through a small filter into a separator, and wash the dish and filter with successive small portions of distilled water until no test for alkaloid is obtained by acidulating a few drops of the filtrate strongly with sulphuric acid and adding iodine T.S. Now add ammonia water until the liquid is distinctly alkaline to litmus, and completely extract the caffeine with successive portions of chloroform, as shown by testing with iodine T.S. Evaporate the combined chloroform solutions, and dry the residue at 80° C. to constant weight. The weight is the amount of caffeine from 5 Gm. of Coffee.

This assay is explained on page 1500.

N. F. Preparation—Fluidextractum Coffeæ.

Uses—It is chiefly used for its flavor and stimulating effects.

CONIUM. N. F. Conium

[Poison Hemlock]

Conium consists of the dried full grown, but unripe fruit of *Conium maculatum* Linné (Fam. *Umbelliferæ*).

Conium contains not more than 2 per cent of foreign fruits, seeds, or other foreign organic matter and yields not less than 0.5 per cent of coniine. After being kept for more than two years, it is unfit for use. Conium should be carefully dried and preserved.

Description—Broadly ovoid, greenish-gray, the two mericarps often separated, each about 3 mm. in length and about 1.5 mm. in diameter, ovoid, somewhat curved, the inner flattened side marked by a deep longitudinal groove, the outer, convex side with five, pale yellow, somewhat crenate ribs, the intervening surfaces wrinkled, pericarp without oil tubes. Odor slight, but when triturated with a solution of potassium hydroxide, strong, disagreeable, and mouse-like; taste characteristic, disagreeable, afterwards somewhat acrid.

For further test see the N. F. V.

Assay—Place 15 Gm. of Conium, in a moderately fine powder, in a 250 cc. flask or bottle, add 150 cc. of purified petroleum benzin, allow to stand five minutes, then add 15 cc. of solution of sodium hydroxide U. S. P., stopper securely and shake the flask vigorously at intervals during two hours. Allow it to stand overnight and again agitate vigorously at intervals during one hour. Allow the mixture to settle, decant 100 cc. of the clear fluid (representing 10 Gm. of Conium) and extract the alkaloids from this by shaking out this with successive portions of weak hydrochloric acid, until a few drops of the acid washings give no test for alkaloid with iodine T.S. Evaporate the combined acid washings on a water bath to a volume of about 10 cc., cool, and transfer to a separator and render it alkaline by the cautious addition of sodium carbonate. Extract the alkaline liquid with successive small portions of purified petroleum benzin, until it gives no test for alkaloid with iodine T.S., and to the combined benzin washings add 10 cc. of tenth-normal sulphuric acid. Stir thoroughly during two minutes, to bring the acid in contact with the benzin solution, then evaporate the benzin layer in a current of warm air. Titrate the acid solution, using cochineal T.S. or methyl red T.S. as indicator. Each cc. of tenth-normal sulphuric acid corresponds to 0.0126 Gm. of coniine.

This assay is explained on page 1500.

N. F. Preparation—Extractum Conii.

Conium contains *coniine*, $C_8H_{17}N$, *conhydrine* or *oxyconiine*, $C_8H_{17}ON$, and *pseudoconhydrine*, *ethyl-piperidine*, and *methylconiine*, $C_8H_{16}CH_3N$; also a little volatile oil and fixed oil. Coniine is a liquid volatile alkaloid, and contains no oxygen. It was the first alkaloid to be made by synthesis. Its odor resembles that of the urine of mice. It is soluble in water, alcohol, and ether.

Uses—Conium is used as a narcotic and sedative. Dose, three grains (0.2 Gm.).

COPTIS. N. F. Coptis

[Goldthread]

Coptis is the dried plant of *Coptis trifolia* (Linné) Salisbury (Fam. *Ranunculaceæ*).

Coptis contains not more than 3 per cent of foreign organic matter.

It contains the yellow alkaloid *berberine* and a white alkaloid called *coptine*.

Description—In loose, matted masses consisting of long, much-branched rhizomes and small roots, together with the leaves. Rhizomes orange or golden-yellow; leaves evergreen, long and slenderly petioled, trifoliate, the segments broadly obovate-cuneate, crenately lobed and toothed with sharp-pointed teeth, prominently veined, smooth, coriaceous, dark green and shining but often drying to a dull brownish hue; flowers, if present, small, solitary, terminating slender scapes; sepals five to seven, oblong, obtuse, deciduous; petals five to six, pale yellow, small club-shaped stamens numerous. Odor faint; taste purely bitter without astringency.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Coptis.

Uses—It is used as a tonic and in mouth-washes for canker-sores and as a gargle for sore throat. Dose, thirty grains (2 Gm.).

CORYDALIS. N. F. Corydalis

[Corydal.—Turkey Corn, Squirrel Corn]

Corydalis consists of the dried tubers of *Dicentra canadensis* (Goldie) Walp or *Dicentra Cucullaria* (Linné) Bernh (Fam. *Fumariaceæ*).

Corydalis contains not more than 3 per cent of foreign organic matter. It contains *corydaline*, $C_{22}H_{27}O_4N$, *fumaric acid*, bitter extractive, and acid resin.

Description—The tubers are spheroidal and frequently vertically depressed, the flattened surface more or less concave, up to 15 mm. in diameter; usually single, rarely two or more in a cluster; externally, minutely pitted or nearly smooth; grayish-brown, grayish-black, or amber-colored and more or less translucent; one of the flattened surfaces with a triangular scar from detached roots, the other usually with remains of the slender rhizome; fracture hard and horny, exhibiting a yellowish, waxy interior, or somewhat tough and granular, exhibiting a yellowish-white interior.

The grains of the granulate bulb of *Bicuculla Cucullaria* are ovoid or triangular-ovoid and up to 12 mm. in length; the larger grains distinctly concave on one surface, with a scar at the apex from the detached petiole, and usually attached to the short root-stock in clusters of three; the smaller grains usually separated from the root-stock, with an acute apex and a scar at the base; externally, yellowish- or grayish-brown, usually translucent; fracture hard and horny, exhibiting a grayish, waxy interior, or granular and tough, exhibiting a whitish interior. Nearly odorless; taste slightly bitter.

For further description see the N. F. V.

N. F. Preparations—Elixir Corydalis Compositum (from Fluidextract); Fluidextractum Corydalis; Fluidextractum Stillingiæ Compositum.

Uses—It is used as a tonic and antisyphilitic. Dose, ten grains (0.6 Gm.).

DELPHINIUM. N.F. Larkspur Seed

[**Delphin.**]

Larkspur seed is the dried ripe seed of *Delphinium Ajacis* Linné (Fam. *Ranunculaceæ*).

Larkspur seed contains not more than 2 per cent of foreign seeds or other foreign organic matter.

Delphinium Ajacis contains *ajacine*, $C_{15}H_{21}O_4N.H_2O$, and *ajaconine*, $C_{17}H_{29}O_2N$. *Delphinium Consolida* contains three unnamed alkaloids.

Description—Irregularly tetrahedral, or somewhat triangulate, acute at one end, obtuse or rounded at the other, about 2 mm. in length and equally broad or slightly narrower; surface black or blackish-brown, occasionally grayish with from 8 to 12 rows of centrifugally elongated epidermal cells transversely encircling the seed and forming wavy continuous vertical walls or ruffles occasionally intersecting and with narrow channels between; seed coat crustaceous; endosperm whitish, flashy and oily; embryo small, in flashy endosperm. Odor very faint; taste bitter, afterward biting and acrid.

For further description see the N. F. V.

N. F. Preparation—Tinctura Delphinii.

Uses—It is used almost entirely for the destruction of lice and the itch-mite. It may be employed as an ointment or as a lotion (see page 299), or in the form of the official tincture (see page 388).

DULCAMARA. N.F. Bittersweet

[**Dulcam.**]

Dulcamara is the dried stem of *Solanum Dulcamara* Linné (Fam. *Solanaceæ*).

Dulcamara contains not more than 2 per cent of foreign organic matter. It contains the alkaloids *solanine*, *solanidine*, and *solaneine*.

Description—In short sections about 5 mm. or less in thickness, cylindraceous, outline of transverse section somewhat angular, longitudinally striate, more or less warty, usually hollow in the center; bark thin, externally pale greenish, or light greenish-brown, glabrous, marked with alternate leaf scars, internally green, the greenish or yellowish wood occurring in one or two concentric rings. Odor slight; taste bitter, afterwards sweet.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Dulcamaræ.

Uses—It is used as a diuretic and sedative. Dose, one drachm (4 Gm.).

GELSEMIUM. N.F. Gelsemium

[**Gelsem.**—Yellow Jasmine Root, Yellow Jessamine]

Gelsemium consists of the dried rhizome and roots of *Gelsemium sempervirens* (Linné) Persoon (Fam. *Loganiaceæ*).

Gelsemium contains not more than 2 per cent of foreign organic matter.

Description—Rhizome cylindrical, usually in pieces from 3 to 20 cm. in length and from 3 to 30 mm. in diameter; externally light yellowish-brown, longitudinally wrinkled with purplish-brown longitudinal lines and transverse fissures; the upper surface with a few stem scars, the

under and side portions with numerous roots and root scars; fracture tough, splintery; internally light brown or pale yellow, bark thin, wood distinctly radiate, excentral, pith disintegrated; roots light brown; fracture one-half transverse, the other oblique or splintery. Odor slight, taste bitter.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Gelsemii; Elixir Sodii Salicylatis Compositum (from Fluidextract); Tinctura Gelsemii.

Gelsemium contains *gelsemine*, $C_{20}H_{22}O_2N_4$, a crystallizable alkaloid melting at 178° C. It has an $[\alpha]_D$ of +15.9. It also contains two amorphous alkaloids one of which is probably *gelseminine*. The activity of the drug seems to be due primarily to the amorphous alkaloids. It also contains volatile oil, starch, resin, fat, coloring matter, etc.

Uses—It is used as an antispasmodic and sedative. Dose, one and one-half grains (0.1 Gm.).

GUARANA. N. F. Guarana

(U. S. P. IX)

Guarana is a dried paste consisting chiefly of the crushed seed of *Paullinia Cupana* Kunth (Fam. *Sapindaceæ*).

Guarana yields not less than 4 per cent of caffeine.

Description—Usually in cylindrical sticks, about 3 to 5 cm. in diameter, externally dark reddish-brown; hard and heavy; fracture uneven, often fissured in the center; internally pale reddish-brown, showing more or less coarse fragments of seed and occasionally their blackish-brown integuments. Odor slight; taste slightly astringent and bitter.

For further description see the N. F. V.

Assay—Place 6 Gm. of Guarana, in fine powder, in a suitable flask or bottle, add 120 cc. of chloroform and shake. Allow to stand five minutes, then add 6 cc. of ammonia water and shake the mixture continuously during one hour, or intermittently (see Proximate Assays, Type Process A, page 1494) during two hours. Allow the mixture to stand overnight, again shake intermittently during one-half hour, then allow the drug to settle. Decant, or filter off through a pledget of purified cotton, 100 cc. of the chloroformic liquid, representing 5 Gm. of Guarana, and evaporate it to dryness. Treat the residue with 10 cc. of weak (about 1 per cent) sulphuric acid with the aid of a gentle heat, allow to cool, filter through a small filter into a separator, and wash the dish and filter with successive small portions of distilled water until no test for alkaloid is obtained by acidulating a few drops of the filtrate strongly with sulphuric acid and adding iodine T.S. Now add ammonia water until the liquid is distinctly alkaline to litmus, and completely extract the caffeine with successive portions of chloroform, as shown by testing with iodine T.S. Evaporate the combined chloroform solutions, and dry the residue at 80° C. to constant weight. The weight is the amount of caffeine from 5 Gm. of Guarana.

This assay is explained on page 1501.

N. F. Preparations—Fluidextractum Guaranæ; Elixir Guaranæ (from Fluidextract).

Guarana contains *caffeine*, $C_8H_{10}N_4O_2$, to the extent of from 3 to 5 per cent and about 25 per cent of tannin, with resin, mucilage, starch, volatile oil, saponin, etc.

Uses—It is used as a nerve stimulant, in doses of thirty to sixty grains (2 to 4 Gm.). It is effective only in comparatively large doses.

IGNATIA. N. F. Ignatia

[Ignat.—Saint Ignatius Bean, Ignatia Amara]

Ignatia is the dried ripe seed of *Strychnos Ignatii* Bergius (Fam. *Loganiaceæ*).

Ignatia contains not less than 2 per cent of the alkaloids of Ignatia and not more than 1 per cent of foreign organic matter. Its constituents are similar to those from nux vomica, although the alkaloids are usually present in smaller amounts.

Description—Heavy, hard, angularly ovate with obtuse angles, from 20 to 30 mm. in length, and about 15 mm. in breadth and thickness; externally grayish or reddish-black, nearly smooth with few or no hairs; fracture granular and translucent in small fragments; a small, irregular cavity in the center. Nearly inodorous and intensely bitter.

For further description see the N. F. V.

Assay—Place 10 Gm. of Ignatia, in fine powder, in a 250 cc. bottle, add 100 cc. of ether-chloroform mixture, and proceed by Type Process A (page 1494). Decant 50 cc. of the ethereal solution to complete the assay, using chloroform as the immiscible solvent in shaking out the alkaline liquid, and determine the alkaloids volumetrically. Each cc. of tenth-normal acid corresponds to 0.0364 Gm. of the alkaloids of Ignatia.

This assay is explained on page 1501.

N. F. Preparations—Extractum Ignatiæ; Tinctura Ignatiæ.

Uses—Similar to nux vomica. Dose, one grain (0.06 Gm.).

KOLA. N. F. Kola

[Kol.—Cola]

Kola is the dried cotyledon of *Cola nitada* (Ventenat) Schott and Endlicher, or of other species of *Cola* (Fam. *Sterculiaceæ*).

Kola yields not less than 1 per cent of caffeine and contains not more than 1 per cent of foreign organic matter. The chief constituent is *caffeine*, with small amounts of *theobromine*. It also contains *kolatin*, *kolanin*, tannic acid, fat, volatile oil, etc.

Description—Irregularly plano-convex, broadly oval, or approaching circular in outline, from 2.5 to 5 cm. in length, or triquetrous; heavy, hard, and tough; brown, with the outer surfaces slightly wrinkled, the inner surfaces lighter and smoother; edges slightly incurved and sharp. Odorless; taste slightly astringent.

For further description see the N. F. V.

Assay—Place 6 Gm. of Kola, in fine powder, in a suitable flask or bottle, add 120 cc. of chloroform and shake. Allow to stand five minutes, then add 6 cc. of ammonia water and shake the mixture continuously during one hour, or intermittently (see Proximate Assays, Type Process A, page 1494) during two hours. Allow the mixture to stand overnight, again shake intermittently during one-half hour, then allow the drug to settle. Decant, or filter off through a pledget of purified cotton 100 cc. of the chloroformic liquid, representing 5 Gm. of Kola and evaporate it to dryness. Treat the residue with 10 cc. of weak (about 1 per cent) sulphuric acid with the aid of a gentle heat, allow to cool, filter through a small filter into a separator, and wash the dish and filter with successive small portions of distilled water until no test for alkaloid is obtained by acidulating a few drops of the filtrate with sulphuric acid and adding iodine T.S. Now add ammonia water until the liquid is distinctly alkaline to litmus and completely extract the caffeine with successive portions of chloroform, as shown by testing with iodine T.S. Evaporate the combined chloroform solutions, and dry the residue at 80° C. to constant weight. The weight is the amount of caffeine from 5 Gm. of Kola.

This assay is explained on page 1501.

N. F. Preparation—Fluidextractum Kolæ.

Uses—It is employed for the same purposes as caffeine. It is also used in cardiac weakness and tropical diarrhea. Dose, one drachm (4 Gm.).

MANACA. N. F. Manaca

[Manac.—Vegetable Mercury]

Manaca is the dried root of *Brunfelsia Hopeana* Bentham (*Franciscea uniflora* Pohl) (Fam. *Solanaceæ*).

The alkaloid *manacine* is claimed to be present and also a fluorescent compound said to be identical with gelsemic acid. It also contains fat, resin, and starch. Manacine is amorphous, slightly bitter and feebly basic and is soluble in water and alcohol. Some investigators doubt the presence of an alkaloid.

Description and Physical Properties—Nearly cylindrical or more or less tortuous, of variable length and up to about 3 cm. in diameter; externally dark brown, wrinkled and with scaly yellowish cork patches, the latter being easily removed from the thin cortex which adheres closely to the wood; inner surface bark thin, wood light yellowish, hard and finely radiate; fracture short and very tough; taste bitter; odor slight.

For further description see the N. F. V.

N. F. Preparations—Elixir Manacæ Compositum; Fluidextractum Manacæ.

Uses—It is employed in the treatment of muscular rheumatism in doses of fifteen grains (1 Gm.).

PAREIRA. N. F. Pareira

[Pareir.—Pareira Brava]

Pareira is the dried root of *Chondodendron tomentosum* Ruiz et Pavon (Fam. *Menispermaceæ*).

Pareira contains not more than 5 per cent of its stems or more than 2 per cent of other foreign organic matter. This root contains an alkaloid usually called *Pelosine*, $C_{18}H_{21}O_3N$; it also contains starch, gum, tannin, and *phlobaphene*. Pelosine has been proved to be identical with *buxine* and *bebeerine*, alkaloids obtained from *Buxus sempervirens* and *Nectandra Rodiæi*. The root is said to contain five alkaloids.

Description—Nearly cylindrical, more or less tortuous, of variable length and from 1 to 6 cm. in diameter; externally brownish-black or blackish-brown with transverse ridges on knot-like projections, occasionally fissured and longitudinally wrinkled or even furrowed; hard, heavy, and tough; when freshly cut having a waxy luster; the transverse surfaces exhibiting several suc-

cessive excentric and distinctly radiate concentric zones of projecting, secondary fibrovascular bundles each from 2 to 4 mm. in width, and separated by distinct concentric zones of parenchyma and stone cells, the zones radially marked by prominent medullary rays. Stems deeply furrowed, grayish in color, usually covered with foliaceous patches of lichens bearing their blackish apothecia; internally grayish-yellow, with a prominent development of wood with a tendency to separate fibrovascular bundles and without a waxy luster. Odor slight; taste very bitter.

N. F. Preparation—Fluidextractum Pareiræ.

Uses—Pareira is used as a tonic, diuretic, and aperient. The dose is thirty grains (2 Gm.).

PASSIFLORA. N. F. Passion Flower

[**Passiflor.**—PASSION VINE]

Passion Flower is the dried flowering and fruiting top of *Passiflora incarnata* Linné (Fam. *Passifloraceæ*).

Passion Flower contains not more than 5 per cent of stems over 8 mm. in diameter or other foreign matter. An alkaloid has been reported, but the constituents have not been carefully studied.

Description—Stems glabrous or slightly pubescent above, striate, from 6 to 8 mm. in diameter, of variable length, woody, hollow, the cavity about one-half the diameter; bark very thin, greenish or purplish; wood very porous and bordered on the inner side by a thin layer of pith; fracture of the wood uneven, of the stem smooth, or the bark coarsely fibrous. Leaves more or less broken, either thick, glabrous or often pubescent, when entire nearly orbicular in outline, base cordate, deeply three- to five-lobed, lobes ovate, acute, finely serrate, petioles from 1 to 5 cm. in length, with two glands near the summit. Tendrils numerous and closely coiled. Flowers solitary, axillary, peduncles as long as the petioles, usually three-bracted, calyx cup-shaped, four to five lobes; lobes linear, imbricated, cuspidate, corona of the fresh flowers purplish; petals four to five, yellow; ovary oblong, stalked; stamens monadelphous in a tube about the stalk of the ovary, separated above, anthers narrow, versatile. Fruit from 4 to 5 cm. in length, an ovoid many-seeded berry; externally green or yellow, shriveled and wrinkled; seeds flat, ovate, yellowish to brown, arilled. Taste and odor slight.

For further description see the N. F. V.

Test for Identity and Purity—Passion flowers yield not more than 12 per cent of ash.

N. F. Preparation—Tinctura Passifloræ.

Uses—It has been used as an application in hemorrhoids, erysipelas, and burns; also internally in neuralgia. It is not often used today. Dose, three grains (0.2 Gm.).

SANGUINARIA. N. F. Sanguinaria

(U. S. P. IX)

[**Sanguin.**—BLOOD ROOT]

Sanguinaria consists of the dried rhizome and roots of *Sanguinaria canadensis* Linné (Fam. *Papaveraceæ*).

Sanguinaria contains not more than 2 per cent of foreign organic matter.

Sanguinaria contains *sanguinarine*, $C_{20}H_{15}O_4N+H_2O$, a colorless alkaloid, which yields bright red salts. Sanguinarine has a melting point of 212° C. and is soluble in the various organic solvents to which it imparts a fluorescence. Other alkaloids are present as *chelerythrine*, *fumarine*, and *homochelidonine*. It also contains malic and citric acids, starch, resins, coloring matter, etc. The liquid preparations invariably deposit a reddish precipitate upon the sides of the bottle. Some of the alkaloids are similar in their action to the less important opium alkaloids.

Description—Of horizontal growth, occasionally branching, more or less cylindrical, somewhat flattened, from 2 to 7 cm. in length, and from 5 to 15 mm. in diameter; externally dark brown, slightly annulate, with a few stem scars on the upper surface and numerous root scars or more or less broken filiform roots and root scars on the lower surface; fracture short, most of the rhizome showing a reddish-brown internal color, somewhat waxy, and with numerous, small, circular, yellowish fibrovascular bundles within about 1 mm. of the epidermis, pith very large. Odor slight; taste persistently acrid and bitter.

For further description see the N. F. V.

N. F. Preparations—Fluidextractum Sanguinariæ; Syrupus Pini Albæ Compositus, Syrupus Pini Albæ Compositus cum Morphina; Tinctura Sanguinariæ.

Uses—It is alterative, sternutatory, stimulant, and emetic. The dose is two to ten grains (0.125 to 0.6 Gm.).

SCOPARIUS. N. F. Scoparius

[**Scopar.**—BROOM TOPS]

Scoparius consists of the dried tops of *Cytisus scoparius* (Linné) Link (Fam. *Leguminosæ*).

Scoparius contains not more than 5 per cent of stems over 3 mm. in diameter and not more than 2 per cent of other foreign organic matter. Scoparius contains *sparteine*

(*lupinidine*), a colorless liquid alkaloid, having the composition $C_{15}H_{26}N_2$. The sulphate of this alkaloid was formerly official (see page 1167). It also contains *sarothaminine* and *Genisteine* as well as the glucoside *scoparin*, $C_{21}H_{22}O_{10}$, which probably represents the diuretic and purgativ action of the drug. (See Sparteine Sulphate, page 1167.)

Description—Stems thin, flexible, with branched twigs, from 1 to 3 mm. in thickness, five-angled; externally dark green, nearly glabrous, with numerous reddish-brown cork patches; internally yellowish, fracture short-fibrous, that of thicker pieces tough and splintery, upper leaves sessile, with often only one obovate leaflet. Odor slight, on bruising more distinct and peculiar; taste disagreeable, bitter.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Scoparii.

Uses—The dose of scoparius in dropsical complaints is fifteen to thirty grains (1 to 2 Gm.).

SOLANUM. N. F. Solanum

[**Solan.**—Horse-nettle Berries]

Solanum is the air-dried ripe fruit of *Solanum carolinense* Linné (Fam. *Solanaceæ*).

Solanum contains not more than 5 per cent of immature fruit and not more than 2 per cent of foreign organic matter. It contains two alkaloids, *solanine* and *solanidine*, also fat, resin, and volatile oil.

Description—Globose, slightly depressed, somewhat shriveled and wrinkled in drying, from 0.8 to 2 cm. in diameter, orange-yellow, glabrous, fleshy, two-celled, many seeded, calyx and pedicel usually persistent; calyx stellate pubescent, deeply five-lobed, the lobes ovate or ovate-lanceolate, acuminate and enclosing half or more of the berry; seeds orbicular, flat, yellow, smooth, shining. Odor pepper-like; taste bitter and acrid.

For further description see the N. F. V.

N. F. Preparation—Fluidextractum Solani.

Uses—It has been employed in epilepsy. Its use is similar to that of dulcamara. Dose, one drachm (4 Gm.).

TONGA. N. F. Tonga

Tonga is a mixture of equal parts of the bark of *Premna arborea* (Forster filius) Farwell (Fam. *Verbenaceæ*) and of the root of *Epipremnum pinnatum* (Linné) Engler (Fam. *Aracæ*).

Tonga contains not more than 5 per cent of foreign organic matter.

Descriptions and Tests—(See the N. F. V.)

The presence of *tongine* and a volatile oil have been reported.

Preparations—Elixir Tongæ et Salicylatum, Fluidextractum Tongæ.

Uses—It has been used as a remedy for neuralgia, but it is of doubtful value. *Dose*, 30 grains (2 Gm.).

Unofficial Drugs Containing Alkaloids

Akazga (Boundou, Quai, Ikaga, Icaya)
An ordeal poison, used in a district on the west coast of Africa. The alcoholic extract acts similarly to nux vomica

Alstonia Constricta
Australian Fever Bark
The bark of *A. constricta*, found in Australia. It contains *alstonine*, $C_{21}H_{20}O_4N_2.3\frac{1}{2}H_2O$, which is very bitter also *porphyrine* and *porphyrosine*

Aspidosperma
Quebracho (U. S. P. IX)
The dried bark of *Aspidosperma Quebracho blanco* Schlechtendal (Fam. *Apocynaceæ*), without the presence or admixture of more than 2 per cent of wood or other foreign organic matter. It contains the alkaloids *aspidospermine*, $C_{22}H_{30}O_2N_2$, *aspidospermatine*, $C_{22}H_{28}O_2N_2$, *aspidosamine*, *quebrachine*, *hydroquebrachine*, and *quebrachamine*. Quebrachine is identical with yohimbine. The commercial *aspidospermine* is usually a mixture of the above alkaloids. In addition it contains two sugars, *quebrachit* and *inosit*, and tannin. In irregular chips or in longitudinal pieces attaining a length of 14 cm. and a thickness of 35 mm.; outer corky layer from 3 to 25 mm. in thickness, brownish-gray or reddish-brown and deeply furrowed, frequently somewhat reticulate with longitudinal and shallow transverse fissures, the crevices being occasionally lined with the mycelia of a grayish mold; outer surface of bark, from which the cork has been separated, light brown or reddish-brown and usually more or less roughened; inner surface occasionally with adhering wood, otherwise light yellowish-brown to light reddish-brown, longitudinally finely striate and finely porous; fracture short-fibrous with projecting bast fibers. Nearly inodorous; taste bitter and slightly aromatic.
Uses—A respiratory sedative, used in dyspnœa (loss of voice), and in asthmatic conditions. It is also used in South America as a substitute for cinchona in the treatment of malarial fevers. Dose, thirty to sixty grains (2 to 4 Gm.). The sulphates of aspidospermine and quebrachine are used hypodermically and by the mouth in doses of one to two grains (0.065 to 0.13 Gm.)

Chelidonium
Celandine
The entire plant *Chelidonium majus* Linné (Fam. *Papaveraceæ*). It contains *chelerythrine*, *chelidonine*, *chelidoxanthin*, and *chelidonic acid*. Used as a diuretic in doses of forty grains (2.6 Gm.)

Coca
Erythroxylon
The dried leaves of *Erythroxylon Coca* Lamarck (Fam. *Erythroxylaceæ*), known commercially as Huanuco Coca, or of *E. Truxillense* Rusby, known commercially as Truxillo Coca. Yielding not less than 0.5 per cent of the ether-soluble alkaloid when assayed as directed in the U. S. P. VIII. It contains *cocaine*, $C_{17}H_{21}O_4N$, and *hygrine* and *coca-tannic acid*. It is used as a nerve stimulant in thirty- to sixty-grain doses (2 to 4 Gm.). As its preparations rapidly deteriorate, the drug and its preparations were all deleted.

Unofficial Drugs Containing Alkaloids—*Continued*

Colchici Flores
Colchicum Flowers
The flowers of *Colchicum autumnale*, found in Europe. They contain a large percentage of *colchicine*

Coptis Teeta
East Indian Goldthread
The rhizome of *C. Teeta*, found in the East Indies. It contains a very large percentage of *berberine*

Curare
Wourari
An extract made by South American Indians from plants belonging to the genus *Strychnos*. It contains an extremely poisonous alkaloid, named *curarine*

Cytisus Laburnum
Laburnum
Poisonous, narcotic. It contains *cytisine* ($C_{20}H_{27}ON_3$) and *laburnine*

Dita
Dita Bark
From the bark of *Alstonia scholaris*, found in the Philippine Islands. It contains ⅓ per cent of a bitter alkaloid, *ditamine*, and 2 per cent. of *ditain*, an uncrystallizable bitter substance

Duboisia
Duboisia
The leaves of *D. myoporoides*, found in Australia. It contains a very poisonous alkaloid, *duboisine*, which is colored reddish-brown by sulphuric acid

Ephedra Vulgaris
A cardiac stimulant and local mydriatic. It contains the alkaloid *ephedrine*

Erythrophlœum
Sassy Bark
The bark of *E. guineense*, found in Africa. It contains the colorless alkaloid *erythrophleine*. Emetic, narcotic, and astringent. Dose of the extract, two-tenths to three-tenths grain (0.015 to 0.02 Gm.)

Eschscholtzia Californica
Chamisso
Soporific and analgesic. It contains a glucoside, and an alkaloid, said to be *morphine*. The extract has been given in doses commencing with twelve and three-tenths grains (0.8 Gm.), increasing to one hundred and eighty-five grains (12 Gm.), a day

Glaucium
Horn Poppy
The plant of *G. luteum*. It contains the alkaloids *sanguinarine*, *glaucine*, and *glaucopicrine*

Gloriosa Superba
An acrid, narcotic poison. It contains two resins and a very poisonous bitter principle, *superbine*

Isopyrum Thalictroides
It contains two alkaloids, *isopyrine* and *pseudo-isopyrine*

Mandragora Officinalis
Mandrake
Anesthetic. It contains an alkaloid, *mandragorine*, and another alkaloid, both of which possess mydriatic properties

Menispermum
Yellow Parilla
Canadian Moonseed
The rhizome and roots of *Menispermum canadense* Linné (Fam. *Menispermaceæ*). It contains *menispine*, *berberine*, resin, etc. It is alterative and tonic Dose, twenty to forty grains (1.3 to 2.6 Gm.)

Muawin Bark
An ordeal poison. It contains an alkaloid, *muawinine*

Papaveris Fructus (N. F. IV)
Poppy Capsules
The dried, fully grown, unripe fruit of *Papaver somniferum* Linné (Fam. *Papaveraceæ*) from which the seeds have been separated. It contains a small amount (about 0.2 per cent) of *morphine;* also minute amounts of *narcotine*, *narceine*, *papaverine*, *rhœadine*, *codeine* and *meconic acid*.
Globular or ovoid, usually from 3 to 3.5 cm. in diameter, more or less sunken or depressed on the sides, contracted at the base into a sort of neck immediately above a tumid ring at the point of attachment with the stalk; crowned at the summit with the seven- to fifteen-rayed stigma disk; outer wall of pericarp smooth, hard, grayish-yellow to brownish-yellow, often marked with black spots; interior surface rugose, finely striated transversely, and bearing thin, brittle, membranaceous placentæ which extend from the sutures toward the center, and bear on their faces and edges numerous minute, conspicuously reticulated, reniform white seeds. Odorless; taste slightly bitter. Syrup of papaverus is made from the capsules (see page 284)
A narcotic similar to opium. Dose, fifteen grains (1 Gm.)

Papaya
Papaw
The leaves of the *Papaw* tree contain *carpaine*, a cardiac depressant

Peganum Harmala
The seed contains about 4 per cent of alkaloid, two-thirds of which is *harmaline*. It is a convulsant poison, has been used as a diaphoretic, an emmenagogue and an anthelmintic

Sophora Speciosa
The poisonous seeds of this tree contain a volatile liquid alkaloid, *sophorine*

Sabadilla Semen
Sabadilla Seed
The seeds of *Veratrum Sabadilla*. These seeds are the commercial source of *Veratrine*. Commercial *veratrine* is a mixture of alkaloids, made up of *cevadine*, *cevadilline*, *veratridine*, *sabadine* and *sabadinine*

Scopola
Scopola
This rhizome when assayed properly yields not less than 0.5 per cent of mydriatic alkaloids. Contains *scopolamine*, *hyoscyamine* and *atropine*. Used as a narcotic and mydriatic. Dose, three-fourth grain (0.045 Gm.)

Spigelia (U. S. P. IX)
Pink Root
The dried rhizome and roots of *Spigelia marilandica* Linné (Fam. *Loganiaceæ*), without the presence or admixture of more than 10 per cent of stems or other foreign matter. Rhizome horizontal or slightly oblique, more or less flexuous, somewhat branched, from 1.5 to 5 cm. in length and from 2 to 5 mm. in diameter; externally dark brown, slightly annulate, with scars of bud scales, the upper surface knotty, from approximate stem-bases, bearing cup-shaped scars; from the lower and lateral portions arise numerous long, rather coarse, sparingly branched, brittle roots; fracture short, internally differentiated into three nearly equal zones of pith, wood and bark. Few if any of the roots exhibit thin, terminal portions with the bark stripped from the slender strands of wood. Stems usually attached to the upper portion of the rhizome, nearly cylindrical, attaining a length of 6 cm. and a diameter of 3 mm., light grayish-brown to purplish-brown, nodes annulate, marked by opposite leaf scars. Odor slightly aromatic; taste bitter, pungent. Spigelia contains a bitter principle, a liquid alkaloid named by Dudley *spigeline*, resin and a trace of volatile oil, with tannin and wax. Alcohol and water extract its virtues. It is used as an anthelmintic. Dose, one drachm (4 Gm.)

Stramonii Semen
Stramonium Seed
The seed of *Datura Stramonium* Linné (Fam. *Solanaceæ*). Similar to the leaves in action and constituents (see page 1138). It contains in addition about 25 per cent of fixed oil

Unofficial Drugs Containing Alkaloids—*Continued*

Staphisagria (U. S. P. IX) Stavesacre — The ripe seeds of *Delphinium Staphisagria* Linné (Fam. *Ranunculaceæ*), without the presence or admixture of more than 2 per cent of foreign vegetable matter. Irregularly triangular, flattened, or somewhat tetrahedral, one side being convex, from 4 to 7 mm. in length and from 3 to 6 mm. in breadth; externally dark brown, becoming lighter with age, and coarsely reticulate; easily cut, showing a somewhat light brown, oily endosperm, enclosing a small embryo at the pointed end. Odor slight, disagreeable; taste intensely bitter and acrid

Staphisagria contains three alkaloids, *delphinine*, $C_{31}H_{49}O_7N$, *delphisine*, and *delphinoidine*. *Staphisagrine*, *staphisagroine*, and *calcitrapine* are also present with fixed oil, protein compounds, mucilage, etc. The alkaloids are soluble in chloroform, fixed oils, alcohol, and ether, and an oleoresin made with petroleum benzin is an active preparation

Uses—It is used principally externally for killing body vermin, and is very poisonous resembling aconite in action. Dose, one grain (0.065 Gm.)

Tabacum Tobacco — The commercial dried leaves of *Nicotiana Tabacum* Linné (Fam. *Solanaceæ*). It contains *nicotine*, a liquid alkaloid, very acrid and poisonous. Tobacco is sedative and emetic in doses of one to five grains (0.065 to 0.32 Gm.)

Veratrum Nigrum Black Hellebore — This drug grown in Central Europe is used as a substitute for veratrum album. It contains *jervine*

Yohimba Bark — The bark of the species *Tabeimontana* containing *yohimbine*. Yohimbine is used as an aphrodisiac

Xanthorrhiza Yellow Root — Tonic. Dose, forty grains (2.6 Gm.). It contains *berberine*

Unofficial Alkaloids and their Salts, with Allied Products

Alstonine, $C_{21}H_{20}O_4N_2.3\frac{1}{2}H_2O$ — From the bark of *Alstonia constricta*. A brownish-yellow, amorphous powder, readily soluble in alcohol

Anagyrine, $C_{14}H_{18}O_2N_2$ — A yellowish, amorphous, hygroscopic, poisonous alkaloid, from *Anagyris fœtida*. Soluble in water, alcohol, and ether

Analgen (Orthoethyoxyana-monobenzoylamidochino-line), $C_{18}H_{16}O_2N_2$ — Antipyretic and antirheumatic. Dose, eight to fifteen grains (0.5 to 1 Gm.), repeated, if necessary, to seventy-five grains (4.86 Gm.) a day

Antispasmin (Narcein Sodium-Sodium Salicylate) $C_{23}H_{26}O_8N.Na+3C_6H_4(OH)COONa$ — Hypnotic and analgesic. Dose, one-half to one grain (0.03 to 0.06 Gm.)

Arecoline Hydrobromide, $C_8H_{13}O_2N.HBr$ — A liquid alkaloid obtained from *areca* (*betel*) nuts

Aspidospermine, $C_{22}H_{30}O_2N_2$ — From the bark of *Aspidosperma Quebracho*. It is a weak base, forming amorphous salts. The hydrochloride is given in doses of one-thirtieth to one-twentieth of a grain (0.002 to 0.003 Gm.)

Bebeerine, $C_{18}H_{21}O_3N$ — From the bark of *Nectandra Rodiæi*. A pale yellow, amorphous powder, of a resinous aspect, inodorous, very bitter, very slightly soluble in water; inflammable and of an alkaline reaction. *Bebeerine sulphate* is given in doses of two to five grains (0.125 to 0.3 Gm.)

Benzoyl Ecgonine, $C_{16}(H).H_{18}O_4N$, or $C_9H_{14}(C_7H_5O)O_3N$ — Cardiac stimulant. Prepared by heating cocaine in aqueous solution to decomposition

Benzoyl Tropeine, $C_{15}H_{19}O_2N+2H_2O$ — Local anesthetic

Berberine, $C_{20}H_{17}O_4N$ — From the bark of the root of *Berberis vulgaris* and others. It occurs in minute yellow crystals, has a bitter taste, is soluble in 100 parts of cold water, and insoluble in ether. Its medicinal action is similar to that of quinine. Dose, one to eight grains (0.065 to 0.5 Gm.)

Betaine Trimethyl-glycoll — An alkaloid found in the juice of the sugar beet

Blennostasine — Supposed to be a derivative of a cinchona alkaloid. Used in hay fever, influenza, and colds, in doses of fifteen to sixty grains (1 to 4 Gm.)

Boldine — From the leaves of *Peumus Boldus*. It imparts to water a bitter taste, is soluble in alcohol, ether, chloroform, etc., and is colored red by nitric and sulphuric acids. The yield of alkaloid is about $\frac{1}{2}$ per cent.

Buxine — From the bark of *Buxus sempervirens*. It is identical with the bebeerine of nectandra bark

Chelerythrine — From *Chelidonium majus*. This alkaloid is identical with *sanguinarine*. It is an acrid poison

Chinoidine (Quinoidine) — A mixture of alkaloids, mostly amorphous, obtained as a by-product in the manufacture of the crystallizable alkaloids from cinchona. Dose, five to thirty grains (0.32 to 2 Gm.)

Chinol, Quinoline monohypochlorite, $C_9H_6N.Cl.O$ — Antipyretic and analgesic. Dose, three to five grains (0.2 to 0.32 Gm.)

Chinoline (Quinoline, Leucoline), C_9H_7N — An artificial alkaloid. A colorless, oily liquid. Sp. gr. 1.081 at 10° C. (50° F.). Antipyretic and antiseptic

Chlorogenine — Identical with *alstonine* (see above)

Cicutine — From *Cicuta virosa*. A volatile alkaloid. An acrid narcotic and poison.

Cinchonidinæ Salicylas, Cinchonidine Salicylate, $C_{19}H_{22}ON_2C_7H_6O_3$ — Antirheumatic. Dose, fifteen to twenty grains (1 to 1.3 Gm.) a day

Cinchonine, $C_{19}H_{22}ON_2$ — An alkaloid obtained from the bark of various species of Cinchona. Insoluble in water. Used in making elixirs, etc., as it is soluble in alcohol

Conhydrine, $C_8H_{17}ON$ — From *Conium maculatum*. It occurs in pearly, iridescent plates, which are easily fusible; odor similar to that of coniine

Coniine, $C_8H_{17}N$ — From *Conium maculatum*. A volatile alkaloid, inflammable, strong alkaline reaction, strong odor, soluble in water, alcohol, ether, chloroform, etc. Used as an antispasmodic. Dose, one-fourth of a grain (0.015 Gm.). *Coniine hydrobromide* is given in doses of one-sixteenth of a grain (0.004 Gm.)

Unofficial Alkaloids and their Salts, with Allied Products—*Continued*

Cornutine Citrate	An alkaloid from ergot, the activity of which is probably due to ergotoxin
Corydaline, $C_{22}H_{27}O_4N$	From the tubers of *Dicentra canadensis*. A white, amorphous powder; its solution has a very bitter taste; it is a tertiary base
Curarine, $C_{18}H_{35}N$?	From *curare*. It occurs in colorless prisms having a very bitter taste. It is colored red by nitric acid
Cytisine, $C_{11}H_{14}ON_2$	From *Cytisus Laburnum*. It occurs in white crystals, is inodorous, and has a bitter, somewhat caustic taste, and an alkaline reaction. Soluble in water and alcohol. It is colored orange-yellow by nitric acid
Daturine	See page 1138. Dose, one sixty-fourth of a grain (0.001Gm.)
Delphinine, $C_{22}H_{35}O_6N$	From the seed of *Delphinium Staphisagria*. It occurs in flat prisms; taste bitter, followed by persistent tingling. Nearly insoluble in water
Diacetylmorphine (U. S. P. IX) Heroine	An alkaloid [$C_{21}H_{23}O_5N$ or $C_{17}H_{17}(O.C_2H_3O)_2ON$] prepared from morphine by acetylization. When alkaloidal morphine is heated with acetylchloride, the synthetic alkaloid, diacetylmorphine is produced. A white, crystalline powder. Without odor. Its saturated alcoholic solution is alkaline to moistened litmus paper. One Gm. of Diacetylmorphine dissolves in about 1700 cc. of water, 31 cc. of alcohol, 1.4 cc. of chloroform, and in 100 cc. of ether at 25° C. Uses—This alkaloid, usually known as *heroin* or *heroine*, was formerly much used as a sedative in cough mixtures and to relieve moderate pain, but a Federal law was passed in 1925 prohibiting its importation and the importation of opium for its manufacture because of its dangerous habit-forming character. Codeine is largely used in its place. The dose was one-twentieth grain (0.003 Gm.)
Diacetylmorphine Hydrochloride Heroine Hydrochloride	The hydrochloride [$C_{21}H_{23}O_5N.HCl+H_2O$ or $C_{17}H_{17}(O.C_2H_3O)_2ON.HCl+H_2O$] of the alkaloid diacetylmorphine. A white, crystalline powder, without odor. One Gm. of Diacetylmorphine Hydrochloride dissolves in 2 cc. of water at 25° C.; soluble in alcohol; insoluble in chloroform or ether at 25° C. Used the same as for diacetylmorphine
Duboisine	From several species of *Duboisia*. It crystallizes in fine, colorless needles. Used as a substitute for atropine. Dose, one sixty-fourth of a grain (0.001 Gm.)
Ergotoxine, $C_{35}H_{41}O_6N_5$	An active alkaloid obtained from ergot
Erythrophleine Hydrochloride	Obtained from *Erythrophlæum guineense* (Sassy bark). Used in place of cocaine. Dose, one-eighth of a grain (0.008 Gm.)
Ethyl-oxy-Caffeine	Called also Ethoxycaffeine. Given in migraine, in doses of six to eight grains (0.38 to 0.5 Gm.)
Geissospermine, $C_{19}H_{24}O_2N_2.H_2O$	From *Geissospermum læve*. It occurs in small white prisms, nearly insoluble in ether and water, and readily soluble in alcohol and dilute acids
Gelsemine, $C_{24}H_{28}O_4N_2$	From *Gelsemium sempervirens*. It occurs in an amorphous, white powder, of a very bitter taste and an alkaline reaction, slightly soluble in cold water. It is colored red, changing to purple when heated with sulphuric acid. *Gelsemine hydrochloride* has been given in doses of one-sixteenth of a grain (0.004 Gm.)
Glaucine	From *Glauceum luteum*. A white, crystalline powder
Glaucopicrine	From *Glauceum luteum*. A white, crystalline powder
Guaranine	From *Paullinia sorbilis*. Identical with caffeine
Hydrastine, $C_{21}H_{21}O_6N$ (U. S. P. IX)	From hydrastis or prepared synthetically. It is made by adding hydrochloric or sulphuric acid to an alcoholic tincture of hydrastis; the berberine is deposited as a crystalline precipitate, ammonia is added to the filtered mother liquor, and the precipitated hydrastine is purified by recrystallization. In white to creamy white, glistening prisms or as a white, microcrystalline powder; permanent in the air. Almost insoluble in water; 1 Gm. is soluble in 170 cc. of alcohol, 1.4 cc. of chloroform, and in 175 cc. of ether at 25° C. also in 22 cc. of alcohol at 60° C. It melts at about 131° C. (For tests of identity and uses see *Hydrastinæ Hydrochloridum*, page 1145)
Hydrastinine Hydrochloride, $C_{11}H_{11}O_2N.HCl$ (U. S. P. IX)	The hydrochloride of an alkaloid obtained by the oxidation of hydrastine. Made by acting on colorless hydrastine with oxidizing agents. It can also be prepared from narcotine and from berberine. Light yellowish needles, or a yellowish-white, crystalline powder. Without odor. One Gm. of Hydrastinine Hydrochloride dissolves in 195 cc. of chloroform, and in 1820 cc. of ether at 25° C.; very soluble in water and alcohol. It melts at about 210° C. with partial decomposition. In an aqueous solution of the salt (1 in 20), potassium dichromate T.S. produces a precipitate which redissolves if gently heated, but on cooling the solution it separates again in glistening needles. No weighable ash remains on incinerating 0.1 Gm. of Hydrastinine Hydrochloride. In an aqueous solution of the salt (1 in 20), bromine T.S. produces a yellow precipitate, which is completely soluble in ammonia water, producing an almost colorless solution (*hydrastine*). Add slowly 4 or 5 drops of a solution of sodium hydroxide (1 in 7) to a solution of 0.2 Gm. of the salt in 3 cc. of distilled water; each drop causes a milky turbidity, which disappears again on shaking. From this solution, after standing for some time, pure white hydrastinine separates, and the supernatant fluid is almost colorless. Add a few drops of ammonia water to 1 cc. of an aqueous solution of Hydrastinine Hydrochloride (1 in 20): no turbidity is produced (*foreign alkaloids*) Hydrastinine hydrochloride is an oxytocic, in doses of one-half to one grain (0.032 to 0.065 Gm.)
Hygrine	From the leaves of *Erythroxylon Coca*. A volatile alkaloid, of a pale yellow color and a burning taste
Hyoscine	Obtained from *Hyoscyamus niger* in the process for obtaining hyoscyamine, and also by boiling hyoscyamine with baryta water, when decomposition takes place, forming hyoscine and hyoscinic acid. Dose, one sixty-fourth of a grain (0.001 Gm.)
Jervine, $C_{26}H_{37}O_3N.2H_2O$	From *Veratrum album*. It occurs, when pure, as a white powder, tasteless, insoluble in water and ether, but soluble in alcohol and chloroform

Unofficial Alkaloids and their Salts, with Allied Products—*Continued*

Kairine, $C_{10}H_{13}ON.HCl.H_2O$	The hydrochloride of an artificial alkaloid prepared from chinoline. It occurs in commerce as a grayish or yellowish, crystalline powder, having a slight phenol-like odor, and a saline, bitter, somewhat aromatic taste, soluble in boiling water. Dose, fifteen grains (1 Gm.)
Kairoline, Tetrahydromethylquinoline or Tetrahydroethylquinoline	Antipyretic. The sulphates are the commercial salts
Laurotetanine	An alkaloid found in a number of plants belonging to the Laurinæ. A powerful poison, acting like strychnine
Lobeline	From *Lobelia inflata*. It is a volatile, yellow, somewhat aromatic liquid, having an acrid taste. Soluble in alcohol, ether, and fixed oils
Lupinine, $C_{10}H_{19}ON$	From different species of *Lupinus*. It occurs in colorless, rhombic prisms having a fruity odor and a very bitter taste
Lupuline	From *Humulus Lupulus*. A liquid alkaloid which has a strong coniine-like odor and an alkaline taste
Menispermine, $C_{18}H_{24}O_2N_2$	From *Cocculus Indicus*
Muscarine, $C_5H_{15}O_3N$	From *Amanita muscaria*. A colorless, crystalline powder, deliquescent, sparingly soluble in chloroform, and insoluble in ether
Nicotine, $C_{10}H_{14}N_2$	From *Nicotiana Tabacum*. A poisonous, oily liquid. It has an unpleasant tobacco-like odor, a burning taste, and a strongly alkaline reaction
Oxyacanthine, $C_{19}H_{21}O_3N$	From *Berberis vulgaris*. It is white, turning yellow on exposure to sunlight, having a bitter taste and an alkaline reaction. Soluble in 30 parts of boiling alcohol and in 1 part of cold alcohol, insoluble in water. Sulphuric acid colors it brown-red, turning to bright red on being heated
Parthenine	From *Parthenium Hysterophorus*. Used in doses of seven to ten grains (0.4 to 0.65 Gm.) in neuralgia
Pelosine	From *Chondodendron tomentosum*. It is amorphous, insoluble in water, slightly soluble in ether
Piperine, $C_{17}H_{19}O_3N$	A crystalline alkaloid occurring in black and white pepper
Piturine, C_6H_8N	From the leaves of *Duboisia Hopwoodii*. A colorless liquid, of a nicotine odor and an acrid taste; on exposure to light it turns yellow and brown; freely soluble in water, alcohol, etc.
Quebrachine, $C_{21}H_{26}O_3N_2$	From the bark of *Aspidosperma Quebracho*. It yields crystallizable salts, and is colored yellow by sunlight
Quinidine Sulphate, $(C_{20}H_{24}O_2N_2)_2.H_2SO_4+2H_2O$	Obtained from the mother liquors after the crystallization of the quinine
Sanguinarine, $C_{20}H_{15}O_4N+H_2O$	From *Sanguinaria canadensis*. It occurs in white crystals, having a bitter, acrid taste; soluble in ether and alcohol
Solanine	From *Dulcamara* and other plants. Dose, one grain (0.06 Gm.)
Sophorine	From the seeds of *Sophora speciosa*. A poisonous alkaloid
Sparteine Sulphate, $C_{15}H_{26}N_2.H_2SO_4.5H_2O$ (U. S. P. IX)	The sulphate of sparteine, a liquid alkaloid obtained from *Cytisus Scoparius* (Linné), Link (Fam. *Leguminosæ*). The salts of sparteine are mostly crystallizable, although the alkaloid itself is liquid. Sparteine is identical with *lupinidine* obtained from *yellow lupin seeds*. In colorless, rhombohedral crystals, or as a crystalline powder. It is hygroscopic, odorless and having a slightly saline and somewhat bitter taste. One Gm. of Sparteine Sulphate dissolves in 1.1 cc. of water and in 3 cc. of alcohol at 25° C.; insoluble in chloroform or ether. Uses—Sparteine sulphate is a cardiac stimulant and narcotic. Dose, one-sixth of a grain (0.01 Gm.)
Staphisagrine, $C_{22}H_{33}O_5N$	From *Delphinium Staphisagria*. It is amorphous, very soluble in ether and in 200 parts of water
Thalline, Tetrahydroparaquinanisol, $C_9H_6H_4N(OCH)_3$	A hemostatic. The sulphate and tartrate are powerful antipyretics. Dose, from four to eight grains (0.25 to 0.5 Gm.)
Theine	See *Caffeine* (page 1150)
Theobromine, $C_7H_8O_2N_4$	From *Theobroma Cacao*. It occurs in minute, colorless or white, bitter crystals, sparingly soluble in water, alcohol, and ether
Tropacocaine Hydrochloride, $C_{15}H_{19}O_2N.HCl$	An alkaloid from coca said to possess greater anesthetic activity than cocaine
Veratroidine, $C_{51}H_{78}O_{16}N_2$	From *Veratrum viride*. It is a white powder, of a bitter taste, soluble in alcohol, ether, chloroform, etc. It is colored yellow by sulphuric acid
Yohimbine, $C_{22}H_{28}O_3N_2.H_2O$	The hydrochloride is used medicinally as an aphrodisiac. The alkaloid is obtained from *yohimboa bark* (*Corynanthe Yohimbi*)

CHAPTER LXXIV

VITAMINS

For centuries a disease called *beri-beri* was prevalent in oriental countries, technically it was known as *polyneuritis*. It was commonest among the poorer classes, particularly those who lived upon rice and fish, and was commonly believed to be due to some toxic substance present in the food, although no evidence of this fact had ever been presented. In 1897 a Dutch scientist named Eijkman produced experimentally a disease resembling beri-beri in pigeons which had been fed on polished rice. Nutrition experts and food chemists had up to recent years classified food values upon the four great nutritional elements: *fats*, *carbohydrates*, *proteins*, and *mineral salts*. Calorific values, the fuel needs of the human engine, had been calculated with great exactness, and the body needs in this respect had been very thoroughly studied and established. In 1912, Casmir Funk, a Polish physiologist and chemist, did some experimental work in New York along the line of Eijkman's observations, and made the discovery that pigeons in which experimental polyneuritis had been produced and in which the disease had been allowed to progress until the birds were in a moribund condition, could be revived and restored to normal health by the administration of minute amounts of the pericarp of the rice grain, the material that had been removed in polishing the rice. He named the unknown and unidentified principle a *vitamin*, because he believed it to belong to the *amino* group of organic compounds and because it was of *vital* necessity to life.

McCollum, at present of Johns Hopkins University, who at that time was an instructor in the University of Wisconsin, made nutrition studies his hobby and, building upon the foundations laid by Eijkman, Funk, and certain Japanese investigators, has since become one of the foremost authorities upon this important subject. The single vitamin of rice pericarp of Funk has been augmented since 1912 by the discovery of a number of others which have still retained the generic name, and which are distinguished by the letters of the alphabet in regular order. At the present time at least seven vitamins are recognized, known as *Vitamins* A, B, C, D, and E respectively, and vitamins X and P, which have so recently been announced that little is known regarding them.

Vitamin A, usually called *Fat Soluble A*, on account of its principal origin, is especially abundant in cod liver oil, butter, egg yolk, and glandular tissues of fowls and food animals. It has been found in but few vegetable fats, but abounds in the green leaves of food plants, as spinach and lettuce, and in the forms of certain cereal grains. Vitamin A protects the individual against a disease of the eyes called *xerophthalmia*, and benefits the organism in other ways.

The vitamin which Funk had discovered was found to exist plentifully in the husks of many cereals, and also in cow's milk. This was called *Vitamin B* or *Water Soluble B*. A third vitamin was later discovered by the Norwegian scientists, Holst and Frolich, particularly in fresh vegetables and fruits. This is called *Vitamin C* or *Water Soluble C* and has antiscorbutic properties in particular.

Cabbage, tomatoes, and orange juice are particularly rich in Vitamin C. A fourth vitamin, called *Vitamin D*, was discovered later, which stimulates

the growth of yeast and probably other microörganisms and which possesses antirachitic properties; and the latest addition called *Vitamin E*, which has been found in wheat and other cereal grains, is essential to the reproduction of the individual and hence has been called the *fertility* vitamin.

Vitamins are called "food accessory" or "growth promoting" substances or "unidentifiable dietary factors". There are no chemical tests for their detection nor have they been extracted and isolated in a state of purity.

Their presence is determined by feeding experiments upon fowls and animals, particularly upon white rats. These experiments must be carefully controlled and must cover a sufficiently long period of time to warrant the establishment of conclusions regarding the presence or absence of these mysterious factors. For fuller information upon the subject see cod liver oil, page 1187, also McCollum's "Newer Knowledge of Nutrition" and the "Vitamine Manual" by Eddy.

Nostrums purporting to contain vitamins in concentrated form are usually misleading in their claims. Any individual who eats normally a variety of foods, especially an abundance of dairy products and fresh vegetables and fruits, is in no danger of vitamin starvation.

The most recent work in the chemistry of the vitamins indicates that the water-soluble vitamins are amino compounds, while the fat soluble vitamins have a composition resembling cholesterol.

The most noteworthy discovery in connection with the studies upon vitamins is that certain of them appear to be capable of development by exposure of food products to the action of ultra violet light. Thus cottonseed oil, which ordinarily is devoid of vitamins, has been given certain qualities by exposure to such rays, as are comparable to the effect of certain natural vitamin containing foods. This has also been done with cholesterol.

CHAPTER LXXV

PRODUCTS FROM ANIMAL SUBSTANCES

The animal products of pharmaceutical interest are not numerous, but some of them are very important.

Protein substances, or, as formerly called, *proteids*, are any one of a group of complex substances forming the essential constituents of living cells and from which all animal and vegetable tissues are built up. They are combinations of amino acids or their derivatives and all contain carbon, hydrogen, oxygen, and nitrogen. Sulphur also occurs in most of the groups, and phosphorus and iron in a few. They are mostly colloidal, are insoluble in ether and alcohol, are coagulated by heat, and may be decomposed by mineral acids, caustic alkalies, proteolytic enzymes and putrefying bacteria, the ultimate products being amino acids. The amino acids are as follows: *glycine*, *alanine*, *serine*, *cysteine*, *cystine*, *phenylalanine*, *tyrosine*, *histidine*, *tryptophane*, *valine*, *leucine*, *isoleucine*, *aspartic acid*, *glutamic acid*, *ornithine*, and *lysine*.

Simple proteins, or those yielding only amino acids on hydrolysis, are represented by *albumins*, *globulins*, *glutelins*, *albuminoids*, *histons*, and *protamins*. *Conjugated proteins*, those combining some other molecule, but not as a salt, are represented by *nucleo-proteins*, *glycoproteins*, *phosphoproteins*, *nucleo-albumins*, *hemoglobins*, *lecithoproteins*.

Derived proteins, resulting from hydrolytic change, are represented by *proteins*, *metaproteins*, *proteoses*, *peptones*, *and peptids*.

The term *protide* has recently been adopted by international agreement to distinguish such nitrogenous substances as yield one or more amino acids by hydrolysis. The term is practically synonymous with protein.

Ptomaines or cadaveric alkaloids are produced when animal substances are subjected to putrefaction or fermentative processes. Many of them are intensely poisonous. They have an alkaline reaction, forming salts like the alkaloids, and may be volatile or fixed, fluid or solid, crystalline or amorphous. Some ptomaines are tasteless and odorless, others have an intensely bitter taste and an aromatic odor. The alkaloids from animal excretions have been given the name of *leucomaines*; nitrogenous poisonous substances derived from animal tissues which are not alkaloids are termed *toxalbumins*.

Modern researches in physiological chemistry, especially the glandular secretions, have revealed the fact that an important part is played by these secretions, many of which contain definite active principles such as suprarenalin and thyroxin. These principles are produced in specialized cell structures (glands) and conveyed by the blood to other parts of the body where their effects are produced. The term *hormone* has been loosely applied to all such substances, and the term *organotherapy* is used to indicate the branch of therapeutics in which these animal glands, their extracts, or their active principles are employed. The term *endocrins* is also applied to the glands.

Serums and vaccines have become important agents in the modern treatment of disease, and these will be discussed in the Chapter on Biological Products.

The animal products of interest in pharmacy are grouped according to the *class* to which they belong, as follows: 1. Mammalia. 2. Pisces. 3. Aves. 4. Insecta. 5. Reptilia. 6. Annelida. There are no official products from the third, fifth, or sixth classes.

Official Products Derived from the Class Mammalia

ADEPS. U.S. Lard

The standards and tests will be found under *Fats*, page 1040.

ADEPS BENZOINATUS. U.S. Benzoinated Lard

The standards and tests will be found under *Fats*, page 1041.

ADEPS LANÆ. U.S. Wool Fat

The standards and tests will be found under *Fats*, page 1042.

ADEPS LANÆ HYDROSUS. U.S. Hydrous Wool Fat

The standards and tests will be found under *Fats*, page 1043.

SEVUM PRÆPARATUM. U.S. Prepared Suet

The standards and tests will be found under *Fats*, page 1043.

SEVUM BENZOINATUM. N.F. Benzoinated Suet

The standards and tests will be found under *Fats*, page 1044.

GELATINUM. U.S. Gelatin

[Gelat.]

A product obtained from animal tissues, such as skin, ligaments, and bones.

Preparation—Bones, cartilaginous material, such an tendons, and hide contain substances called *collagens* which are capable of undergoing hydrolysis when boiled with water. The collagens yield in this manner the adhesive principle *glutin*, which predominates in glue, and the gelatinizing principle *chondrin*, which predominates in gelatin. Glue and gelatin therefore are closely related products, the latter being made from sound selected stock.

Bone gelatin, which is the finest variety for edible use and pharmaceutical purposes, is made from clean bones which are first treated with hydrochloric acid to remove calcium phosphate, the residue used in gelatin manufacture being known as *ossein*. The ossein is boiled with water, the solution clarified by filtration, decolorized with bone black if necessary, and evaporated to a degree of concentration, which, upon cooling, produces a stiff jelly. This is cut into slabs and dried upon aluminum wire netting under sanitary conditions, in a current of warm, dry, clean air. The sheets are marketed in convenient sizes or the material may be cut, granulated or powdered by mechanical means. Low grade gelatin is sometimes prepared by the use of bleaching agents such as sulphur dioxide, and such material sometimes contains injurious amounts of metallic impurities such as copper, lead, zinc, and arsenic, which are excluded by the official text. For capsule making only, a special form of gelatin is permitted in which the bright sparkling appearance and freedom from decomposition is produced by the use of a limited amount of sulphur dioxide.

Description and Physical Properties—In sheets, flakes, shreds, or as a coarse or fine powder. It is colorless or yellowish, and has a very slight, characteristic odor and taste. When dry, it is stable in the air, but when moist or in solution, it decomposes.

Gelatin is insoluble in cold water, but swells and softens when immersed in it, gradually absorbing from 5 to 10 times its own weight of water. It is soluble in hot water, acetic acid, and in a hot mixture of glycerin and water. It is insoluble in alcohol, chloroform, ether, benzene, carbon disulphide, and in fixed or volatile oils.

Tests for Identity—An aqueous solution of Gelatin (1 in 100) yields no precipitate with copper sulphate T.S. or mercuric chloride T.S., but is precipitated by solutions of chromium trioxide or trinitrophenol T.S. Even a very dilute solution of Gelatin (1 in 5000) is at once rendered turbid by the addition of tannic acid T.S.

Tests for Purity—A hot solution of Gelatin in distilled water (1 in 40) is free from a putrid odor, and is not more than slightly acid to litmus paper. In a layer 2 cm. in thickness the solution is only slightly opalescent and on cooling to 6° C., and standing for several hours, it forms a firm, transparent or translucent jelly.

Incinerate 0.5 Gm. of Gelatin: it yields not more than 2 per cent of ash. Dissolve this ash with the aid of heat in a slight excess of hydrochloric acid and a few drops of nitric acid: the resulting solution diluted with distilled water to 25 cc. meets the requirements of the test for *heavy metals*, page 1519.

Heat 1.5 Gm. of Gelatin with 30 cc. of hydrochloric acid (1 in 4) in a 150 cc. Erlenmeyer flask on a water bath, and, when the Gelatin has dissolved, add 3 cc. of bromine T.S., and heat on a water bath, for 30 minutes, shaking the flask occasionally. Then add 0.5 Gm. of potassium iodide and follow it with 0.5 cc. of 25 per cent solution of stannous chloride. Heat the solution for five minutes on a water bath, cool and subject it to the test for *arsenic*, page 1512. The stain, if any, is not greater than that produced in a test made with the same quantities of the reagents and 2 cc. of the standard arsenic test solution.

Dissolve 20 Gm. of Gelatin in 150 cc. of hot distilled water in a flask having a round bottom and a long neck, add 5 cc. of phosphoric acid and 1 Gm. of sodium bicarbonate, and at once connect the flask with a condenser. Distil 50 cc., receiving the distillate under the surface of 50 cc. of tenth-normal iodine. Acidulate the distillate with a few drops of hydrochloric acid, add 2 cc. of barium chloride T.S., and heat on a water bath until the liquid is nearly colorless. The precipitate of barium sulphate, if any, when filtered, washed and ignited, weighs not more than 0.003 Gm., corresponding to not more than 0.004 per cent of sulphur dioxide, correction being made for any sulphate which may be present in 50 cc. of the tenth-normal iodine.

NOTE—Gelatin to be used for capsules for medicines may contain not more than 0.15 per cent of sulphur dioxide.

U. S. P. Preparation—Gelatinum Glycerinatum.

Uses—Gelatin is largely used in pharmacy to coat pills and form capsules, and as a vehicle for suppositories.

PEPSINUM. U. S. Pepsin

[Pepsin.]

Pepsin is a substance containing a proteolytic enzyme obtained from the glandular layer of the fresh stomach of the hog, *Sus scrofa* var. *domesticus* Gray (Fam. *Suidæ*).

Pepsin digests not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumen. Pepsin of a higher digestive power may be brought to this standard by admixture with pepsin of a lower digestive strength or with lactose.

Preparation—Pepsin is made from hogs' stomachs which are macerated in water acidulated with hydrochloric acid, for several days, with frequent stirring. The strained liquid, if not clear, is clarified by allowing it to stand for twenty-four hours, and decanting. Sodium chloride, or other suitable precipitating medium is then dissolved in the solution to cause the precipitation of the pepsin, which comes to the surface. After several hours the floating pepsin is skimmed from the surface and purified by solution and reprecipitation. *Purified pepsin*, or *scale pepsin*, is made by concentrating an acidulated solution of pepsin in a vacuum apparatus and spreading the thick solution on glass plates to form scales, as is done with the scale salts of iron. It is in the form of yellowish scales. It is sometimes prepared in thicker scales which are broken up to form *granular pepsin*. When in these forms, pepsin is very soluble, and analysis has shown the presence of as much as ten per cent of free hydrochloric acid. One of the best forms of commercial pepsin is the "*spongy*" variety said to be produced by drying the pepsin solution in vacuum driers which causes the pepsin to puff and assume a spongy form.

An insoluble pepsin freed from acid is also largely used for dispensing in powders and capsules, as it is not hygroscopic, and can be dispensed without becoming moist. This form is said to consist of the dried and pulverized stomach tissue containing the unremoved pepsin.

Description and Physical Properties—Lustrous, white or pale yellow, transparent or translucent scales, granules or spongy masses, or a fine, white or cream-colored, amorphous powder free from any offensive odor, and having a slightly acid or saline taste. It is not more than slightly hygroscopic.

Pepsin is freely soluble in water, the solution being more or less opalescent. It is nearly insoluble in alcohol, chloroform, and ether.

Dry Pepsin is not injured by heating to 100° C. The activity of Pepsin in solution is destroyed by alkalies or by temperatures exceeding 70° C.

Tests for Identity—An aqueous solution of Pepsin (1 in 50) is acid to litmus paper.

An aqueous solution of Pepsin yields precipitates with solutions of tannic or gallic acid and with solutions of the salts of many heavy metals.

On heating a saturated solution of Pepsin in acidulated water to 100° C., it becomes milky or yields a light, flocculent precipitate and loses all proteolytic power.

Assay—Mix 25 cc. of normal hydrochloric acid with 275 cc. of distilled water. Dissolve 0.1 Gm. of Pepsin in 150 cc. of this acid. Select a hen's egg, which is not less than five and not more than twelve days old and has been kept in a cool place, and immerse it in boiling water during fifteen minutes. As soon as the egg has sufficiently cooled to handle, remove the shell and pellicle and all of the yolk and at once rub the albumen through a clean, dry, hair or brass, No. 40 sieve, reject the first portion that passes through the sieve, and place 10 Gm. of the succeeding portion in a wide-mouthed bottle of 100 cc. capacity. Immediately add 20 cc. of the acid, and stir the mixture with a rubber-tipped glass rod so as to separate thoroughly the particles of albumen from each other. Rinse the rod with 15 cc. more of the acid and, after warming the mixture to 52° C., add exactly 5 cc. more of the acidulated solution of Pepsin. At once cork the bottle securely, invert it three times, and place it in a bath that has been previously regulated to maintain a temperature of 52° C. Keep the bottle at this temperature for two and one-half hours, agitating the contents every ten minutes by inverting it once. Then remove it from the bath, pour the contents into a conical measure having a diameter not exceeding 1 cm. at the bottom, and transfer the undigested egg albumen, which adheres to the sides of the bottle, to the measure with the aid of small portions (about 15 cc. at a time) of distilled water, until the total amount used measures 50 cc. Stir the mixture well and allow it to stand for half an hour. The deposit of undissolved albumen does not measure more than 1 cc.

The relative proteolytic power of pepsin, stronger or weaker than that just described, may be determined by ascertaining through repeated trials the quantity of the Pepsin solution made as directed in the assay, required to digest, under the prescribed conditions, 10 Gm. of boiled and disintegrated egg albumen. Divide 15,000 by this quantity expressed in cc. to ascertain how many parts of egg albumen one part of Pepsin will digest.

Preserve in well-closed containers.

N. F. Preparations—Elixir Cinchonæ Alkaloidorum, Ferri et Pepsini; Elixir Pepsini (from Glycerite); Elixir Pepsini, Bismuthi et Strychninæ; Elixir Pepsini et Bismuthi; Elixir Pepsini et Ferri; Elixir Pepsini et Rennini Compositum; Glyceritum Pepsini; Liquor Ferri Peptonati; Liquor Ferri Peptonati et Mangani; Liquor Pepsini (from Glycerite); Liquor Pepsini Antisepticus; Liquor Pepsini Aromaticus; Pepsinum Saccharatum; Succus Citri et Pepsini (from Glycerite); Vinum Pepsini (from Glycerite).

Uses—Pepsin is used to aid the digestion of food and is given in dyspepsia in doses of three to thirty grains (0.2 to 2 Gm.). Pepsin is only active when in an acid medium of the hydrogen ion concentration corresponding to about 0.2 per cent of free hydrochloric acid. More than 18 per cent of alcohol in pepsin solutions and much agitation cause rapid deterioration. Pepsin is destroyed in the presence of alkalies and also by metallic salts, such as those of copper, lead, silver, mercury, bismuth, etc.

PEPSINUM SACCHARATUM. N.F. Saccharated Pepsin

[Pepsin. Sacchar.]

	Metric	Alternative
Pepsin	**10 Gm.**	175 gr.
Lactose, recently dried and in very fine powder	**90 Gm.**	3 oz. av. 262 gr.
To make	**100 Gm.**	4 oz. av.

Triturate the pepsin with the lactose to a uniform, fine powder. Keep the product in well-stoppered bottles. The dose is fifteen grains (1 Gm.) representing about 1½ grains of pepsin.

LIQUOR PEPSINI. N. F. Solution of Pepsin

[Liq. Pepsin.]

	Metric	Alternative
Glycerite of Pepsin (see note below)	**50 cc.**	1 fl. oz. 288 min.
Diluted Hydrochloric Acid	5 cc.	77 min.
Glycerin	**315 cc.**	10 fl. oz. 38 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix them by very gentle agitation.

NOTE—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly when at or above normal room temperature. To insure the dispensing of this solution at standard strength, it is strongly recommended that an excess of pepsin, above that directed in the formula, of 25 per cent to 50 per cent be used in preparing this Solution to allow for such loss of activity, and that it be stored in a cool place.

Solution of Pepsin is a transparent, yellowish liquid, with a characteristic odor, an acid, saline, characteristic taste, and an acid reaction.

One cc. of this Solution will digest 10 Gm. of egg albumin, carrying out the test according to the details of the U. S. P. X assay under *Pepsinum*, page 1173.

The dose is two fluidrachms (8 cc.), representing about one-half grain of pepsin.

LIQUOR PEPSINI ANTISEPTICUS. N. F. Antiseptic Solution of Pepsin

[Liq. Pepsin. Antisept.]

	Metric	Alternative
Pepsin (see note below)	**50.0 Gm.**	1 oz. av. 293 gr.
Diluted Hydrochloric Acid	**5.0 cc.**	77 min.
Glycerin	**50.0 cc.**	1 fl. oz. 288 min.
Alcohol	**10.0 cc.**	154 min.
Menthol	**0.5 Gm.**	7 gr.
Eucalyptol	**0.5 cc.**	8 min.
Methyl Salicylate	**0.5 cc.**	8 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the diluted hydrochloric acid with 800 cc. [25 fl. oz. 288 min.] of cold distilled water and dissolve the pepsin in this liquid by gentle stirring; then add the glycerin. Dissolve the menthol, eucalyptol, and methyl salicylate in the alcohol, add to the first solution, then add sufficient distilled water to make the product measure 1000 cc. [2 pints]. Set aside for twenty-four hours, and filter.

NOTE—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly at or above normal room temperature. To insure the dispensing of this Solution at standard strength, it is strongly recommended that the quantity of pepsin in the formula be increased to 65 Gm. or 75 Gm. to allow for such loss in activity, and that the Solution be stored in a cool place.

Antiseptic Solution of Pepsin is a transparent, brownish-yellow liquid having an aromatic, eucalyptus-like odor, and an acid, pleasant, aromatic taste, and an acid reaction.

One-tenth cc. of this Solution will digest 10 Gm. of egg albumen, carrying out the test according to details of the U. S. P. X assay under *Pepsinum*, page 1173.

Approximate alcohol content, by volume, 0.9 per cent.

Uses—This solution is used as a dressing for old wounds causing the digestion of extraneous tissue and promoting healing. It is not used internally.

LIQUOR PEPSINI AROMATICUS. N. F. Aromatic Solution of Pepsin

[Liq. Pepsin. Arom.]

	Metric	Alternative
Pepsin (see note below)	**17.50 Gm.**	255 gr.
Diluted Hydrochloric Acid	**5.00 cc.**	77 min.
Glycerin	**250.00 cc.**	8 fl. oz.
Alcohol	**35.00 cc.**	1 fl. oz. 58 min.
Oil of Cinnamon	**0.25 cc.**	4 min.
Oil of Pimenta	**0.25 cc.**	4 min.
Oil of Clove	**0.50 cc.**	8 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Mix the diluted hydrochloric acid with 700 cc. [22 fl. oz. 192 min.] of cold distilled water and dissolve the pepsin in this liquid by gentle stirring; then add the glycerin. Dissolve the oils in the alcohol and add to the aqueous solution, then add sufficient distilled water to make the product measure 1000 cc. [2 pints] and mix thoroughly by gentle agitation. Set the mixture aside for twenty-four hours, then filter.

NOTE—Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly at or above normal room temperature. To insure the dispensing of this Solution at standard strength it is strongly recommended that the quantity of pepsin directed in the formula be increased to 25 Gm. to allow for such loss in activity, and that the solution be stored in a cool place.

Aromatic Solution of Pepsin is a pale yellow, transparent liquid, with a pleasant, aromatic, cinnamon-like odor, a strong, sweet, aromatic taste and an acid reaction.

One-fourth cc. of the Solution digests 10 Gm. of egg albumen, carrying out the test according to the details of the U. S. P. X assay under *Pepsinum*.

Approximate alcohol content, by volume, 3 per cent.

Uses—It is used as a digestant; the dose is two fluidrachms (8 cc.), representing about two grains of pepsin.

PANCREATINUM. U.S. Pancreatin

[Pancreat.]

Pancreatin is a substance containing enzymes, principally amylopsin, trypsin, and steapsin, obtained from the fresh pancreas of the hog, *Sus scrofa* var. *domesticus* Gray (Fam. *Suidæ*) or of the ox, *Bos taurus* Linné (Fam. *Bovidæ*).

It converts not less than 25 times its weight of starch into soluble carbohydrates and not less than 25 times its weight of casein into proteoses. Pancreatin of a higher digestive power may be brought to this standard by admixture with lactose.

Preparation—Pancreatin is made by cutting the fresh pancreas into small pieces, kneading thoroughly with water, straining the liquid, and then filtering; an equal volume of alcohol is added to the filtrate and the precipitate is dried and powdered. The constituent *amylopsin* converts starch into maltose and forms small amounts of dextrose. Slight acidity checks this reaction and destroys the enzyme. *Trypsin* acts upon proteins and nucleoproteins, changing them into peptones and polypeptids. An excess of mineral acid soon decomposes it, although it keeps fairly well in 25 to 50 per cent alcohol and best in 50 per cent glycerin. Both ferments are most active at 40° C. in a slightly alkaline medium.

Description and Physical Properties—A cream colored, amorphous powder, having a faint, characteristic, but not offensive odor.

Pancreatin is slowly and incompletely soluble in water; insoluble in alcohol.

Pancreatin changes proteins into proteoses and derived substances, and converts starch into dextrins and sugars. Its greatest activities are in neutral or faintly alkaline media; more than traces of mineral acids or large amounts of alkali hydroxides render it inert. An excess of alkali carbonates also inhibits its action.

Tests for Purity—Introduce 2 Gm. of Pancreatin into a flask of about 50 cc. capacity, add 20 cc. of ether, stopper, and set it aside for several hours, mixing by rotating at frequent intervals. Decant the supernatant ether by means of a guiding rod into a plain filter of about 7 cm. diameter, previously moistened with ether, and collect the filtrate in a tared beaker. To the residue remaining in the flask, add a further portion of 10 cc. of ether, proceeding as directed before, then a third portion of 10 cc. of ether, and transfer the ether and the remainder of the pancreatin to the filter. Allow to drain, evaporate the ether spontaneously, and dry the beaker and residue to constant weight at 100° C.: the residue weighs not more than 0.06 Gm. (*fat*).

Assay for Starch Digestive Power—Shake 10 Gm. or more of powdered potato starch with about 10 times its weight of cold distilled water, and, after draining the mixture on a filter, wash it with the same quantity of distilled water. Place the washed starch at once in an air bath, and maintain a temperature of about 50° C. until the starch is sensibly dry. Reduce it to a fine powder, and place it in a well-stoppered bottle. Determine the percentage of water remaining in the starch by drying about 0.5 Gm. of it in an air bath, gradually raising the temperature to 120° C. and maintaining it at that temperature for four hours. Of the washed and partially dried starch, mix a quantity equivalent to 7.5 Gm. of dry starch in a 400 cc. beaker with 10 cc. of cold distilled water, add 190 cc. of boiling distilled water, and boil the mixture gently with constant stirring for five minutes or until a translucent, uniform paste is obtained. Replace the water lost by evaporation, and cool the paste to 40° C. in a water bath previously adjusted to this temperature and add a

solution of 0.3 Gm. of Pancreatin in 10 cc. of distilled water, just previously made at 40° C. Mix well, and maintain the same temperature for exactly five minutes, when a thin, nearly clear liquid is produced. At once add 0.1 cc. of this liquid to a previously made mixture of 0.2 cc. of tenth-normal iodine and 60 cc. of distilled water. No blue, red or violet color is produced.

Assay for Casein Digestive Power—Place 0.1 Gm. of finely powdered casein in a 50 cc. volumetric flask, add 30 cc. of distilled water, and shake well to bring the casein into suspension. Add exactly 1 cc. of tenth-normal sodium hydroxide, and heat the mixture at 40° C. until the casein is completely dissolved which should not require more than thirty minutes. Cool, add sufficient distilled water to make 50 cc., and mix well. Dissolve 0.1 Gm. of Pancreatin in 500 cc. of distilled water. Mix 1 cc. of glacial acetic acid with 9 cc. of distilled water and 10 cc. of alcohol. Place 5 cc. of the casein solution in a test tube, add to it 2 cc. of the well-shaken Pancreatin solution and 3 cc. of distilled water, and mix by gentle agitation. Immediately immerse the test tube in a water bath at 40° C., and keep it at this temperature for one hour. Then remove from the bath, and add 3 drops of the acetic acid mixture. No precipitate is produced.

Preserve in well-closed containers.

N. F. Preparations—Liquor Pancreatini; Pulvis Pancreatini Compositus.

Uses—Pancreatin is used to aid digestion. Pepsin and pancreatin are not active in the same media. What is suitable for one will destroy the other, hence, it is illogical to give them in the same combination, as was done in the older compound digestive elixirs, which, however, are still in demand as physicians insist upon prescribing them however illogical their constitution. It should not be given in combination with acids; weak alkalies assist its action. The dose is from five to ten grains (0.3 to 0.6 Gm.).

LIQUOR PANCREATINI. N. F. Solution of Pancreatin

[**Liq. Pancreat.**—Liquor Pancreaticus, Pancreatic Solution]

	Metric	Alternative
Pancreatin	**17.5 Gm.**	255 gr.
Sodium Bicarbonate	**50.0 Gm.**	1 oz. av. 293 gr.
Glycerin	**250.0 cc.**	8 fl. oz.
Compound Spirit of Cardamom	**3.5 cc.**	54 min.
Alcohol	**65.0 cc.**	2 fl. oz. 38 min.
Magnesium Carbonate	**8.0 Gm.**	117 gr.
Sodium Chloride	**5.0 Gm.**	73 gr.
Chloroform	**2.0 cc.**	31 min.
Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Triturate the pancreatin, sodium chloride, and the sodium bicarbonate gradually with 625 cc. [20 fl. oz.] of distilled water; add the alcohol, compound spirit of cardamom and magnesium carbonate; mix them thoroughly by shaking, and pour the mixture upon a wetted filter, returning the first portions of the filtrate until it passes through clear. Wash the filter with sufficient distilled water to obtain 748 cc. [23 fl. oz. 449 min.] of filtrate. To this add the chloroform and glycerin and mix.

Solution of Pancreatin is a pale yellow, transparent liquid, with an aromatic odor, and a saline, sweet, aromatic taste and an alkaline reaction.

Assay—Add 5 cc. of Solution of Pancreatin to 25 cc. of tepid, distilled water, contained in a flask, then add 100 cc. of cow's milk which has previously been heated to 40° C. Keep the temperature at 40° C. for 30 minutes. At the end of this time the milk is so completely peptonized that on diluting 3 cc. with 9 cc. of distilled water, then mixing with 3 cc. of acetic acid, no coagulation occurs.

Dose—1 fluidrachm (4 cc.).

PULVIS PANCREATINI COMPOSITUS. N. F. Compound Pancreatin Powder

The formula for this powder, frequently called *Peptonizing Powder*, and used in the preparation of a predigested milk, will be found on page 483.

Unofficial Digestive Enzymes

The following is an abstract of a discussion on enzymes and their action, taken from the 1925 N. N. R. with permission:

In medicine, enzymes or digestive ferments are used internally for the purpose of supplementing or replacing deficient or about normal alimentary secretions; outside of the body for the digestion of food prior to its administration and locally for the softening of dead tissues or the solution of false membranes.

Most digestive enzyme preparations used in medicine are obtained from the digestive glands.

The *peptic enzymes* digest proteins and curdle milk under appropriate conditions. They are used frequently to coagulate milk in the preparations of junket, whey, etc. They are also used to favor the digestion of proteins in the stomach. For this purpose they act efficiently only in the presence of hydrochloric or other suitable acids.

The *tryptic enzymes* are commonly prepared from pancreatic tissue. Dried pancreas and pancreatic extracts are generally supposed to contain all the enzymes characteristic of the gland. They are extremely uncertain in their activity, however. The starch-digesting action (amylopsin or diastase content) is generally the most satisfactory, although it varies greatly. The protein digestion (trypsin content) is so slight, with many samples, as to be practically negligible and the fat-digesting lipase or steapsin, because of its instability, is practically absent from all. Most pancreatic preparations are very unstable, even when undiluted; and after dilution, they often deteriorate within a day. The so-called isolated ferments are more or less purified extracts.

Trypsin acts in a slightly alkaline medium on proteins converting them into peptones and polypeptids, and carries the cleavage to the point where these are split down into the amino acids. It acts best at a temperature of about 40° C. and in a feebly alkaline medium not exceeding a strength of 1 per cent of sodium bicarbonate. Under ordinary conditions trypsin is largely destroyed in the stomach and there is very little reason to expect any action from it in the intestines when it is given by the mouth.

Trypsin has been applied locally for the solution of diphtheric and other false membranes.

In aqueous solution, the enzyme is uncertain in action and aqueous solutions for assay or for any application of the enzymes are to be prepared only at the moment required. It should not be kept for any length of time in any solution of an alkaline or acid reaction or it will become inactive. It is readily soluble in alcohol of from 25 to 50 per cent strength, and in such menstruum is relatively stable. It is most stable in 50 per cent glycerin solution.

Trypsin in any menstruum in which this enzyme is stable, exerts (in vitro) a destructive influence on other enzymes, whether those normally associated with trypsin—amylopsin, for instance—or placed in contact with it in solution, as, for instance, pepsin.

Determination of Tryptic Value by the Fuld-Gross method, which is more definite than the U. S. P. assay and is easily carried out:

It depends on the digestion of a sodium caseinate solution to the point at which it no longer gives a precipitate with dilute acetic acid. A casein solution of 0.2 per cent strength is prepared by dissolving 100 mgm. of pure casein in 2 cc. of twentieth-normal sodium hydroxide, by aid of very gentle heat and diluting to 50 cc. A dilute acid is prepared with 50 cc. of alcohol, 45 cc. of water and 5 cc. of glacial acetic acid.

The trypsin solution is made by dissolving in the proportion of 20 mgm. to 50 cc. of water.

Six portions of the casein solution of 5 cc. each containing 10 mgm. of casein, are measured out, and diminishing portions of the trypsin solution are transferred to test tubes, but always made up to 5 cc. For the milligram of casein, the weights of trypsin may be taken as follows: 2 mgm., 1.3 mgm., 0.8 mgm., 0.5 mgm., 0.3 mgm., and 0.1 mgm. The series of test tubes containing casein and trypsin, so charged, are incubated one hour at 40° C. and then withdrawn from the bath. To each tube, 3 drops of the dilute acetic acid is added. If full digestion has taken place, the acid fails to produce a precipitate. The last tube in which no precipitate is formed gives an approximate measure of the digesting power of the enzyme preparation, which may be sufficient.

A closer result may be obtained by making up a new series of enzyme solutions of just one-tenth the strength of the last. These are to be incubated with the casein solution in the same way, the final test being made as before.

When tested in this manner, 1 part of trypsin should digest at least 75 parts of casein.

As originally suggested, this Fuld-Gross test employed a much weaker casein solution; but there is a distinct advantage in using as much casein as here recommended, and any enzyme of reasonable strength should react with this weight of casein. The weak casein solutions are useful in testing very weak tryptic solutions, in scientific investigations mainly.

Amylopsin, the starch-digesting enzyme of the pancreas, converts starch into maltose and forms a small amount of dextrose. It acts best at a temperature of about 40° C. and in a slightly alkaline medium. It is very sensitive to free acids. Even slight degrees of acidity check the action and destroy the ferment. Enzymes comparable to amylopsin (amylases) are obtained from the salivary glands and from certain molds.

Amylopsin and other amylases are rarely used for the digestion of starch in the preparation of food, because malt diastase is preferable. It is not likely to be of service to secure the digestion of starch in the intestine because it is likely to be destroyed in the stomach.

Determination of Amylolytic Value—(For diastases, malt and pancreas preparations.) The A.M.A. Council on Pharmacy and Chemistry does not endorse the methods which are based on the time of change from blue to red given by iodine, or the time of disappearance of all color, but instead it has adopted as the standard the amount of starch that can be converted to colorless end-point in ten minutes, by a given weight of the product working according to the details described in the *J. A. M. A.* 51: 140 [July 11] 1908, and *Jour. Chem. Soc.* 30: 798, 1908.

Succus Citri et Pepsinum, N. F. IV—*Lime Juice and Pepsin*—Add 400 cc. of glycerite of pepsin to 600 cc. of lime juice and filter the mixture. This preparation should not be dispensed unless it has been recently prepared.

Uses—It is a pleasantly flavored digestant; dose, two fluidrachms (8 cc.).

Elixir of Enzymes, N. N. R.—A solution containing pepsin and rennet in a menstruum containing 15 per cent of alcohol.

Elixirs of enzymes is a light yellow, palatable, liquid preparation. One part digests about 70 parts of coagulated egg albumen in two and one-half hours. Eight cc. (2 fluidrachms) coagulates 500 cc. (1 pint) of milk in a few minutes.

Uses—This elixir is claimed to be useful as an aid to digestion and as a vehicle for various drugs. Dose, from one to two fluidrachms (4 to 8 cc.) with meals; for children in proportion.

Manufactured by Armour and Company.

Enzymol, N. N. R.—An extract prepared from the fresh animal stomach, said to contain the activated gastric enzyme in association with the soluble constituents with which the pro-enzyme is naturally associated. It is free from alcohol, contains a trace of thymol, and has an acidity due to combined hydrochloric acid equivalent to 0.26 to 0.3 per cent of actual hydrochloric acid. It is adjusted to a definite proteolytic power by the U. S. P. assay method for pepsin, and contains 25 per cent of glycerin by weight.

Enzymol is a light straw-colored fluid.

Uses—Enzymol is said to be useful as an application to old sores, ulcers and slow-healing wounds. It is said to correct offensive odors, to exert a solvent action on pus and sloughing and necrotic tissue, and to impart a healing stimulus. It is said to have been effective in cases which have long remained unhealed and have resisted treatment. Dose: It is made ready for use by the addition of from one-half to one or two volumes of water; for the solution of necrotic and carious bone, and in some large abscess cavities, it is advised

that the preparation be diluted with two volumes of 0.2 per cent solution of hydrochloric acid. A small vial, containing diluted hydrochloric acid and a pipette, for measuring, accompany the package of enzymol.

Manufactured by Fairchild Bros. and Foster.

Essence of Pepsin-Fairchild, N. N. R.—An aromatized, faintly acid liquid obtained by direct extractions from the pig stomach glands, and from the lining membrane of the calf stomach, and containing the entire soluble constituents of the fresh stomach glands—the proteolytic and milk-curdling enzymes, coagulable nucleoproteids, organic and inorganic extractives—and 18.5 per cent alcohol.

Uses—Essence of pepsin-Fairchild is claimed by the manufacturers to be of value in disorders of stomach digestion, as a vehicle for the administration of drugs, and in the preparation of whey and other milk food for the infant and invalid. Dose, one fluidrachm (4 cc.) or more.

Manufactured by Fairchild Bros. and Foster.

Gastron, N. N. R.—A solution of the gastric tissue juice obtained by direct extraction from the mucosa of the fresh stomach of the pig and containing the activated principles of the gastric cells, the enzymes and the associated organic and inorganic constituents in an acid, aromatized menstruum containing 25 per cent glycerin by weight. It has an acidity corresponding approximately to 0.25 per cent absolute hydrochloric acid, and 1 cc. dissolves 200 Gm. coagulated egg albumen under standard conditions.

Gastron is a viscid, slightly opaque, straw-colored fluid. Heat and strong alcohol cause coagulation of gastron.

Uses—Gastron is claimed to exhibit the characteristic enzyme properties of gastric secretion. It is designed to present in stable form a complete gastric gland extract for use in disorders of gastric functions Dose, from one to two fluidrachms (4 to 8 cc.) diluted with a little cold water or with acidulated water. It may be administered before, in divided doses during, or after meals.

Manufactured by Fairchild Bros. and Foster.

Trypsin, N. N. R.—The proteolytic enzyme of the pancreas, separated to a considerable extent from the other constituents of the gland.

Uses—See discussion of tryptic enzymes in preceding general article, Digestive Enzymes.

Trypsin-Armour—It is stated that Trypsin-Armour is standardized so that 1 part digests at least 100 parts of casein according to the Fuld-Gross method. Trypsin-Armour is prepared from the fresh pancreas of hogs with the view of retaining the proteolytic ferment in an especially active condition. It has been activated by enterokinase.

It is a light yellow powder, possessing a faint odor, and a meat-like taste. It is not completely soluble in water at once, but dissolves almost entirely in time. Dose: Trypsin-Armour is applied locally by means of a brush or as a spray. About 6 grains (0.4 Gm.) is mixed with 2 grains (0.125 Gm.) sodium bicarbonate and triturated in a mortar while 1 or 2 drachms of distilled water is added. The mixture is then warmed to from 38° to 40.6° C. and applied immediately. The application may be repeated several times an hour if necessary, a fresh solution being made before each application. The internal dose is two grains (0.125 Gm.), or more, three times daily. It should not be used for hypodermic injection.

Manufactured by Armour and Company.

Trypsin-Fairchild—When tested by the Fuld-Gross method it is said that trypsin-Fairchild converts 200 times its weight of casein to the standard end-point. Trypsin-Fairchild, is a fine dry powder, in which form the enzyme is permanent when protected from moisture. It is slowly but not completely soluble in water.

Trypsin-Fairchild has from four to five times the strength of pancreatin-U. S. P. The tryptic power of Fairchild's trypsin by the method proposed by Sir William Roberts is 10,000 units. Dose: Trypsin-Fairchild may be given in doses of 1 grain (equal to from 4 to 5 grains pancreatin-U. S. P.) and upward, best in a capsule with some diluent as milk sugar, and if indicated, with sodium bicarbonate. It is locally applied in solution or after trituration of the trypsin with some appropriate diffusible powder.

Manufactured by Fairchild Bros. and Foster.

Diazyme Essence, N. N. R.—A liquid said to contain the amylolytic enzyme of the pancreas, devoid of trypsin and lipase in a menstruum containing 18.5 per cent of alcohol by volume.

Diazyme essence is an amber fluid of aromatic taste and odor and slightly acid reaction.

One cubic centimeter will convert 125 Gm. of pure starch mucilage, containing 5 Gm. of dry starch, the mixture being kept at 40° C., so that the solution will cease to give a color reaction with iodine at the end of ten minutes.

Uses—Diazyme is capable of digesting starch and is claimed to be useful in compensating deficient salivary and pancreatic action in the digestion of starch. Dose, from one to two fluidrachms (4 to 8 cc.).

Manufactured by Fairchild Bros. and Foster.

Diazyme Glycerole, N. N. R.—A liquid said to contain the amylolytic enzyme of the pancreas, devoid of trypsin and lipase, in a menstruum containing about 60 per cent of glycerin by volume.

Diazyme glycerole is a dense, amber fluid, of agreeable taste and odor, and of slightly acid reaction.

At 40° C., 1 cc. will convert 125 Gm. of pure starch mucilage containing 5 Gm. of dry starch, so that the solution will cease to give a color reaction with iodine in ten minutes.

Uses and Dose—The same as those of diazyme essence.

Manufactured by Fairchild Bros. and Foster.

Holadin, N. N. R.—*Extractum Pancreaticum Integrum*—An extract of the entire pancreas containing all the constituents of the gland and exhibiting great potency in respect to the several known enzymes trypsin, amylopsin, lipase and the milk-curdling ferment.

Holadin is a grayish-white powder, slightly aromatized, somewhat hygroscopic, freely but not wholly soluble in water.

Uses—Holadin has power to digest starch and protein and to split fats. It is claimed to be useful in various diseases in which digestion of food is imperfect. Dose, from three to nine grains (0.2 to 0.6 Gm.), three hours after meals and at bedtime.

Manufactured by Fairchild Bros. and Foster.

Panase, N. N. R.—A combination of the digestive enzymes of the pancreas derived from the pancreatic gland of the pig.

Panase is a light, yellowish-white powder having a slight odor and somewhat mucilaginous taste. It is not entirely soluble in water or glycerin, owing to the small amount of protein present. Filtration of its solution, however, does not impair its digestive activity.

Uses—Panase is intended to be used in cases in which it is believed that the enzymes of the pancreas are deficient or in which it is desired to hasten the digestion of starch. Dose, two grains (0.13 Gm.) or more.

It is incompatible with strong alcohol, acids, alkalies and other substances which destroy the activity of enzymes.

Manufactured by Frederick Stearns and Company.

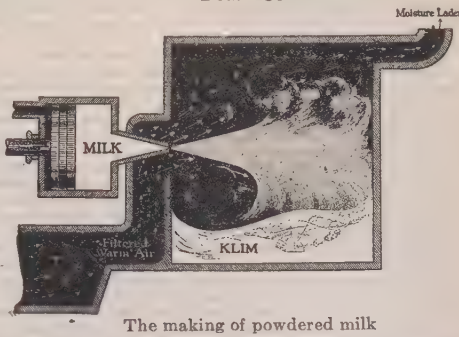
LAC VACCINUM. N. F. Cow's Milk

The fresh unpasteurized milk of the domestic cow, *Bos taurus* Linné (Fam. *Bovidæ*), without modification, and complying with the legal standards of the State or community in which it is sold.

N. F. Preparation—Lac Fermentatum.

Uses—Milk is recognized by the N. F. solely for the preparation of fermented milk (see page 1182). Milk is marketed and sold in most states under rigid regulations concerning the health of the cows, the transportation conditions for the milk, and the amounts of fat and total solids. The minimum butter fat content of milk as regulated by law in most communities is 3.25 per cent, and the minimum content of total solids is 11.50 per cent. Preservatives and coloring matters are prohibited in milk by all food laws. It is also largely sold in cans as *condensed milk*, a product obtained by evaporating whole milk or partially skimmed milk in vacuum and preserving it with cane sugar, and also as *evaporated milk*, obtained by evaporating whole milk without adding sugar and preserving it by sterilization. Another commercial form is known as *desiccated milk* or *milk powder*. In preparing powdered milk the original milk is put into a cylinder and forced out through tiny orifices by great pressure, so that it comes out in the form of a cloud or mist, just exactly as from a huge atomizer. This milk spray enters a chamber or room through which are blowing strong currents of filtered warm air. The milk mist is whirled about the chamber just as the wind blows clouds of snow or fog.

FIG. 439



The making of powdered milk

This warm air immediately absorbs the moisture in the milk and the solid portion falls like snow in drifts of powdered milk. This moisture-laden air passes out through muslin screens which prevent any of the powdered milk from escaping. Fig. 439 illustrates the process. One of the extensively used powdered milks is sold under the trade name "Klim". It is largely used by bakers and confectioners and in the manufacture of ice cream, and is an excellent emulsifying agent for cod liver oil.

Unofficial Lactic Acid-Producing Organisms and Preparations

The following abstract, taken from the 1925 N. N. R., is a valuable review of the therapeutics and of the products developed about the use of lactic acid-producing organisms:

Milk soured by acid-producing organisms more or less common to ordinary commercial milk, or by certain types or species intentionally added with or without the association of alcohol-producing yeast (*kefir, kumyss*), has been used as a food for centuries. This practice is due to the fact that the products are palatable to many, or to the belief among the laity, as well as physicians, that they are beneficial in the correction of certain disorders of the gastro-intestinal tract. The theories of Metchnikoff gave a great stimulus to the employment of fermented milks. His theories of "intestinal putrefaction" were in part that the products of putrefaction, occurring chiefly in the large intestine, were absorbed and that their action on the walls of the blood vessels produced arteriosclerosis and premature senility. He also advanced the theory that the growth of proteolytic bacteria which elaborated these poisons could be modified or prevented by the implantation in the intestine of lactic acid-producing bacteria such as *Bacillus bulgaricus*.

During recent years, reports have been published which indicate that the growth in the intestinal canal of the normally present *Bacillus acidophilus* may be increased so as to make it the predominating organism, by the administration of lactose (sugar of milk), by milk, inoculated and fermented with *Bacillus acidophilus*, or by the administration of viable cultures of *Bacillus acidophilus* in conjunction with lactose. Because of these reports, *Bacillus acidophilus* products have come into use in this country. While no one subscribes seriously today to the original theories of Metchnikoff, there are many who believe that the regulation of types of bacteria and of bacterial activities in the intestine is of much importance. Since *Bacillus acidophilus* and its very close neighbor, *Bacillus bifidus* are common and, as a rule, the predominating types in the intestines of breast-fed infants and furthermore, since extensive experiments have been made which show these organisms to be of a strictly non-putrefactive and apparently harmless nature, many give added weight to the claims made for their therapeutic value.

There is evidence that the administration of sour milk is at times beneficial, particularly in pediatrics, in which field fermented milks have found a wide application. Sour milk and sour milk products are used in vomiting, and in acute diarrhea as well as in chronic disturbances of the gastro-intestinal tract. It is not known at present why sour milks are of value, but a wide clinical observation gives a basis for the opinion that, for certain types of gastric and intestinal disturbances, fermented milk accomplishes more than sweet milk with a similar fat, sugar and protein content. No one, of course, will deny the great value of milk, whether sweet or soured by the so-called "lactic acid-producing bacteria", as a growth-promoting and energy yielding food.

Recent observations seem to indicate that *Bacillus bulgaricus* cannot be implanted or made to proliferate in the intestine even when administered in large numbers. Much doubt is cast, therefore, on any alleged physiologic action of this organism in the intestine. For this reason, and because *Bacillus acidophilus*,

according to reports, can be successfully implanted, the preference is now given by many to lactic acid bacillus cultures prepared with *Bacillus acidophilus*.

There is little, if indeed any, satisfactory proof that liquid cultures or aqueous suspensions of lactic acid-producing organisms are of real value as local applications of mucous membranes or in arresting putrefaction or suppuration in wounds, abscesses and sinuses. In such conditions, their use appears to be still in the experimental stage.

Sour milk has generally been administered in the form of buttermilk (artificially or naturally soured with *Streptococcus lacticus* predominating) or milk soured with lactic acid-producing organisms such as *Streptococcus lacticus* or *Bacillus bulgaricus* or fermented milks (kefir, kumyss).

To these may now be added the so-called *Bacillus acidophilus* milk which is prepared by the inoculation of milk which has been previously sterilized or heated for about an hour, at or near boiling temperature, with a pure starter made by inoculating pressure-sterilized milk with viable *B. acidophilus* and incubating at from 35° to 37° C. for from twenty to twenty-four hours. On the completion of proper ripening, which should take place within from twenty to twenty-four hours at from 35° to 37° C., a product is obtained which is slightly sour to the taste and has a characteristic odor not very unlike ordinary pure buttermilk. There is a slight separation of whey, but, on thoroughly mixing, the product has a uniform creamy consistency. *Bacillus acidophilus* milk is produced in various laboratories and dairies, though in many instances with partial success only. It may be made from fresh skim milk, whole milk, or from skim milk to which varying amounts of cream have been added. In all milk culture work, mass inoculation with the use of a sterile pipette is necessary. The preparation of uniform, pure Bacillus acidophilus milk requires adequate facilities, the aid of a trained technician, and close adherence to instructions.

Bacillus acidophilus and *Bacillus bulgaricus* belong to a group of bacteria, the lactobacillus group, which has not until recently received much scientific attention, but which is widely distributed in nature. Both are long and fairly slender bacilli, which at times have a tendency to filament formation. They are preferably micro-aerophilic, but grow well under ordinary aerobic conditions. They are gram-positive, though in old cultures individual rods or filaments may at times fail to retain the stain. In spite of claims to the contrary branching may be observed only occasionally, the branched forms resembling more or less another organism of this group, *Bacillus bifidus*, which quite commonly reveals branching.

Both organisms require carbohydrates for their successful cultivation. Glucose, galactose and lactose broth are fairly suitable, but much less favorable than milk or milk whey. Milk is a particularly good medium for the preservation of viability. For isolation purposes and for colony study, whey-agar and galactose or lactose-agar may be used to advantage.

Bacillus acidophilus and *Bacillus bulgaricus* have very many points in common. They differ, however, in the following respects: 1. *B. acidophilus* is relatively slow in acid production in milk, the amount of acid produced during twenty-four hours' incubation, rarely exceeding 1 per cent, whereas milk cultures of *B. bulgaricus* may attain an acidity of 3 per cent in the same period of time. 2. Except in the case of so-called border strains, *B. acidophilus* attacks maltose with acid production, while *B. bulgaricus* is unable to do so. 3. *B. acidophilus* is of intestinal origin, and, therefore, can adapt itself to intestinal conditions. Whereas *B. bulgaricus* is an ordinary saprophyte and is unable to develop or even to maintain itself in the digestive tract.

The group of lactobacilli is probably one large group which consists of many varieties in the same way as the *B. coli* and the streptococcus groups. Certain members of the lactobacillus group (acidophilus and bifidus types) are found in the feces of man and animals. Others (bulgaricus type) are very common in cow barns and in dairies, and in various dairy products. The well-known *Bacillus bulgaricus* is the predominating organism in the oriental sour milk products and it is to this type of the lactobacillus group that these products in a large measure owe their characteristic properties. All cultures of *B. acidophilus* and *B. bulgaricus* deteriorate with age, and, therefore, should be used soon after they are prepared. While viability appears to be preserved best in milk cultures, even these should have a brief expiration limit, and should be kept at relatively low temperature. Experience has shown that *B. bulgaricus* and *B. acidophilus* are short-lived in so-called tablets and powders. Bacteriologic examination of such powders and tablets and of various broth cultures, has often shown them to contain, at the most, but few living aciduric organisms. All lactic-acid ferment preparations should be kept at or near ice-chest temperature and marked with an expiration date.

Bacillus Acidophilus Milk-Lederle, N. N. R.—Whole milk cultured with *Bacillus acidophilus*. It contains not less than fifty million of viable organisms (*B. acidophilus*) per cubic centimeter.

Whole milk is sterilized at 100° C. for 2 hours, cooled at 37° C. and inoculated with a twenty-four hour culture of *B. acidophilus*. After inoculation, the milk is kept at 37° C. for from 20 to 24 hours, until an acidity is reached so that 10 cc. will require for neutralization 11 cc. of tenth-normal sodium hydroxide using phenolphthalein T.S. as indicator. The product is then cooled to 5° C., agitated until homogeneous and transferred to 200 cc. bottles, which are closed with seals. The strain of *B. acidophilus* used is one isolated by Rettger. To insure its adaptability to intestinal implantation, the bacillus is freshly isolated from intestinal contents as frequently as is necessary.

Uses—During recent years reports have been published which indicate that the growth in the intestinal canal of the normally present *Bacillus acidophilus* may be increased so as to make it the predominating organism by the administration of milk inoculated with *B. acidophilus* by the administration of viable cultures of the *Bacillus acidophilus* in conjunction with lactose, or by the administration of lactose alone. The therapeutic value of the administration of cultures of *B. acidophilus* is still in the experimental stage. Dose, for adults, 1000 cc. of bacillus acidophilus milk-Lederle per day increased or decreased to meet requirements. When employed in infant feeding, it may be diluted with boiled water. It must be kept in a cool place and should be used prior to the date stamped on the package.

Manufactured by Lederle Antitoxin Laboratories.

Bacillus Bulgaricus-Squibb, N. N. R.—A pure culture of *Bacillus bulgaricus*, marketed in twelve tubes each containing 12 cc. The culture is grown on whey.

Uses—See preceding general article. Dose, the contents of from one to three tubes daily, one-half hour after meals or before retiring. These tubes should be kept in a cold place and are not guaranteed beyond the date stamped on the package.

Manufactured by E. R. Squibb and Sons.

B. B. Culture, N. N. R.—A pure culture of *Bacillus bulgaricus*, marketed in bottles, containing about 90 cc. (3 fluidounces).

Uses—B. B. culture is adapted both for internal and external use. Dose, from one to two fluidrachms (4 to 8 cc.) three times a day in sweetened water before meals. For babies of any age, 1 teaspoonful every three hours. The date of issue and of expiration is stated on each bottle.

Manufactured by the B. B. Culture Laboratory, Inc.

Bulgara Tablets-H. W. & D, N. N. R.—Tablets containing a practically pure culture of *Bacillus bulgaricus*.

Bulgara tablets consist of the slowly dried cultures mixed with milk sugar and starch, each tablet weighing 5 grains (0.3 gm.) and containing a sufficient number of viable organisms to effect the souring of a pint of sterile milk in less than twenty hours.

Uses—See preceding general article. Dose, one or two tablets before or after meals. The diet should contain a sufficiency of sugar.

Bulgara tablets are marketed in tubes, each containing fifty tablets, with an expiration date stamped on the label.

Manufactured by Hynson, Westcott and Dunning.

Bulgarian Bacillus Liquid-Mulford, N. N. R.—A pure culture in tubes of *Bacillus bulgaricus*.

Uses—See preceding general article. Dose, one tube of the culture in three tablespoonfuls of water, containing a lump of sugar, or in a half or a full glass of milk. This dose should be repeated morning and evening after meals. The culture is marketed in packages of twenty tubes. The tubes must be kept in a cold place and should not be used after the date stamped on the package.

Manufactured by the H. K. Mulford Company.

Bulgarian Bacillus Tablets-Mulford, N. N. R.—Tablets containing a practically pure culture of *Bacillus bulgaricus*.

A culture of *Bacillus bulgaricus* grown on whey is mixed with starch, sugar and milk sugar, dried and compressed into tablets.

Uses—See preceding general article. Dose, for adults and children, one or two tablets after meals and at bedtime. For infants, 1 or 2 tablets with each feeding. An expiration date is stamped on the label.

Manufactured by the H. K. Mulford Company.

Cheplin's B. Acidophilus Milk, N. N. R.—A milk culture of *Bacillus acidophilus*. It contains not less than fifty million of viable organisms (*B. acidophilus*) per cubic centimeter at the time of sale.

Uses—See preceding general article. Dose, for adults, from 500 to 1000 cc. increased or decreased to meet individual requirements. When employed in infant feeding, it may be diluted with water which has been boiled and cooled, or with lime water in such proportions as the case may demand but it should be borne in mind that the product is made from skimmed milk and does not contain the growth promoting factor of milk fat; lactose (sugar of milk) should be added to restore the normal sugar content. Cheplin's *B. acidophilus* milk is marketed in bottles containing 400 cc. It must be kept on ice and should be consumed within the period of time stamped on the package (three weeks from date of preparation).

Manufactured by Cheplin Biological Laboratories, Inc.

Fresh skimmed cow's milk, standardized with 40 per cent. cream so that its final fat content in not less than one-half of 1 per cent is sterilized in one heating at 120° C. for 15 minutes. After cooling to at least 37° C., the milk is inoculated with a twenty-four hour culture of pure strains of *B. acidophilus* which have been grown by repeated transfers, sufficiently long in milk to develop rapidly and bring about proper coagulation of the casein. Viable milk cultures of the organisms are employed as the inoculum. After inoculation the milk is kept at 37° C. for from 20 to 24 hours until an acidity is reached so that 10 cubic centimeters will require for neutralization 10 cubic centimeters of tenth-normal sodium hydroxide solution, using phenolphthalein as indicator. The product is then agitated until completely homogeneous, transferred to 400 cc. bottles, which are closed with seals and cooled to 5° C. The strains of *B. acidophilus* used are isolated by Cheplin. To insure maximum therapeutic effects and colonization within the human alimentary canal, the organism is freshly isolated from human intestinal contents as frequently as is found necessary through actual feeding experiments.

Culture Bacillus Acidophilus-Medical Laboratories, Inc., N. N. R.—A broth culture of bacillus acidophilus in bottles containing about 120 cc. It contains from 250 to 500 million of viable organisms (*B. acidophilus*) per cubic centimeter at the time of sale.

Uses—See preceding article. Dose, from one to four fluidrachms (4 to 16 cc.) before meals. Each bottle bears an expiration date.

Manufactured by the Medical Laboratories Inc.

Culture of Bacillus Bulgaricus-Coleman, N. N. R.—A pure culture of *Bacillus bulgaricus* marketed in bottles, each bottle containing about 90 cc.

The culture is grown on a medium composed of whey broth containing dextrose.

Uses—This culture is stated to be suitable for all purposes for which *Bacillus bulgaricus* is used. See preceding general article. Dose, from four to twelve cc. in sweetened water or milk half an hour after meals. The culture must be kept in a cold place and should not be used after the time stamped on the bottle.

Manufactured by The Coleman Laboratories.

Culture of Bacillus Bulgaricus-Fairchild, N. N. R.—A pure culture in vials of *Bacillus bulgaricus*, each vial containing about 7 cc.

The bacilli are obtained by inoculation and incubation on Cohendy peptone-sugar-broth medium.

Uses—See preceding general article. Dose, internally, the contents of one vial is the usual daily dosage. The vials must be kept in a cold place and are not guaranteed beyond the date stamped on the package.

Manufactured by Fairchild Bros. and Foster.

Culture of the Bacillus Bulgaricus Lederle, N. N. R.—A pure culture of *Bacillus bulgaricus* in vials containing about 5 cc. each.

The culture is grown on one of the following mediums: calcium carbonate lactose broth, calcium carbonate dextrose broth, calcium carbonate Cohendy broth, or Cohendy broth.

The material for one of the above mentioned broths is sterilized for thirty minutes on three successive days and then placed in the incubator for at least forty-eight hours to determine its sterility before using. The material is then put into large flasks, inoculated from test tube cultures of the bacillus and incubated at 37° C. for from twenty-four to ninety-six hours. It is then tested to see that it is free from contaminating organisms.

The preparation is light yellow and has the odor and taste of the particular medium employed as its base.

Uses—See preceding general article. Dose, three or more vials daily. The culture must be kept in a cold place and should be used prior to the date stamped on the package.

Manufactured by Lederle Antitoxin Laboratories.

Galactenzyme Bouillon, N. N. R.—Suspension of Bacillus Bulgaricus-Abbott.—A pure culture in vials of *Bacillus bulgaricus* (Type A), each vial containing about 6 cc.

Cultures of a pure and virile strain of *Bacillus bulgaricus* (Type A) are grown in a specially prepared bouillon.

Uses—Galactenzyme bouillon is designed for internal administration in the treatment of intestinal fermentative diseases with the design of obtaining the growth of the bacilli in sufficient numbers in the alimentary tract to secure their characteristic action against putrefactive fermentation. It is also used for topical applications in nasal, aural, throat, urethral and other affections when the use of such a culture is indicated. Dose, the contents of one vial in a little sweetened water or milk, once or twice daily, perferably on an empty stomach. A small quantity of carbohydrate food should be included in the dietary.

It must be kept in a cold place and is not guaranteed beyond one year from the date stamped on the label.

Manufactured by The Abbott Laboratories.

Galactenzyme Tablets, N. N. R.—Tablets Bacillus Bulgaricus-Abbott—Tablets containing a practically pure culture of *Bacillus bulgaricus* (Type A).

Cultures of a pure and virile strain of *Bacillus bulgaricus* (Type A) are grown on sterilized milk. This milk culture of the organism is mixed with purified milk sugar. The mixture is dried in a stream of sterile, filtered air, at low temperature and the dried product compressed into tablets under aseptic conditions.

Uses—The same as for galactenzyme bouillon (see above). Dose, one, two or three tablets, three times a day, with meals. The diet should be regulated to meet the condition which may be present.

The tablets must be kept in a cold place and are not guaranteed beyond one year from the date stamped on the label.

Manufactured by The Abbott Laboratories.

Kefir Fungi, N. N. R.—A mixture of bacteria and yeasts capable of causing lactic acid fermentation of milk.

Kefir occurs in the form of white irregular, slightly round bodies, the size of a walnut with a very rough, furrowed surface, and of a tough gelatinous consistency. The substance contains *Sacchraromyces cerevisiæ* (Heyden), *Bacillus acidi-lactici* (Hueppe), *Dispora caucasico* (Kern). It acts on milk as follows: Fat, salt and water of the milk remain unaffected. The lactose is gradually decreased and the lactic acid increased. Alcohol is produced along with carbon dioxide; 10 per cent of the casein is converted into acid albumin and peptones, 10 per cent into hemialbumose and the rest loses its lime.

Uses—See preceding general article. Dose: Kefir kumyss may be prepared by adding active kefir grains to fresh cows' milk, kept at a temperature of from 21° to 27° C. until the effect of fermentation becomes apparent by the rising of the grains to the surface. The grains may then be strained off, and the milk, which then contains sufficient yeast cells to insure continuance of the fermentation, left to itself in well corked bottles.

Lactampoule, N. N. R.—A pure culture in ampuls of the *Bacillus bulgaricus*, each ampul containing about 12 cc.

The bacilli are obtained by the usual bacteriologic method, the growth of the bacilli on modified Cohendy peptone-sugar-broth medium.

Uses—See preceding general article. The ampuls must be kept in a cold place, and are not guaranteed beyond the date stamped on the package.

Manufactured by Fairchild Bros. and Foster.

Lactic Bacillary Tablets-Fairchild, N. N. R.—Tablets said to be made from a practically pure culture of *Bacillus bulgaricus*.

The culture of the Bulgarian bacillus is obtained by inoculation and incubation on modified Cohendy peptone-sugar-broth medium. This culture is reduced to a pulverulent form by the addition of sterile lactose, desiccated and compressed. The tablet is friable and contains an abundance of the true Bulgarian lactic acid bacterium.

Uses—See preceding general article. Dose, one or two tablets before or after meals. The tablets should be kept in a cold place and should not be used after the date given on the label.

Manufactured by Fairchild Bros. and Foster.

Vitalait Culture Bacillus Acidophilus, N. N. R.—A pure culture of *Bacillus acidophilus* in vials, each containing about 7 cc. It contains not less than three hundred million of viable organisms (*B. acidophilus*) per cubic centimeter at the time of sale.

Uses—See preceding article. Dose, the contents of one vial diluted with water, and followed by a quantity of sugar of milk is the usual daily dose. Each vial bears an expiration date.

Manufactured by The Vitalait Laboratory.

Vitalait Culture Bacillus Bulgaricus, N. N. R.—A pure culture of *Bacillus bulgaricus* marketed in vials.

The culture is grown in sterile skimmed milk, its incubation period being twenty-two hours. The average bacterial count of the finished culture is stated to be 200 million per cubic centimeter.

Uses—Condensed vitalait is designed for internal administration. See preceding general article. Dose, the contents of one vial in water or milk just before retiring is the usual daily dose. Each vial bears an expiration date.

Manufactured by The Vitalait Laboratory.

Vitalait Starter, N. N. R.—A culture in vials of *Bacillus bulgaricus* and *Streptococcus acidi-lactici* in symbiosis.

Bacillus bulgaricus and *Streptococcus acidi-lactici* are grown in skimmed milk without the addition of any chemical, and the culture sent out represents these organisms growing in this medium.

Uses—Vitalait starter is intended for the home preparation of fermented milk. Dose: The vitalait starter (sufficient to prepare from 1 to 3 quarts [1.1 to 3.4 liters] of fermented milk) is sent on request of the physician to the patient twice a week, with directions for the preparation of the fermented milk. Vitalait starter is sent within three hours of the time incubation is complete and must be used within five days from the date of mailing stamped on the label.

Manufactured by The Vitalait Laboratory.

LACTOSUM. U. S. Lactose

The description and tests for Milk Sugar will be found under the sugars on page 898.

LAC FERMENTATUM. N. F. Fermented Milk

[**Lac. Ferment.**—KUMYSS]

	Metric	Alternative
Cow's Milk (not pasteurized)	**1000 cc.**	**2 pints**
Compressed Yeast	**3 Gm.**	**44 gr.**
Sucrose	**35 Gm.**	**1 oz. av. 74 gr.**

Dissolve the sucrose in the milk, contained in a strong bottle, add the yeast, close the bottle securely and keep it at a temperature between 23° and 32° C. for six hours; then transfer it to a cool place, preferably a refrigerator.

The N. F. Fermented Milk is not similar in chemical composition or in properties to genuine Kumyss or similar lactic fermentation products as it is a preparation in which

sucrose is caused to undergo alcoholic fermentation by yeast. A discussion of the lactic acid producing organisms and preparations of these will be found under the unofficial products (see page 1179). Dose, eight fluidounces (250 cc.).

ACIDUM LACTICUM. U.S. Lactic Acid

[Acid. Lact.]

A mixture of lactic acid and lactic anhydrides equivalent to a total of not less than 85 per cent and not more than 90 per cent of $CH_3.CHOH.COOH$.

Preparation—Lactic acid may be made from sour milk, cheese, meat juice, and from some vegetable sources. Formerly it was obtained from cheese, and owing to its frequent occurrence in the decomposition of animal products it is considered here. It is now most conveniently prepared by treating cane sugar with sulphuric acid, so as to convert it into invert sugar, then adding solution of caustic soda and heating the mixture until it is transformed to such an extent that it no longer affects Fehling's solution, showing the absence of sugar. Sulphuric acid is added, and the sodium sulphate formed is crystallized out, an addition of alcohol causing the precipitation of the remainder. The alcoholic liquid contains impure lactic acid; one-half of it is heated and zinc carbonate added until effervescence ceases; the other half of the alcoholic liquid is now added and the whole allowed to cool. Zinc lactate crystallizes out; this, by treatment with hydrogen sulphide, yields zinc sulphide, lactic acid remaining in solution.

Description and Physical Properties—A colorless, or slightly yellow, nearly odorless, syrupy liquid. It absorbs moisture on exposure to air.

Lactic Acid is miscible with water, alcohol, and ether, but is insoluble in chloroform, petroleum benzin, and carbon disulphide.

Specific gravity: about 1.206 at 25° C.

Lactic Acid cannot be distilled without decomposition.

Tests for Identity—Lactic Acid is strongly acid to litmus paper and responds to the reactions for lactates, page 1183.

Tests for Purity—Ash: not more than 0.006 Gm. from 5 cc. of the Acid.

Ten cc. portions of an aqueous dilution of the acid (1 in 100) remain unaffected by the addition of 1 cc. of silver nitrate T.S. (*chloride*), or 1 cc. of barium chloride T.S. (*sulphate*).

The addition of 1 cc. of copper sulphate T.S. to 10 cc. of an aqueous dilution of the acid (1 in 20) causes no turbidity (*sarcolactic acid*).

No turbidity is produced on heating the Acid with an excess of calcium hydroxide T.S. (*citric, oxalic, phosphoric, or tartaric acid*).

Add a few drops of Lactic Acid to 10 cc. of hot alkaline cupric tartrate V.S.: no red precipitate is produced (*sugars*).

Carefully superimpose 5 cc. of Lactic Acid upon an equal volume of sulphuric acid in a clean test tube and keep the temperature at 15° C.: no dark color develops at the zone of contact of the two liquids upon standing for fifteen minutes (*readily carbonizable substances*).

An aqueous dilution of the Acid meets the requirements of the test for *heavy metals*, page 1519.

Assay—Add 50 cc. of normal sodium hydroxide to about 2.5 cc. of Lactic Acid, accurately weighed in a tared 250 cc. flask, and boil for twenty minutes. Titrate the excess of alkali in the hot solution with normal sulphuric acid, using phenolphthalein T.S. as indicator. Make a blank test, using 50 cc. of half-normal sodium hydroxide, and from the comparisons make any necessary corrections. Each cc. of normal sodium hydroxide corresponds to 0.09006 Gm. of $CH_3.CHOH.COOH$.

Preserve in glass-stoppered bottles.

N. F. Preparations—Elixir Calcii Lactophosphatis; Elixir Glycerophosphatum Compositum; Elixir Pepsini Compositum, Elixir Pepsini et Rennini Compositum; Elixir Terpini Hydratis et Creosoti Compositum; Emulsum Olei Morrhuæ cum Calcii Lactophosphate; Syrupus Calcii Lactophosphatis.

Uses—Lactic acid is chiefly used to form the lactates, which are believed to be more easily assimilated than most salts. It is rarely prescribed alone, but may be given in doses of one-half to three fluidrachms (2 to 12 cc.) largely diluted.

Tests for Lactates

Lactates—Solutions of lactates, when acidulated with sulphuric acid, potassium permanganate T.S. added, and the mixture heated, evolve acetaldehyde which is recognizable by its odor.

FEL BOVIS. U. S. Oxgall

Oxgall is the fresh bile of the ox, *Bos taurus* Linné (Fam. *Bovidæ*).

The bile of man and of several animals contains the sodium salts of conjugated cholic acids in varying proportions; in ox and human biles especially glycocholic acid, $C_{26}H_{43}O_6N$; and taurocholic acid, $C_{26}H_{45}O_7NS$. Fresh oxgall is said to contain about 3 per cent, each of sodium glycocholate and sodium taurocholate; also *lecithin*, *cholesterol*, and minor acids and pigments.

Description and Physical Properties—A brownish-green or dark green, somewhat viscid liquid, having a characteristic odor and a disagreeable, bitter taste.

Tests for Identity—Mix two drops of Oxgall with 10 cc. of water and a drop of a freshly prepared solution of 1 part of sucrose in 4 parts of water, and cautiously add sulphuric acid until the precipitate first formed is redissolved. The mixture gradually acquires a brownish-red color, changing successively to carmine, purple, and violet.

A frothy mixture is produced when Oxgall is shaken with water.

Tests for Purity—Specific gravity: 1.015 to 1.025 at 25° C.

Oxgall is neutral or faintly alkaline to litmus paper.

No assay for Oxgall is official, but the following method was suggested by H. B. Dunning, and is used in the standardizing of commercial oxgall preparations:

Assay for Oxgall—Weigh 5 Gm. of Oxgall into a 50 cc. beaker and mix thoroughly with 20 cc. of a warm, saturated solution of magnesium sulphate, adding only a few drops at first, and allow to stand until entirely separated. Pipette off the lower stratum into a small, single-folded filter, resting in a two-ounce funnel. Treat the residue in the beaker, with three additional 20 cc. portions of the saturated solution of magnesium sulphate, warmed as before, and transfer all washings to the same filter. Place the funnel containing the filter and the beaker containing the residue, in a hot-air oven and dry overnight at a temperature not exceeding 110° C. Then add 20 cc. of dehydrated alcohol, or more if required to produce a thin, clear solution, and triturate carefully until the mass is thoroughly disintegrated and all of the bile salts are dissolved. Transfer the solution and undissolved magnesium sulphate to a dried filter and wash both the contents of the beaker and the filter with dehydrated alcohol, into a tared Erlenmeyer flask, until thoroughly extracted. Concentrate the solution on a water bath to about 10 cc. and, when cool, add 80 cc. of ether. Shake thoroughly, allow to stand until the supernatant liquid is clear (about one hour), and separate it. Mix this with 20 cc. of ether and separate as before. Repeat this once more, then place the flask in a warm air oven until most of the ether is driven off and afterwards dry in a hot air oven at 100° C., for two hours.

The residue should weigh at least 2.5 Gm., equivalent to 50 per cent of bile salts.

U. S. P. Preparation—Extractum Fellis Bovis.

Uses—It is administered with the intention of supplying a deficiency of bile in the intestines, in certain indications. A powdered extract is now official, replacing the formerly official purified oxgall. The dose is five to fifteen grains (0.3 to 1 Gm.).

The bile salts in various forms are more generally used than other preparations. They constitute the main active principles of bile, and therefore share the actions and uses of the latter, perhaps with the advantage of more constant composition. When injected into the circulation, they cause severe nervous and cardiac depression, not observed when they are given by the mouth. They are generally credited with a slight antiseptic and laxative action, with enhancing the efficiency of the resinous hydragogue cathartics and with emulsifying and hence favoring the absorption of fat. They stimulate the secretory activity of the liver, increasing both the fluids and solids of the bile.

They have been used in obstructive jaundice, although the rationale is somewhat doubtful; their use in biliary fistula is more reasonable, if the nutrition is noticeably affected.

Unofficial Bile Salts and Bile-Salt Compounds

Bilein, N. N. R.—Sodii Glyco-Taurocholas Bovis-Abbott—A mixture of the essential salts of the bile.
Uses—See preceding article under Oxgall.
Manufactured by The Abbott Laboratories.

Bile Salts-Fairchild, N. N. R.—A preparation obtained from fresh oxgall, consisting essentially of sodium glycocholate and sodium taurocholate, in the proportion existing in ox-bile.
Uses—See preceding article under *Oxgall*.
Dose, from one-half to two grains (0.03 to 0.13 Gm.).
Manufactured by Fairchild Bros. and Foster.

Glycotauro-H. W. & D., N. N. R.—Bile-Salts-H. W. & D.—Concentrated ox-bile freed from bile pigments, standardized to contain 50 per cent of the natural mixture of sodium glycocholate and sodium taurocholate. Each gram represents approximately 15 cc. of fresh ox-bile.

Glycotauro is prepared by evaporating ox-bile in the presence of animal charcoal, extracting the residue with purified methyl alcohol, filtering, evaporating the filtrate and mixing the residue with glycerin.

Glycotauro is a soft semi-solid mass of light brown color, bile-like odor and slightly bitter taste. It is easily soluble in water and alcohol. Its specific gravity is about 1.22.

Uses—See preceding article under *Oxgall*. It is also prepared in tablets with enteric coating.

Manufactured by Hynson, Westcott and Dunning.

Ovogal, N. N. R.—*Albumen Cholicum*—A combination of bile acids with egg albumin.

Ovogal is a greenish-yellow powder, insoluble in water, dilute acids, ether, benzol, fats, etc. Alcohol and acetone do not dissolve it, but after long action remove from it small amounts of the bile acids. Alkalies dissolve ovogal, splitting it into albumin and bile acids (glycocholic and taurocholic acid).

Uses—Ovogal is said to pass the stomach without marked decomposition and to be dissolved and absorbed in the intestine.

For therapeutic indications see preceding article under *Oxgall*.

Dose, from eight to fifteen grains (0.5 to 1 Gm.), several times daily, in capsules, with water, tea, coffee or fruit juices.

Manufactured by J. D. Riedel Aktiengesellschaft, Berlin, Germany (Riedel and Company).

EXTRACTUM CARNIS. N. F. Extract of Beef

[**Ext. Carnis.**—Beef Extract]

The residue obtained from fresh beef broth by evaporation at a low temperature.

Preparation—The solid extract of beef, which is recognized by the N. F., usually known as the "Liebig type", is made by chopping fresh lean beef, cooking it with boiling water, straining, cooling, and separating fat and gelatin from the liquid. Finally this aqueous extract is evaporated to a soft mass in a vacuum apparatus. The yield from beef is from 2 to 3 per cent, one ounce of the extract representing about two pounds of beef. Beef extract of good quality contains the important nitrogenous bases, *creatine*, *creatinine*, *xanthine*, *sarkine*, and *carnine*, and the N. F. provides a test for the amount of nitrogen obtainable. A cheap grade of beef extract is sometimes made by boiling down the liquor or brine in which corned beef has been "pickled". This may be recognized by the high sodium chloride content, sometimes reaching 20 or 25 per cent, and by the presence of saltpetre.

Official Description—A yellowish-brown to dark brown pasty mass.

Odor, Taste, and Reaction—Agreeable meat-like odor and taste; slightly acid.

Solubility—Twenty-five Gm. of Extract of Beef, diluted to 250 cc. with distilled water, yields a nearly clear solution, free from sediment. Separate portions of this solution respond to the following tests:

Tests for Identity and Purity—*Nitrate*—Boil 10 cc. of the solution for one minute with 1.5 Gm. of purified animal charcoal, add distilled water to replace that lost by evaporation and filter: the filtrate produces no blue coloration when one drop is added to three drops of a solution of diphenylamine (1 in 100) in concentrated sulphuric acid.

Distribute 10 cc. of the solution over dry sand or asbestos and dry to constant weight in a flat-bottomed porcelain dish in an oven at a temperature of 105° C.: it yields a residue of not less than 0.75 Gm. equivalent to 75 per cent of solids in the original extract.

Sodium Chloride—Incinerate the residue from 10 cc. of the solution obtained in the preceding test; the ash does not exceed 30 per cent of the residue, nor does the sodium chloride in the ash exceed 10 per cent of the residue when determined as directed under the assay for chlorides (see page 1514).

To 100 cc. of the solution contained in a 500 cc. Kjeldahl flask, add 5 Gm. of barium carbonate and 100 cc. of distilled water and, using a connecting bulb, distil 100 cc. into 10 cc. of half-normal hydrochloric acid T.S. Titrate the excess of acid, using cochineal T.S. as indicator, and from the acid consumed by the distillate calculate the percentage of nitrogen as ammonia. This does not exceed 0.35 per cent of the total solids.

Transfer 25 cc. of the solution to a 100 cc. Erlenmeyer flask, add 50 cc. of alcohol and shake the mixture thoroughly. When the precipitate has subsided, filter, collect the precipitate upon a 9 cm. counterpoised filter, wash the precipitate three times with a mixture of two volumes of alcohol and one volume of distilled water and then dry it to constant weight at 105° C. The weight of this precipitate does not exceed 10 per cent of the total solids. (Reserve the filtrate and washings for the following determination of nitrogen.)

Nitrogen—To an aliquot portion of the alcoholic filtrate from the preceding test, corresponding to 1 Gm. of the alcohol soluble solids, add 4 cc. of sulphuric acid and evaporate to dryness in a 500 cc. Kjeldahl flask. Determine the nitrogen by the Gunning-Kjeldahl method. The amount of nitrogen thus found is not less than 0.06 Gm.

N. F. Preparation—Elixir Carnis et Ferri.

Uses—It is a stimulant, but has little nutritive value. Used in the N. F. Elixir, which was formerly a "wine", and largely as a food and tonic.

CETACEUM. U. S. Spermaceti

[Cetac.]

A fatty substance obtained from the head of the sperm whale, *Physeter macrocephalus* Linné (Fam. *Physeteridæ*).

Preparation—Spermaceti is obtained by the forcible expression of the oleaginous compound found in the head of the sperm whale to separate the liquid portion which is known as sperm oil, and which is a liquid wax. The solid fat is termed *cetin* and also belongs to the class of waxes.

Spermaceti is a mixture of several proximate constituents of which cetin, or cetyl palmitate ($C_{16}H_{33}OCOC_{15}H_{31}$) predominates. When recrystallized from alcohol, *cetin* is obtained, while the alcohol on evaporation deposits an oil, *cetin elain*, which when saponified yields *cetin elaic acid*, an acid resembling but distinct from, oleic acid.

Description and Physical Properties—White, somewhat translucent, slightly unctuous masses, having a crystalline fracture, and a pearly luster. It has a very faint odor and a bland, mild taste. It is free from rancidity.

Spermaceti is insoluble in water, nearly insoluble in cold alcohol, and only slightly soluble in cold petroleum benzin. It is soluble in boiling alcohol, ether, chloroform, carbon disulphide, and in fixed or volatile oils.

Tests for Purity—Specific gravity: 0.938 to 0.944 at 25° C., as determined by the method given under *Cera Flava*, using alcohol warmed to from 38° to 40° C.

Spermaceti melts between 42° and 50° C.

It dissolves completely in fifty parts of boiling alcohol (*paraffin*), and the solution is neutral or not more than slightly acid to moistened litmus paper.

Warm a mixture of about 1 Gm. of Spermaceti and 10 cc. of ammonia T.S. in a stoppered vessel until the Spermaceti is melted, shake it thoroughly for a few minutes, cool and filter; on acidulating this filtrate with hydrochloric acid, it may become turbid, but yields no precipitate (*stearic acid*).

U. S. P. Preparation—Unguentum Aquæ Rosæ.

History—Spermaceti in the time of Shakespeare and previously was called "*parmcety*" and was largely used internally as well as in ointments and cerates. There was considerable mystery as to its real origin for many centuries. It was believed by some to be the sperm, by others to be the marrow and by still others to be the brain substance of the whale. Some believed it to be a solidified form of the froth of foam of the sea.

Uses—Spermaceti is one of the solid fatty substances employed to give consistency to cerates and ointments, as in the well-known ointment of rose water.

Official Products of the Fam. Phasianidæ

OVUM GALLINACEUM. N. F. Fresh Egg

[Ovum Gallin.]

The recently laid egg of the hen, *Gallus domesticus* Temminck (Fam. *Phasianidæ*).

The characteristics by which the freshness of an egg may be determined are the specific gravity which is usually about 1.07 and should not be less than 1.05, the coherence and firmness of the yolk, the absence of wateriness in the white and the character of the chalaza, that invisible membrane which gives coherence to the white.

N. F. Preparation—Linimentum Terebinthinæ Aceticum.

OVI ALBUMEN RECENS. N. F. Fresh Egg Albumen

[Ovi Album.]

The freshly separated liquid white, or albumen, of recently laid egg of the hen, *Gallus domesticus* Temminck (Fam. *Phasianidæ*).

It is composed of about 85 per cent of water, the remainder being solid matter, chiefly a proteid compound with minute amounts of fat, sugar, and inorganic salts. It is precipitated

by most acids (phosphoric and acetic being exceptions) and coagulated by alcohol, heat, tannin, phenol, camphor, etc. It forms precipitates with the salts of most heavy metals and is therefore a valuable antidote in poisoning by mercury, copper and other salts. It is used officially chiefly in preparing the albuminates and peptonate of iron.

N. F. Preparation—Linimentum Opii Compositum.

OVI VITELLUM RECENS. N. F. Fresh Egg Yolk

[Ovi Vitel.]

The freshly separated yolk of recently laid egg of the hen, *Gallus domesticus* Temminck (Fam. *Phasianidæ*).

It is a viscid yellowish liquid and consists of fatty substances, chiefly olein and margarin, which are emulsified by a protein compound called *vitellin*. It also contains inorganic salts, coloring matter, *cholesterol*, and *lecithin*.

N. F. Preparations—Emulsum Olei Morrhuæ Cum Vitello; Glyceritum Vitelli.

Uses—It is used pharmaceutically as an emulsifying agent.

Official Product of the Class Pisces

OLEUM MORRHUÆ. U. S. Cod Liver Oil

[Ol. Morrh.—Oleum Jecoris Aselli]

The fixed oil obtained from the fresh livers of *Gadus morrhua* Linné and of other species of *Gadus*.

Cod Liver Oil may be assayed for its vitamin A potency, and should then contain at least 50 units per Gm. Cod Liver Oil so assayed must be labeled. "This unit is not a measure of the antirachitic activity of Cod Liver Oil."

Preparation—The highest grade of medicinal cod liver oil can be obtained only from strictly fresh cod livers. These should be from healthy fish, and they should be removed from the fish within a few hours after the fish are caught. The oil is separated from the livers by steam cooking. For this purpose, low pressure steam is conducted directly into the cooking kettles containing the livers, and ordinarily it requires only a short time to cook livers sufficiently so that the oil is released from the weakened tissues surrounding the oil cells. The oil is then quickly separated from all water and liver tissue.

When livers of high quality are used and the manufacturing procedure is carried out under carefully controlled, sanitary conditions, the resulting crude oil is of a light yellow color, and of good flavor and odor. Such an oil requires no purification nor chemical refining.

Due, however, to long established trade demands it is necessary to remove the cod liver stearin so that the oil will remain clear at all temperatures above freezing. To accomplish this, the cod liver oil manufacturer chills the crude medicinal oil. After the cod liver stearin has crystallized out, it is a simple matter to separate the stearin and non-freezing oil by filter pressing. In order to preserve the natural vitamin content of cod liver oil, it should be stored out of contact with the air, and preferably in a cool place.

Cod liver oil consists chiefly of olein. Palmitin and stearin are present in small proportions; minute traces of iodine, chlorine, bromine, phosphorus, and sulphur have been reported, but these are not in sufficient quantity to have any medicinal effect. Active constituents of a basic character have also been reported. These were present in oil of a former period as the probable result of putrefactive changes in the livers. Preparations are still upon the market containing these substances and free from any of the oil or oily constituents, but their value has not been demonstrated. An alcoholic extract, *morrhuol*,

made by shaking cod liver oil with alcohol and concentrating the product has also been prepared but is of doubtful value. The most important use for cod liver oil is its favorable influence in rickets and its degree of activity in this respect is capable of demonstration by physiological tests. Dr. Arthur D. Holmes has supplied a summary of the methods now in use (1926), as follows:

Determination of Antirachitic Potency

Different investigators use different procedures for detecting the antirachitic factor. One group of investigators uses a diet consisting of:

Patent flour	95 per cent
Calcium lactate	2.9 per cent
Sodium chloride	2.0 per cent
Iron citrate	0.1 per cent

They rely on the radiographs and microscopic examination of the bones as a basis for judging concerning the presence or absence of rickets in the experimental animals.

Another group of investigators feeds its experimental animals a rickets-producing diet consisting of:

Whole wheat kernel	33 per cent
Whole maize kernel	33 per cent
Gelatin	15 per cent
Wheat gluten	15 per cent
Sodium chloride	1 per cent
Calcium carbonate	3 per cent

These animals are maintained on this diet for a thirty-five-day pre-experimental period. After that, the animals are fed the substance to be tested for five days. Then the animals are killed and the femur and tibia are removed and examined to determine whether calcification has taken place.

Another group of investigators, who believe that the antirachitic factor is also growth-stimulating, feeds its experimental animals a rickets-producing diet consisting of:

Yellow corn	76 per cent
Wheat gluten	20 per cent
Calcium carbonate	3 per cent
Sodium chloride	1 per cent

They supplement their observations concerning the calcium deposition with data concerning increase in the animals' body weight during the experimental period. Other diets have also been proposed.

Professor Dutcher (*Jour. Biolog. Chem.*, vol. LXVI, No. 2, Dec. 1925, p. 401) suggests a colorimetric determination of the phosphorus content of the blood and a chemical determination of the per cent of ash in the bones (the femurs) of the experimental animals, thus avoiding the necessity for exceptional proficiency in pathology required for other proposed tests for determining antirachitic value.

From the above, it is evident that the method for testing for the antirachitic vitamin is not as well standardized as that for testing for the fat-soluble A vitamin, and the entire subject is still in the stage of experimentation.

The vitamin content of cod liver oil is at present its most outstanding assayable factor. It contains at least two vitamins, A and C. See *Vitamins*, page 1168.

While the per cent of fat-soluble A vitamin is not an evidence of the antirachitic value of cod liver oil, it is believed to be a reliable indication of the care with which the cod liver oil has been prepared and preserved. The U. S. P. X has introduced an optional method for determining the vitamin A content and established a definite unit value. On this basis it is known that oils of high vitamin A potency can be produced through care in manufacture and physicians may thus be assured of quality when such products are used. The U. S. P. X vitamin A assay method is as follows:

Vitamin A Assay for Cod Liver Oil—Cod Liver Oil may be assayed by the following process. When so assayed the Oil should contain at least 50 units per Gm. and must be labeled "This unit is not a measure of the antirachitic activity of Cod Liver Oil".

This assay is based upon the estimation of the minimum amount of Cod Liver Oil necessary to meet specific growth-promoting requirements in a standard test animal. The test animals shall be albino rats from a constant source and bred preferably under the control of the experimenter.

The vitamin A potency of Cod Liver Oil shall be expressed in units per gram of oil, the unit to be the minimum daily amount of Cod Liver Oil required to cure induced symptoms of vitamin A starvation in young albino rats, and to cause a gain in weight of from 10 to 20 Gm. within a period of thirty-five days under the conditions of growth and diet specified in this assay.

Place on a vitamin A free diet, rats not less than twenty-five days and not more than twenty-nine days old and weighing not less than 35 Gm., and not more than 45 Gm.

The basal diet is to be composed as follows:

Casein, or desiccated fresh meat, rendered free from vitamin A	18 per cent
Salt mixture, such as that of Osborne and Mendel* or McCollum and Davis†	4 per cent
Starch, sufficient to make	100 per cent

Use sufficient dried brewer's yeast to meet the vitamin B requirements of the animal, mixing it with the basal diet during the vitamin A free period.

The rats shall begin receiving the Cod Liver Oil to be tested after not less than seven days of stationary or declining weight, and from the time of feeding the test oil, they shall be kept in separate cages.

The test period shall continue for thirty-five days and the potency of the oil shall be judged from the rat or rats showing a gain on the thirty-fifth day of between 10 and 20 Gm. over the weight at the beginning of the test, and the cure of the induced symptoms of vitamin A starvation.

Each test shall be controlled by at least two standard rats which have received no Cod Liver Oil. These animals may serve as controls for any number of concurrent tests on which the same basal diet is used.

No oil shall be labeled as assayed by the U. S. P. method unless it contains at least 50 units per Gm. of Oil.

The diet for rats used as breeders shall be composed as follows:

Finely ground whole wheat	66 per cent
Whole milk powder	33 per cent
Sodium chloride	1 per cent

The antirachitic requirements of the breeders shall be assured.

Description and Physical Properties—A pale yellow, thin, oily liquid. It has a peculiar, slightly fishy, but not a rancid odor, and a fishy taste.

Cod Liver Oil is slightly soluble in alcohol, but is soluble in ether, chloroform, carbon disulphide, and in ethyl acetate.

Tests for Identity and Purity—Specific gravity: 0.918 to 0.927 at 25° C.

A solution of 1 drop of the Oil in 1 cc. of chloroform, when shaken with 1 drop of sulphuric acid, acquires a violet-red tint, gradually changing to reddish-brown.

Dissolve 2 Gm. of Cod Liver Oil in 20 cc. of a mixture of equal volumes of alcohol and ether, which previously has been neutralized with tenth-normal sodium hydroxide, using 5 drops of phenolphthalein T.S. as indicator, and titrate with tenth-normal sodium hydroxide to the production of a pink color which persists for fifteen seconds: not more than 1 cc. of tenth-normal sodium hydroxide is required (*free acid*).

Unsaponifiable matter: not more than 1.5 per cent, page 1520.

Saponification value: not less than 180 and not more than 190, page 1519.

Iodine value: not less than 140 and not more than 180, page 1519.

Preserve in a cool place, in well-closed containers which have been thoroughly dried before filling.

Assay—Proceed as directed under the vitamin A assay for *Cod Liver Oil*, page 1188.

U. S. P. Preparation—Emulsum Olei Morrhuæ.

N. F. Preparations—Emulsum Olei Morrhuæ cum Hypophosphitibus; Emulsum Olei Morrhuæ cum Malto; Emulsum Olei Morrhuæ cum Vitello.

Uses—Cod liver oil is used as a nutrient and alterative in wasting diseases, notably phthisis. Dose, one to four fluidrachms (4 to 15 cc.).

RENNINUM. N. F. Rennin

The partially purified milk-curdling enzyme obtained from the glandular layer of the stomach of the calf, *Bos taurus* Linné (Fam. *Bovidæ*), and capable of coagulating not less than 25,000 times its weight of fresh milk. Rennin of a higher coagulating power may be brought to the standard by admixture with sodium chloride and lactose. Rennin deteriorates rapidly and must be kept in well-stoppered, amber-colored bottles, and stored in a cool place.

Preparation—It is usually prepared by digesting the mucous membrane of calves' stomachs for twenty-four hours in a one-half per cent sodium chloride solution, filtering, then adding hydrochloric acid to the filtrate to make one per cent acid, again filtering and saturating the filtrate with sodium chloride. On standing, the enzyme separates as a white flocculent mass and is carefully dried.

Official Description—Rennin occurs as a grayish-white or yellowish-white powder, or as pale yellow grains or scales. It is slightly hygroscopic.

Odor and Taste—Characteristic and slightly saline taste and a peculiar, not unpleasant odor.

Solubility—It is slowly soluble in water and in diluted alcohol, the solutions being more or less opalescent.

Tests for Purity—When mounted in water or diluted alcohol and examined microscopically it shows no cellular structure, and no blue coloration is produced on the addition of iodine T.S.

*See Jour. Biol. Chem., Vol. 15, page 317 (1913).
†See Jour. Biol. Chem., Vol. 33, page 55 (1918, No. 185).

Assay—Mix 0.1 Gm. of Rennin with 50 cc. of distilled water by gentle stirring or trituration in a mortar (vigorous shaking or violent agitation must be avoided) and allow the liquid to stand for exactly 15 minutes. Place 50 cc. of cow's milk having an acidity of not less than 0.14 per cent nor more than 0.15 per cent calculated as lactic acid (increasing the acidity of the milk, if low, by the addition of the required amount of lactic acid, or reducing it, if high, by the addition of the required quantity of sodium hydroxide) in a beaker about 12 centimeters high and 5 centimeters in diameter. Warm the milk rapidly on a water bath to 43° C., add 1 cc. of the Rennin solution and stir the mixture slowly for 10 seconds. Maintain the temperature at 43° C., until the milk begins to thicken, as shown by a distinctly convex surface when the beaker is tipped to an angle of about 45°. This thickening must take place within 10 minutes from the time of the addition of the Rennin solution. An additional 30 seconds on the water bath produces a firm curd.

The acidity of the milk used is ascertained by titrating 50 cc. of the undiluted milk with normal solution of sodium hydroxide, using phenolphthalein T.S. as indicator.

N. F. Preparation—Elixir Pepsini et Rennini Compositum.

Uses—It is used to produce a curd in milk, oftentimes for a food called *junket*, also as a digestant. The form in which it is usually sold is called "Essence of pepsin" (see page 332), or as *junket tablets* or a preparation called *liquid rennet*.

Official Products of the Class Insecta

CANTHARIS. U. S. Cantharides

[**Canthar.**—Spanish Flies, Russian Flies]

Cantharides consists of the dried insects, *Cantharis vesicatoria* (Linné) De Geer (Fam. *Meloideæ*).

Cantharides yields not less than 0.6 per cent of cantharidin and not more than 10 per cent of moisture.

Cantharides owe their blistering properties to *cantharidin* $C_{10}H_{12}O_4$, which is the inner anhydride (lactone) of cantharidic acid.

Cantharidin occurs as colorless glistening, inodorous crystals; 0.1 Gm. on incineration should leave no weighable residue. Cantharidin is very slightly soluble in water, petroleum benzin or alcohol (90 per cent); soluble in chloroform (1 in 65), in acetic ether (1 in 150), and in acetone (1 in 40), and is soluble also in fixed oils. A 0.1 per cent solution in a fixed oil raises blisters when kept in contact with the skin. The melting point is from 210° and 212° C. Cantharidin slowly volatilizes at 100° C., more rapidly at higher temperatures. It is soluble in solution of sodium hydroxide, the solution depositing crystals of cantharidin when acidified. Gently warmed with sulphuric acid it yields a colorless solution, from which it is separated unchanged when freely diluted with water.

Cantharidin may be obtained from various species of *Cantharis* or of *Mylabris*. It may be prepared by digesting powdered cantharides with a mixture of concentrated sulphuric acid and acetic ether at ordinary temperature, then mixing with barium carbonate and exhausting the mixture with acetic ether. The solvent may be removed by distillation and the residue then allowed to stand for some time to allow the cantharidin to crystallize. The resulting crystals may be washed with petroleum benzin to remove the fat and then recrystallized from hot alcohol.

Uses—Preparations of cantharidin are used in place of corresponding preparations of cantharides and have the advantage of being more cleanly and more uniform in strength. Cantharidin is recognized by the British, French, and Swiss Pharmacopœias. Cantharidin is more toxic to the kidney when the urine is acid than when it is alkaline.

Dose—$\frac{1}{250}$ to $\frac{1}{120}$ grain (0.00025 to 0.0005 Gm.).

An assay has been appended to the U. S. P. X text of cantharides to indicate the cantharidin content. In the British Pharmacopœia, cantharidin, obtained from any of the species of Cantharis or Mylabris, has replaced the drug, and all British preparations are made directly from cantharidin, but it is so costly and difficult to obtain that its replacement of cantharides in the United States Pharmacopœia was not believed to be practicable.

Description and Physical Properties—*Unground Cantharides*—From 15 to 25 mm. in length, 5 to 8 mm. in breadth, oblong, somewhat compressed above; of a brilliant green or bluish-green, metallic luster, changing in different parts, especially beneath to a golden-green; head triangular, separated into two lateral lobes by a faint median line; mandibles stout and partly concealed; antennæ filiform, of eleven conical joints, the upper ones being black; eyes comparatively small; prothorax angulate; legs with five tarsal joints; wings membranous and brownish; elytra or wing sheaths each with two parallel lines and finely wrinkled; odor strong, disagreeable; taste slight, afterwards acrid.

Cantharides with an ammoniacal odor must not be used.

Powdered Cantharides—Grayish-brown, with shining green particles and a number of long, pointed, spicules 0.500 mm. in length and 0.020 mm. in width.

Assay—Place 15 Gm. of Cantharides, in moderately coarse powder in a stout bottle of not less than 250 cc. capacity, add 150 cc. of a mixture of benzene, two volumes, and purified petroleum benzin, one volume, and then add 2 cc. of hydrochloric acid. Stopper the bottle tightly, shake it

well, and allow it to stand about ten hours. Now gradually warm the bottle and its contents to about 40° C., and maintain it at approximately that temperature with frequent shaking during three hours, avoiding evaporation. If necessary add additional solvent to replace any lost by evaporation. Cool the mixture, decant or filter off 100 cc. of the clear solution, and evaporate this rapidly in a tared beaker or wide-necked flask to a volume of about 5 cc. Add 5 cc. of chloroform to the residue and set it aside in a moderately warm place. When the solvent has all evaporated, add to the crystals 10 cc. of a mixture of equal volumes of dehydrated alcohol and purified petroleum benzin, which has previously been saturated with pure cantharidin, allow the mixture to stand during fifteen minutes, and then decant the liquid, through a pledget of purified cotton. Wash the crystals with successive portions of a saturated solution of cantharidin, similar to that directed above, until free from fat, and coloring matter, and pass the washings through the same pledget of purified cotton. Then wash the cotton with a very small quantity of warm chloroform to dissolve any adhering crystals, collect the chloroform in the tared flask or beaker containing the washed crystals, evaporate the solvent with the aid of a blast of air, dry the crystals at 60° C. for one half hour, and weigh. The resulting weight will be the amount of cantharidin obtained from 10 Gm. of Cantharides.

U. S. P. Preparations—Ceratum Cantharidis; Emplastrum Cantharidis (from Cerate); Tinctura Cantharidis.

Uses—Cantharides are used as an aphrodisiac and are poisonous. When applied externally they produce vesication. Dose, one-half grain (0.03 Gm.).

COCCUS—Cochineal

See chapter on Coloring Principles, page 842.

CERA FLAVA. U. S. Yellow Wax

[Cer. Flav.—Beeswax]

Yellow Wax is obtained by melting and purifying the honeycomb of the bee, *Apis mellifera* Linné (Fam. *Apidæ*).

Preparation—Wax is now known to be a peculiar secretion of bees. Yellow wax is obtained on the large scale by first abstracting the honey from the combs by shaving off the ends of the cells, draining, and then placing them in centrifugals. The honey is rapidly whirled out, water is added, and the wax is thoroughly and quickly cleaned; it is then melted and strained and run into flat dishes or molds to cool and harden.

Beeswax is a mixture of three different substances, which may be separated from one another by alcohol—*viz.*: 1. *myricin*, insoluble in boiling alcohol, and consisting chiefly of *myricyl palmitate*, $C_{30}H_{61}(C_{16}H_{31}O_2)$, which is an ester of *palmitic acid* $C_{16}H_{32}O_2$, and *myricyl alcohol*, $C_{30}H_{62}O$; 2. *cerin* or *cerotic acid*, $C_{27}H_{54}O_2$ (formerly called *cerin* when obtained only in an impure state), which is dissolved by boiling alcohol, but crystallizes out on cooling; 3. *cerolein*, which remains dissolved in the cold alcoholic liquid. This latter is probably a mixture of fatty acids, as indicated by its acid reaction to litmus paper.

Description and Physical Properties—A solid, varying in color from yellow to grayish-brown. It has an agreeable, honey-like odor, and a faint, characteristic taste.

When cold, it is somewhat brittle, and when broken presents a dull, granular, non-crystalline fracture. It becomes plastic from the heat of the hand.

Yellow Wax is insoluble in water and sparingly soluble in cold alcohol. Boiling alcohol dissolves the cerotic acid and a portion of the myricin, which are constituents of Yellow Wax. It is completely soluble in chloroform, ether, and in fixed or volatile oils, partly soluble in cold benzene or in carbon disulphide, and completely soluble in these liquids at about 30° C.

Tests for Identity—Specific gravity: 0.950 to 0.960 at 25° C. determined as follows: Melt the Wax at a low temperature and allow it to fall in separated drops from just above the surface into alcohol that has been warmed to from 45° to 50° C. Allow the globules to remain in the alcohol until it has cooled spontaneously to room temperature (20° to 25° C.), then remove the Wax and keep it at room temperature for twenty-four hours. Prepare a mixture of four volumes of alcohol and enough distilled water to make ten volumes and allow it to stand until free from air bubbles. Moisten the globules of Wax with distilled water by means of a brush, and place them by means of forceps in the alcohol solution just prepared and contained in a beaker. Then add alcohol, or air-free distilled water, as required to the mixture, kept at 25° C., until the globules of the Wax

float and rest indifferently in the liquid. Finally determine the specific gravity of the alcohol-water mixture. The figure thus obtained represents the specific gravity of the Wax examined.

Yellow Wax melts between 62° and 65° C.

Tests for Purity—Boil 1 Gm. of Yellow Wax for half an hour with 35 cc. of an aqueous solution of sodium hydroxide (1 in 7), the volume being preserved by the occasional addition of distilled water; on cooling, the Wax separates without rendering the liquid opaque, and no precipitate is produced in the liquid after filtration through glass wool or asbestos on the addition of an excess of hydrochloric acid (*fats or fatty acids, Japan wax, rosin or soap*).

Warm about 3 Gm. of Yellow Wax, accurately weighed, in a 200 cc. flask with 25 cc. of neutral dehydrated alcohol until melted, add 1 cc. of phenolphthalein T.S. and while warm titrate with half-normal alcoholic potassium hydroxide until a permanent, faint pink color is produced: the acid number so obtained is not less than 18 and not more than 24, page 1512. Now add 25 cc. of half-normal alcoholic potassium hydroxide and 50 cc. of alcohol, boil the mixture for four hours under a reflux condenser, and titrate the excess of the alkali with half-normal hydrochloric acid: the ester number so obtained is not less than 72 and not more than 77, page 1517.

U. S. P. Preparations—Ceratum Cantharidis; Ceratum Resinæ; Unguentum; Unguentum Acidi Borici; Unguentum Acidi Tannici (from Unguentum); Unguentum Belladonnæ; Unguentum Phenolis; Unguentum Picis Pini.

N. F. Preparations—Ceratum Resinæ Compositum; Emplastrum Fuscum Camphoratum; Mulla Creosoti Salicylata; Unguentum Picis Compositum; Unguentum Resorcinolis Compositum.

Uses—Its use is chiefly to give consistence to fatty vehicles.

CERA ALBA. U.S. White Wax

[**Cer. Alb.**—Bleached Beeswax]

Yellow Wax, bleached.

Preparation—The color of yellow wax is discharged by exposing it with an extended surface to the combined influence of air, light, and moisture. The process of bleaching is often conducted upon a large scale. The wax, previously melted, is made to fall in streams upon a revolving cylinder kept constantly wet, upon which it concretes, forming thin layers. These, layers are spread upon linen cloths stretched on frames and exposed to the air and light, care being taken to wet and occasionally turn them. In a few days they are partially bleached; but to deprive the wax completely of color it is necessary to repeat the whole process once, if not oftener. When sufficiently white, it is melted and cast into small circular cakes.

Description and Physical Properties—A yellowish-white solid, somewhat translucent in thin layers. It has a faint, characteristic odor, is free from rancidity, and is nearly tasteless.

Tests for Identity and Purity—The acid value is not less than 17 and not more than 23, and the ester value not less than 72 and not more than 79, as determined by the methods under *Cera Flava*.

In other respects White Wax has the characteristics of, and responds to, the tests for identity and purity under *Cera Flava*.

U. S. P. Preparations—Ceratum; Unguentum Aquæ Rosæ.

N. F. Preparations—Ceratum Camphoræ; Ceratum Plumbi Subacetatis; Petroxolinum Spissum; Unguentum Camphoræ; Unguentum Sinapis.

Uses—Wax is used in pharmacy principally to give consistence to cerates and ointments.

ACIDUM FORMICUM. N.F. Formic Acid

An aqueous solution containing not less than 24 per cent and not more than 26 per cent of HCOOH.

Preparation—It occurs free in ants, especially *Formica rufa*, from which its name is derived, also in other insects and the secretion of some animals. It is also prepared by oxidizing methyl alcohol, by the direct combination of CO and KOH at 100° C. and by other chemical processes. Commercially it is prepared by heating together 50 parts of glycerin and 50 parts of oxalic acid to 105° C., cooling to 50° C., again adding 50 parts of oxalic acid and then distilling at 115° C.

Formic Acid is a clear, colorless liquid; of a strongly acid reaction and a characteristic pungent odor. Specific gravity about 1.058 at 25° C. It is miscible with water or alcohol. (For further tests and the assay see the N. F. V.)

N. F. Preparation—Spiritus Acidi Formici.

Uses—Used chiefly to produce the alkaline formates for making syrups and elixirs, but it has been used as an irritant and vesicant when applied locally—and as a stimulant, like ammonia, in a dose of five minims (0.3 cc.).

Organs of Animals

The following statement concerning the therapeutic value of the animal glands, commonly spoken of as *endocrins*, has been copied in abstract, from the 1925 N. N. R., with permission.

"The discovery of the importance of internal secretions has led to extensive clinical trials with preparations of the so-called ductless glands, and other tissues which elaborate or are supposed to elaborate, such internal secretions. Four of these, the thyroid and suprarenal glands, the posterior lobe of the pituitary, and insulin obtained from the pancreas, have given decisive therapeutic results. Two of these are official in the Pharmacopœia". The active principle of the suprarenal, now official as *epinephrine* and that of the pituitary as *solution of pituitary*, have won a recognized place in therapeutics. "The other organ products are scarcely beyond the experimental stage. Their active principles have not been isolated, and they are most commonly used in the form of the powdered dried gland. The gross fat and connective tissue is removed as completely as possible, and the drying is conducted at a relatively low temperature. The powder (often improperly called an 'extract') is frequently compressed into tablets". The strength of these is usually stated in terms of the dried gland. "Since in general, there are no tests for the quality, or even identity of these powdered products, the physician, unless he can himself supervise their preparation, is forced to rely on the general reputation of the manufacturer."

PITUITARIUM. U. S. Pituitary

[**Pituitar.**—Hypophysis Sicca U. S. P. IX]

Pituitary is the cleaned, dried and powdered posterior lobe obtained from the pituitary body of domesticated animals which are used for food by man.

Description and Physical Properties—A yellowish or grayish amorphous powder, having a characteristic odor. It is only partially soluble in water.

U. S. P. Preparation—Liquor Pituitarii.

The pituitary gland is a small, reddish, ellipsoidal organ situated in a depression of the sphenoid bone and attached to the brain by a pedicle. It consists of two lobes, an anterior portion, which is the larger, and a posterior portion, the part of the gland which is official. Both lobes possess therapeutic activity, but are different in their action. The anterior portion is essential for life, death soon following its removal, and if partially destroyed or if diseased, normal growth is retarded or other evidences of malnutrition follow. The anterior lobe is not largely used in medical practice.

Uses—The posterior lobe, containing an active principle which has been called *pituitrin*, has a marked effect upon plain muscle, especially upon those of the blood vessels and the uterus. Extract of the posterior lobe injected subcutaneously is employed against uterine atony and in postpartum as well as in other forms of uterine hemorrhage. Pituitary extracts should not be injected

during the first stage of labor because, if the cervix be not fully dilated, the energetic contractions may cause rupture of the uterus. It has also been recommended in shock and in various other conditions of temporary low blood pressure, but the benefits are doubtful. It is useful in intestinal paresis whether following abdominal operations or complicating pneumonia. It has also been used to control diabetes insipidus with temporary benefit. Oral administration gives feeble or doubtful results; and the extracts should always be injected hypodermically or intramuscularly. The dose of the dried gland is one-half grain (0.03 Gm.).

LIQUOR PITUITARII. U. S. Solution of Pituitary

[**Liq. Pituitar.**—Liquor Hypophysis U. S. P. IX, Pituitary Extract]

Solution of Pituitary contains the water-soluble principle or principles from the fresh posterior lobe of the pituitary body of cattle, 1 cc. having an activity upon the isolated uterus of the virgin guinea pig, corresponding to not less than 80 per cent and not more than 120 per cent of that produced by 0.005 Gm. of the Standard Powdered Pituitary, prepared as directed below. The solution should be sterile.

Preparation—Commercially pituitary solutions are prepared in much the same manner as described in detail for the preparation of the standard powder (see below).

Description and Physical Properties—A transparent liquid, colorless, or nearly so, having a faint, characteristic odor.

Assay—Prepare a solution as follows: Carefully weigh a suitable amount of the dried Standard Powdered Pituitary, place this weighed powder in a small agate mortar and moisten with a few drops of distilled water containing 0.25 per cent of acetic acid. Triturate the moistened powder thoroughly until the whole is of an impalpable frothy consistence. Add a few cc. of the 0.25 per cent acetic acid solution and stir the mixture thoroughly. Transfer to a hard glass test tube or beaker; rinse the small agate mortar with the acetic acid solution and add the rinsings to the pituitary mixture; then add enough 0.25 per cent acetic acid to make the final volume of the mixture of the same number of cc. as the number of milligrams of dried pituitary powder originally taken. Heat this mixture to the boiling point for not more than one minute and filter. The filtrate contains in each cc. the active principle of 0.001 Gm. of the dried standard powder. Place this solution in hard glass ampuls and sterilize by fractional sterilization for twenty minutes on three successive days at a temperature not exceeding 100° C. Preserve in a cool place (from 5° to 20° C.). This standard solution should not be kept more than six months.

The apparatus used for making the test may be any modification of the general type for studying the activity of the isolated smooth muscle of mammals. It must be provided with an accurate temperature-regulating device. The chamber in which the uterus is suspended should have a capacity of not less than 100 cc.

Use healthy guinea pigs weighing between 175 Gm. and 350 Gm. They should not have been pregnant and should not be in heat. It is recommended that young female pigs be segregated at the time of weaning and kept thereafter out of sight and smell of the males.

Kill a guinea pig by a blow on the head, or by decapitation, and immediately remove the entire uterus from the body. Suspend a part or all of one horn of the uterus in a chamber containing oxygenated Locke-Ringer solution (page 1547), one end of theuterus being attached to a muscle lever which is weighted as necessary. The temperature of the bath should be between 37° and 38° C. but should not vary more than one-tenth of a degree throughout the whole assay. When the uterus is completely relaxed, which is generally in from fifteen to thirty minutes, it is ready to begin the test. This is done by adding alternately varying doses of the standard extract and of the solution to be tested to the bath in the muscle chamber until quantities of the two solutions are found which give equal, sub-maximal contractions in at least two successive pairs of contractions. The strengths of the two solutions are in inverse ratio to the quantities necessary to produce these equal contractions.

Standard Powdered Pituitary

Select a number, not less than 25, of fresh posterior lobes of the pituitary body of cattle, removed within thirty minutes of the death of the animal, and carefully free them from all extraneous tissue, immediately after their removal. As soon as they are so prepared, drop them into a flask containing a quantity of acetone corresponding to not less than 4 cc. of acetone for each pituitary body. Allow them to remain in the acetone for three hours and then remove them and immediately cut them into small pieces with scissors and place the material in fresh acetone equal to that first employed. Macerate overnight and then remove it and dry it in a vacuum desiccator

over calcium chloride, at a temperature not above 50° C. for five hours. At the end of this time remove the material and grind it in a mortar until it will pass through a No. 40 sieve. Dry this powder for at least twelve hours in a vacuum desiccator over calcium chloride at a temperature not over 50° C. Extract this dried powder in a small Soxhlet continuous extraction apparatus with acetone for three hours and again dry it in a desiccator over calcium chloride for twelve hours. This dried powder should be preserved in a cool, dark place, in sealed ampuls *in vacuo*, or in vacuum desiccators over calcium chloride until used for the preparation of the standard solution.

Leave the material in the acetone.

Uses—The solution of pituitary body is the form most frequently used, as it possesses the advantage over the dried glands of more definite standardization therefore greater dependability. The assay is complicated and requires delicate mechanism and, as the best method is yet to be proven, the U. S. P. has authorized the United States Hygienic Laboratory at Washington, D. C., to prescribe the exact details of the test. Its uses are the same as described under *Pituitarium* (see page 1193), the dose being fifteen minims (1 cc.). Solution of Pituitary is offered the profession under various trade names such as *Pituitary Liquid, Pituitary Solution, Solution Pituitary Extract, Pituglandol, Pituitrin, Hypophysin, Pituitol*, etc.

Pituitrin "S" (*Surgical*) is a stronger preparation than that of the U. S. P.

Unofficial Pituitary Preparations

Desiccated Pituitary Body-Armour, N. N. R.—The dried substance of the entire pituitary body of the ox, including the infundibulum and the anterior and posterior lobes without the addition of preservative or diluent. It is said to contain all the active principles naturally existing in the gland.

Pituitary body desiccated-Armour is a light yellowish-gray powder, practically odorless and tasteless. One part represents approximately 5 parts of fresh gland.

Uses—See Pituitary Gland. Dose, from one to three grains (0.06 to 0.2 Gm.), three times a day.

Manufactured by Armour and Company.

Desiccated Pituitary Substance (Anterior Lobe) Armour, N. N. R.—The anterior lobe from the pituitary of the ox, separated, dried and powdered without the addition of preservative or diluent.

Uses—Hyperactivity of the anterior lobe has been believed to produce accelerated and abnormal growth (gigantism). Preparations of the anterior lobe have been given in the later stages of acromegaly, with reported benefit in some instances, but there is doubt as to its value in this condition. It is contraindicated in the early stages of acromegaly. Dose, from one to ten grains (0.06 to 0.60 Gm.) in powder or tablet.

Manufactured by Armour and Company.

EPINEPHRINA. U. S. Epinephrine

[**Epineph.**—Lævo-Methylaminoethanolcatechol]

Epinephrine is [$C_9H_{13}O_3N$ or $C_6H_3(OH)_2(CHOH.CH_2NHCH_2)$.—1,2-dihydroxy-4²-methyl-amino ethyl-4¹-ol benzene] a substance with feeble basic properties, obtained from the suprarenal gland of the sheep or other animal; also made synthetically. In solution it is generally dispensed in the form of a salt such as epinephrine borate, chloride or sulphite.

Preparation—This active constituent, of the suprarenal glands, *epinephrine*, is alkaloidal in character and was discovered by Dr. John J. Abel. Fuerth also claimed the discovery of an active constituent which he called *suprarenine* (*suprarenaline*), and Takamine introduced a crystalline substance which he named *adrenalin*. These substances proved to be identical, and the official title is that originally given to it by Abel.

Adrenalin is prepared by digesting the finely cut glands with acidulated water for five hours, at about 70° C, then heating to 90° C. to coagulate albuminoids, and expressing the mixture. The digestion in acidulated water is repeated, the expressed liquids freed from fat, concentrated *in vacuo*, mixed with alcohol to precipitate inert constituents, and then precipitated by the addition of ammonia water. The crude adrenalin which separates, after several hours' standing, is purified by solution in acid alcohol and again precipitated by the addition of ammonia water. It is also prepared synthetically.

Description and Physical Properties—A white or light brownish, microcrystalline, odorless powder, gradually darkening on exposure to the air.

Epinephrine is very slightly soluble in water and in alcohol. It is insoluble in ether, chloroform, acetone, and in fixed or volatile oils.

Tests for Identity and Purity—Epinephrine combines with acids, forming salts which are readily soluble in water, and from these solutions the base, may be precipitated by ammonia or alkali carbonates.

The acid solution is not affected by solutions of trinitrophenol, tannic acid, phosphomolybdic acid, mercuric potassium iodide, or platinic chloride.

A saturated aqueous solution of Epinephrine is slightly alkaline to litmus paper.

A slightly acid, aqueous solution of Epinephrine (1 in 1000) gives with ferric chloride T.S. an emerald-green color, turning to cherry-red and finally to brown on standing. Other oxidizing agents produce red, pink, or violet colors which change to brown. Fixed alkali hydroxides cause the solution to darken on standing, but do not precipitate the Epinephrine.

The ash from 0.1 Gm. is negligible.

Preserve in well-closed containers, protected from light.

Uses—Epinephrine acts peripherally on a variety of structures, probably by stimulating the sympathetic nerve endings. Its most important therapeutic actions consist of a constriction of the blood vessels, with consequent high rise of blood pressure; a stimulation of the vagus center with slowing of the heart, and a direct stimulant and tonic effect on the heart muscle, similar to that of digitalis. Large doses also cause glycosuria. The effect of a single dose is fleeting. It is not irritant. The effects are seen on local application and intravenous and intramuscular injection. When given to animals, by mouth or hypodermically, moderate doses have almost no action.

Dilute watery solutions rapidly lose their strength, the deterioration being accompanied by a reddish or brownish discoloration.

The incompatibilities of epinephrine are the same as those of alkaloids. Its solutions should be kept tightly-stoppered and protected from the light.

Epinephrine is chiefly used locally for its vasoconstrictor action, in hemorrhage and in catarrhal and congestive conditions. It cuts short asthmatic paroxysms (when used as a spray for the larynx and for hypodermic injections). Intravenous injections are effective in shock and anesthesia accidents (care being taken not to give an overdose). It has also been recommended in heart disease but opinions are divided as to the benefits to be expected from administration by mouth.

The vasoconstrictor action of epinephrine is used to intensify and prolong the anesthetic effect of local anesthetics by retarding the circulation in the affected part and thus hindering the dilution of the anesthetic agent by too rapid absorption into the blood stream.

Dose—From 5 to 30 minims (0.3 to 2.0 cc.) of a 1 in 1000 solution, every two or three hours. Hypodermically, from 1 to 15 minims (0.006 to 1 cc.) of a 1 in 1000 solution, diluted with sterile water. Locally, it is used in solution varying in strength from 1 in 15,000 to 1 in 1000, for ordinary applications, in oily solution for sprays, in ointment for application to mucous membranes, such as the eye or the nose, where a slower but more lasting action is desired, and in suppositories.

The identical product is sold under various names such as *adrenalin, adnephrin, adrenamine, epirenan, hemisine, hemostatin, paranephrin, renaline, renalina, supracapsulin, supranephrane,* and *suprarenalin.*

LIQUOR EPINEPHRINÆ HYDROCHLORIDI. U.S. Solution of Epinephrine Hydrochloride

[Liq. Epineph. Hydrochlor.]

Solution of Epinephrine Hydrochloride is a solution of epinephrine in water and hydrochloric acid, containing in each 100 cc. not less than 0.095 Gm. and not more than 0.105 Gm. of $C_9H_{13}O_3N$.

Solutions of the isolated active principle of the suprarenal glands have largely replaced, in practice, solutions prepared from the dried suprarenal gland. They have a number of advantages over the latter; they may be made of definite strength, whereas the activity of commercial preparations of the dried glands varies greatly, and they are less liable to bacterial infection. They are, however, much more expensive than solutions made from the dried gland.

Epinephrine is exceedingly sensitive to oxidizing agents. It is decomposed by the slightest trace of iron or other metals in the water and special purity tests of the water are necessary for making a permanent solution. Then the water must be recently boiled and cooled to free it from air. The solution must be slightly acid and must contain a preservative to prevent the growth of germs and fungi, to which this solution is prone. And finally it needs to be bottled with the exclusion of air and should contain a reducing agent to prevent oxidation.

Prof. Wilbur L. Scoville suggests the following formula:

Epinephrine	1.0 Gm.
Trichlor-tertiary butyl alcohol	5.0 Gm.
Sodium chloride	8.5 Gm.
Diluted hydrochloric acid	3.0 cc.
Sodium bisulphite	2.0 Gm.
Sterilized distilled water to make	1000 cc.

Trichlor-tertiary butyl alcohol has been found by test to be the most efficient antiseptic for this preparation. Other antiseptics in use in this solution are *chloroform* or *chloral hydrate*, used by some, and *camphor* the least efficient of all. Finally, if the solution is to be stored it should be bottled in bottles from which the air has been removed and replaced with some non-oxidizing gas.

Description and Physical Properties—A nearly colorless, slightly acid liquid, gradually turning dark on exposure to air and light. When the solution has become brown in color or contains a precipitate it must be rejected.

Tests for Identity—The addition of 1 drop of ferric chloride T.S. to 10 cc. of the solution produces an emerald-green color which soon turns to a cherry-red and finally to brown. Other oxidizing agents produce red to pink or violet colors which change on standing. Fixed alkali hydroxides darken it, but do not precipitate the epinephrine.

Uses—For uses and dose see Epinephrina (page 1196).

Unofficial Suprarenal or Related Products

SUPRARENALUM SICCUM—Dried Suprarenals
(U. S. P. IX)

[Desiccated Suprarenal Glands]

The suprarenal glands of animals which are used for food by man. The glands must be cleaned, dried, freed from fat, and powdered, and contain not less than 0.4 per cent and not more than 0.6 per cent of epinephrine, the active principle of the suprarenal gland. One part of Dried Suprarenals represents approximately 6 parts of fresh glands, free from fat. Assayed biologically 1 Gm. of Dried Suprarenals contains the equivalent of ten milligrammes of lævo-methylaminoethanol-catechol.

A light yellowish-brown, amorphous powder; slightly characteristic; partially soluble in water.

Dried Suprarenals contain not more than 7 per cent of moisture, and the yield of ash does not exceed 7 per cent.

Assay—Add 0.005 Gm. of finely powdered manganese dioxide and 10 cc. of distilled water to 0.01 Gm. of Dried Suprarenals; thoroughly shake the mixture several times during one hour and filter. Compare the color of the filtrate in a test tube or in any convenient manner, with the color of cobaltous chloride T.S. and dilute gold chloride T.S. combined as follows: Mix 1.85 cc. of cobaltous chloride T.S. with 0.95 cc. of diluted gold chloride T.S. and 7.2 cc. of distilled water; the color corresponds to 0.2 per cent of epinephrine in the filtrate obtained above; 2.95 cc. of cobaltous chloride T.S. with 1.25 cc. of diluted gold chloride T.S. and 5.8 cc. of distilled water corresponds in color to 0.4 per cent of epinephrine; 4.05 cc. of cobaltous chloride T.S. with 1.35 cc. of diluted gold chloride T.S. and 4.6 cc. of distilled water corresponds in color to 0.6 per cent of epinephrine; 5.15 cc. of cobaltous chloride T.S. with 1.55 cc. of diluted gold chloride T.S. and 3.3 cc. of distilled water corresponds in color to 0.8 per cent of epinephrine.

The percentages of epinephrine indicated by the above color standards are based upon the maceration of 0.01 Gm. of the Dried Suprarenals in 10 cc. of distilled water as directed above, and filtering. In samples containing more than 0.8 per cent of epinephrine, 0.005 Gm. of the Dried Suprarenals may be taken—in

which case the percentage stated above—as indicated by the color standards, should be doubled. The standard color solutions keep unchanged if sealed in glass tubes.

For a method of assaying Dried Suprarenals, see Biological Assays.

Uses—Desiccated suprarenal glands in powder is used in Addison's disease, and solutions have been employed as hemostatics. Dose, of the dried glands, four grains (0.25 Gm.).

L-Suprarenin Synthetic Bitartrate, N. N. R.—The acid tartrate of synthetic epinephrine obtained by the method of Stolz and Flaecher (*Ztschr. f. physiol. Chem.* 58:189).

Synthetic epinephrine (the free base) is a white odorless powder nearly insoluble in water, alcohol and ether. It melts at from 211° to 212° C. It rotates polarized light to the left, the rotation being

$$[a]\frac{19.6°}{D} = -51.4°$$

It has the chemical and physical properties of epinephrine obtained from suprarenal glands.

L-Suprarenin Synthetic Bitartrate is a white, odorless powder soluble in water and yielding a solution which has an acid reaction. L-suprarenin synthetic bitartrate melts at 149° C. and its aqueous solution rotates polarized light to the left.

Uses—See Epinephrine. Synthetic epinephrine has the physiologic effects of natural epinephrine obtained from suprarenal glands.

Manufactured by H. A. Metz Laboratories, Inc.

Tyramine Hydrochloride, N. N. R.—Tyramine—Parahydroxyphenylethylamine hydrochloride—$OH.C_6H_4CH_2CH_2NH_2.HCl$.—The hydrochloride of the base parahydroxyphenylethylamine $OH.C_6H_4.CH_2.CH_2.NH_2$ obtained synthetically.

Uses—The actions of tyramine hydrochloride resemble those of epinephrine; they are less powerful but more persistent. It is absorbed much more readily.

Tyramine hydrochloride produces a rise of blood pressure, mainly by vasoconstriction. This suggested its employment in shock or collapse, but it has not been very successful. It is useless as a local hemostatic.

Tyramine hydrochloride seems to have a possible field in obstetrics, since it contracts the uterus and thus checks post-partum hemorrhage; but it is not so powerful as pituitary extract. It is also useful in that it antagonizes the respiratory depression of morphine, thus rendering this drug safer in childbirth. Dose, tyramine hydrochloride acts fairly well from the stomach, but is best given hypodermically, in doses of from one-third to two-thirds grain (0.02 to 0.04 Gm.), dissolved in water.

The base parahydroxyphenylethylamine was isolated from ergot by Barger and also prepared synthetically by him by the reduction of parahydroxyacetonitrile with sodium in alcoholic solution. (Transactions of the Chemical Society, 1909, xcv.) It had previously been obtained by heating tryosine; hence its name. It is chemically and physiologically related to epinephrine.

Tyramine hydrochloride occurs as a white, or almost white, crystalline powder, soluble in water and forming a neutral solution.

Manufactured by F. Hoffmann-LaRoche and Company.

THYROIDEUM. U. S. Thyroid

[**Thyroid.**—Thyroideum Siccum U. S. P. IX, Desiccated Thyroid Glands]

Thyroid is the cleaned, dried, and powdered thyroid gland, previously deprived of connective tissue and fat. It is obtained from domesticated animals which are used for food by man.

Thyroid contains not less than 0.17 and not more than 0.23 per cent of iodine in thyroid combination, and must be free from iodine in inorganic or any other form of combination than that peculiar to the thyroid gland. One part corresponds to approximately 5 parts of the fresh glands.

Preparation—Selected thyroid glands of the sheep are minced, dried, treated with petroleum benzin to remove fat, dried again, and powdered. The active constituent seems to be an organic combination of iodine, sometimes called *thyroglobulin*, for the iodine content of which the U. S. P. has fixed a standard and assay.

Description and Physical Properties—A yellowish, amorphous powder, having a slight, characteristic odor.

Tests for Purity—Thyroid contains not more than 6 per cent of moisture.

Ash: not more than 5 per cent.

Assay—Mix 1 Gm. of Thyroid in a nickel crucible of about 125 cc. capacity, with 15 Gm. of a mixture composed of 138 parts by weight of anhydrous potassium carbonate, 106 parts of anhydrous sodium carbonate, and 75 parts of potassium nitrate. Spread an additional 5 Gm. of this fusion mixture evenly over the surface. Heat the crucible over a free Bunsen flame until no further carbonization is observed, cool, and dissolve the residue in about 150 cc. of distilled water, warming to hasten solution. Transfer this solution to an Erlenmeyer flask of about 500 cc. capacity, and add approximately 50 cc., or its equivalent, of a fresh solution of chlorinated soda (containing 2.5 per cent of chlorine by weight). Treat the mixture with enough phosphoric acid, diluted with an equal volume of distilled water, to produce an appreciable yellow tint of free chlorine, add about 10 cc. more of phosphoric acid, diluted with an equal volume of distilled water, and boil for one-half hour or until the volume has been reduced to about 150 cc. Cool the liquid, add 10 cc. of a freshly prepared aqueous solution of potassium iodide (1 in 100), and titrate the

liberated iodine with freshly prepared two-hundredth-normal sodium thiosulphate, starch T.S., being used as indicator just before the end of the reaction.

Each cc. of two-hundredth-normal sodium thiosulphate used corresponds to 0.0001058 Gm. of iodine derived from thyroid glands.

This assay is explained on page 1465.

Uses—Desiccated thyroid glands in powder is used in myxedema, for which it may be said to be almost a specific; also in the treatment of cretinism. Dose, one to four grains (0.065 to 0.25 Gm.).

THYROXINUM. U. S. Thyroxin

[Thyrox.]

Thyroxin [$(C_8H_5ONI_3).C_2H_4COOH = 584.90$] is an active principle obtained from the thyroid gland, and contains not less than 63 per cent of iodine.

Description and Physical Properties—White or slightly yellow, needle-like, odorless crystals or powder.

Thyroxin is insoluble in water and practically insoluble in alcohol or other usual organic solvents, but in the presence of mineral acids it dissolves in alcohol. It is soluble in solutions of the alkali hydroxides and when alkaline solutions are saturated with sodium chloride the sodium salt of thyroxin separates.

Tests for Identity—Ignite a few milligrams of Thyroxin with about 0.1 Gm. of sodium carbonate, dissolve the residue in 2 cc. of distilled water, acidulate with acetic acid, add 1 cc. of chloroform and a few drops of chlorine T.S.: the chloroform acquires a violet color.

Tests for Purity—The ash from 0.01 Gm. is negligible.

Dry about 0.02 Gm. of Thyroxin over sulphuric acid for twenty-four hours: the loss in weight is negligible (*water*).

Shake 0.01 Gm. of Thyroxin with 10 cc. of distilled water during five minutes, and filter. Acidulate the filtrate with one drop of diluted nitric acid, and add 3 drops of tenth-normal silver nitrate: the turbidity so produced is not greater than that produced in a control test by one drop of fiftieth-normal hydrochloric acid (*soluble iodides*).

Assay—Mix about 0.02 Gm. of Thyroxin, previously dried over sulphuric acid for twenty-four hours and accurately weighed, with about 0.5 Gm. of anhydrous potassium carbonate in a small platinum crucible. Cover the mixture with an additional 1 Gm. of anhydrous potassium carbonate, and heat gradually until it is completely decomposed. Treat with distilled water and transfer to a 100 cc. graduated flask. Heat the solution on a water bath and add potassium permanganate solution (1 in 20), drop by drop, until the liquid remains pink. Then add, drop by drop, just enough alcohol to discharge the pink color, cool, and dilute to the mark with recently boiled and cooled distilled water. Mix well and filter through a dry filter into a dry flask, rejecting the first 20 cc. of the filtrate. To 50 cc. of the filtrate add about 0.5 Gm. of potassium iodide and 30 cc. of diluted sulphuric acid, and titrate the liberated iodine with two-hundredth-normal sodium thiosulphate, using starch T.S. as indicator towards the end. Correct for any iodine liberated in a blank made with the same quantities of distilled water, sulphuric acid, and potassium iodide. Each cc. of two-hundredth-normal sodium thiosulphate corresponds to 0.0001058 Gm. of iodine.

This assay is explained on page 1465.

Uses—Thyroxin is used essentially for the same purpose as Dried Thyroids, U. S. P., but the dosage may be more accurately determined and results more quickly obtained. It is indicated in cases of diminishing or absent thyroid functioning, such as simple goiter, cretinism and myxedema.

Dose—from 0.2 mgm. to 2 mgm. Thyroxin should always be given in minimum doses and in each case the optimum amount should be determined by trial. For the exact determination of this dose, the establishment of the basal metabolic rate for each given case is necessary.

Thyroxin may be administered either by intravenous injection or by mouth. In those cases in which thyroxin is not absorbed quantitatively when given by mouth it may be given intravenously according to the following directions: Place a known amount of pure crystalline thyroxin—from 1 to 10 mgm.—in a small sterile test tube, such as is used for the Wassermann test. Add 1 drop of 10 per cent sodium hydroxide solution and about 1 cc. of water. Warm and agitate the solution until the crystals are dissolved, and then sterilize by placing the tube in boiling water. Transfer the solution to a sterile hypodermic syringe, rinse out the test tube with 1 cc. of sterile distilled water, which is added to the syringe, and then inject the contents of the syringe intravenously.

Manufactured by E. R. Squibb and Sons.

Thyroxin Crude is also recognized by the N. N. R. It is the partially purified disodium salt of thyroxin, approximately 25 per cent admixed with the acid-insoluble humus-like products of protein hydrolysis.

The uses are the same as those of thyroxin, except that it is not to be used for injection but is administered orally. In certain individuals in whom the thyroxin equivalent is not absorbed quantitatively, the pure crystalline thyroxin should be given intravenously (see under thyroxin).

PANCREAS

The pancreas is a gland having, in general, two functions: (1) it secretes into the intestine a digestive juice containing the enzymes trypsin, lipase and amylase (see *Pancreatin*, page 1175); (2) it secretes into the blood a hormone, insulin, which regulates the process of carbohydrate metabolism. A discussion of this substance follows (see under Insulin).

Oral Administration of Pancreatic Preparations—In diabetes, reliance on the oral administration of the pancreatic preparations thus far prepared has so little justification that such practice merits the most vigorous condemnation. Many reputed antidiabetic pancreatic preparations are on the market with claims that they are effective if taken by mouth. The most widely heralded of them have been subjected to the scrutiny of clinical tests controlled with simultaneous laboratory investigation. None of these thus tested has shown any effect on blood sugar or glycosuria. Completely negative results were obtained when these preparations were given in the doses recommended by their exploiters as well as in doses twenty times as large. The claim that such preparations exert, in some mysterious manner, a rejuvenating or stimulating action on the diseased pancreas is based on uncontrolled clinical observation (N. N. R. 1925).

Unofficial Product from the Pancreas

The following extract from the 1925 N. N. R., on the subject of Insulin, supplies important information which should be available to the pharmacist:

Insulin—Insulin is an aqueous solution of an active principle from pancreas which effects sugar metabolism. The strength of insulin is expressed in "units", one unit being one-third of the amount required to lower the blood sugar to an average of 0.045 per cent over a period of five hours in a normal rabbit weighing 2 kilograms, which has been previously starved for twenty-four hours.

Uses—It has been demonstrated that the administration of insulin to diabetic dogs and to man in severe cases of diabetes mellitus restores to the body the lost ability to oxidize carbohydrate, and that glycogen is again stored in the liver. If insulin is administered at suitable intervals to a person suffering from diabetes mellitus, the blood sugar is maintained at a normal level and the urine remains free of sugar; fat is also burned and as a result, ketone bodies do not appear in the urine and diabetic acidosis and coma are prevented.

The administration of insulin is indicated in cases of diabetes mellitus which cannot be controlled at a satisfactory level by dietetic treatment. In such cases with proper regulation of diet, insulin should be administered in such amounts as to prevent glycosuria and a too great hyperclycemia. In some cases the dosage of insulin may be gradually decreased as the body power of utilizing carbohydrate returns toward normal.

Overdosage of insulin is followed by the development of serious symptoms which demand immediate treatment. The patient complains of weakness and fatigue and a feeling of nervousness or tremulousness. This is followed by profuse sweating, which is the most characteristic sign of overdosage. There is sometimes pallor or flushing. In the more severe forms there is acute distress with mental disturbances and even unconsciousness. These symptoms are relieved by the administration of some form of available carbohydrate by mouth or stomach tube, or, if the patient is comatose, by the intravenous injection of from 5 to 20 Gm. of pure glucose in a five to fifty per cent sterile solution. Physicians treating patients with insulin should be impressed with the necessity of having adequate supplies of sterile solution of glucose at hand. In case of emergency when sterile solution of glucose is not available, a subcutaneous injection of 0.3 cc. to 0.6 cc. of 1 in 1000 solution of epinephrine may be employed, but this must always be followed by carbohydrates by mouth. The injection of epinephrine must be employed carefully as its action depends on the presence of glycogen of which there is usually very little in the diabetic organism.

Dose—Insulin is administered by injection into the loose subcutaneous tissue of the body, usually thirty minutes before meals. There is no average dose of insulin for diabetics; each case must be studied individually. Except when complications occur insulin is not indicated when a patient has adequate glucose tolerance to provide him with a diet sufficient for light work. The dose depends upon the amount of glucose in such a diet as he is unable to metabolize; *i. e.*, the glucose excretion on a known diet. A convenient formula is: $\frac{\text{Average Gm. glucose excreted}}{1.5} = \text{sufficient units of insulin to render most patients aglycosuric.}$ Usually the daily dose is administered in two portions, one before breakfast and the other before supper. The carbohydrate of the diet should be distributed evenly between the three meals. With large daily dosage (40 units or more) insulin should be injected before each meal. When the patient becomes aglycosuric the dose usually can be reduced by one-third. Sufficient should be used to keep the fasting blood sugar normal but hypoglycemia should be avoided. If patients are not under careful control half the estimated dose may be used and the dose gradually increased until therapeutic results are obtained.

In cases of coma or severe acidosis an initial dose of 30 to 60 units may be given (in coma intravenously), followed at 3 to 4 hour intervals by doses of 20 units or more subcutaneously. Administer 1 Gm. of glucose for each unit of insulin used, The patient should never become hypoglycemic. Examine the urine hourly for glucose. If patient becomes sugar free more glucose must be given. More than 150 units of insulin in twelve hours is rarely needed.

In a small number of cases of *diabetes mellitus*, insulin can be discontinued, particularly with patients who receive it because of an exacerbation caused by complications, and where diabetes is of recent onset (though perhaps the latter should receive it intermittently as a prophylactic against increasing severity). Insulin was isolated and its therapeutic value demonstrated by Dr. F. B. Banting, while conducting researches in the University of Toronto. The University maintains full control of the product through patent rights expiring in 1940, but have arranged for its manufacture and distribution by a number of pharmaceutical manufacturers.

OVARY

The ovaries produce internal secretions which are necessary for the proper functioning of the uterus and which also have obscure effects on metabolism and on the nervous system. It is believed that ovarian function is maintained by hormone action, but the hormones themselves have so far not been isolated. While the action of some of the ovarian hormones appears to be exclusively on the organs of the genital tract or on the ovary itself, other hormones appear to have perhaps indirectly a more general influence (basal metabolism, bone-growth, nervous system).

Various preparations of the ovary of animals have been used in the treatment of conditions believed to be due to ovarian dysfunction on the assumption that the preparations contain the active principles or hormones of the ovary. Preparations of the whole ovary, corpus luteum, liquor folliculi and ovarian residue have been employed.

Rational as ovarian therapy may theoretically appear to be in some conditions, the actual results are rarely striking, and often nil to the careful observer. It cannot be assumed that a commercial preparation can replace the normal ovarian secretion in the patient's body, or for that matter that it originally contains any of the active hormones of the ovary. Further, it is not unlikely that whatever activity may be present in ovarian preparations given by mouth, is destroyed by the digestive juices, and there is considerable evidence that the aqueous extracts prepared for hypodermic use are inert. It may also be noted that favorable results interpreted as due to ovarian therapy have most often been reported in conditions in which the symptoms are subjective. Frequently favorable reports have concerned cases in which ovarian products were given together with preparations of the thyroid gland, the activity of which is not destroyed in the digestive tract.

Ovarian Substance-Armour, N. N. R.—The entire fresh ovaries (including the corpora lutea) of the hog, cleaned, dried and powdered, without the addition of either preservative or diluent.
A yellowish powder having a peculiar odor; it is partially soluble in water.
Dose—From 1 to 10 grains (0.06 to 0.60 Gm.), three times daily.
Manufactured by Armour and Company.

Ovarian Substance-L. & F. Desiccated, N. N. R.—The entire fresh ovary (including the corpora lutea) of the hog, freed of extraneous matter, dried and powdered without the addition of diluent or preservative, one part representing approximately 6½ parts of the fresh gland.
A yellowish powder having a peculiar odor, partially soluble in water.
Dose—From 2 to 5 grains (0.12 to 0.3 Gm.).

Ovarian Substance-Wilson, N. N. R.—The entire fresh ovaries (including the corpora lutea) of the hog or cow, mechanically freed from fat, dried and powdered. It contains no diluent or preservative.
A yellowish powder, having a characteristic odor. It is partially soluble in water.
One part represents approximately seven parts of the fresh ovary.
Dose—From 1 to 3 grains (0.06 to 0.2 Gm.).
Manufactured by The Wilson Laboratories.

Whole Ovary-H. W. & D., N. N. R.—Whole ovarian glands of the cow (including the corpora lutea), selected, freed from extraneous matter and dried *in vacuo*.
A yellowish powder, having a peculiar odor. It is partially soluble in water.
One part represents approximately 5 parts of the fresh animal ovary.
Dose—5 grains (0.3 Gm.) or more daily, modified to meet the requirements of the special case.
Manufactured by Hynson, Westcott and Dunning.

Whole Ovary-Lederle, N. N. R.—Whole ovarian glands of the hog or cow, freed from extraneous matter and dried at or below 38° C.
A yellowish powder, having a peculiar odor. It is partially soluble in water.
One part represents approximately 5 parts of the fresh animal ovary.
Dose—5 grains (0.3 Gm.) or more daily.
Manufactured by the Lederle Antitoxin Laboratories.

Ovarian Residue-H. W. & D., N. N. R.—The residue from the fresh ovaries of the hog after the ablation of the corpus luteum.
Ovarian residue-H. W. & D. is a grayish powder, having a characteristic odor.
Uses—Ovarian residue is used for the same conditions as the entire ovarian substance; but it is claimed to have the advantage of being somewhat more stable in composition.
Dose—From 5 to 10 grains (0.3 to 0.6 Gm.).
Manufactured by Hynson, Westcott and Dunning.

Ovarian Residue-Lederle, N. N. R.—The residue from the fresh ovaries of the hog or cow after the ablation of the corpus luteum, dried and powdered, without the addition of preservative or diluent.
One part of ovarian residue-Lederle represents approximately 5 parts of fresh substance.
Uses—Ovarian residue is used for the same conditions as the entire ovarian substance.
Dose—3 grains (0.2 Gm.) or more daily.
Manufactured by Lederle Antitoxin Laboratories.

Ovarian Residue-L. & F. Desiccated, N. N. R.—The residue from the fresh ovary of the hog after removal of the corpus luteum, dried and powdered without the addition of diluent or preservative.
A yellowish powder having a peculiar odor; partially soluble in water.
One part represents approximately 8 parts of the fresh substance.
Dose—5 grains (0.3 Gm.), three times a day, to be increased if required.
Manufactured by Lehn and Fink, Inc.
Capsules Ovarian Residue-L. & F. Desiccated, 5 grains.
Tablets Ovarian Residue-L. & F. Desiccated, 2 grains.
Tablets Ovarian Residue-L. & F. Desiccated, 5 grains.

Ovarian Residue-Wilson, N. N. R.—The residue from the fresh ovaries of the cow after the ablation of the corpus luteum.
A grayish powder, having a peculiar odor.
Dose—1 to 3 grains (0.06 to 0.2 Gm.).
Manufactured by The Wilson Laboratories.

Corpus Luteum-Lederle, N. N. R.—The fresh substance from the corpora lutea of the hog or cow, dried and powdered without the addition of preservatives or diluent.
Dose—2 grains (0.12 Gm.) or more daily.
Manufactured by Lederle Antitoxin Laboratories.

Corpus Luteum-L. & F. Desiccated, N. N. R.—The fresh substance of the corpora lutea of the ovaries of the hog, dried and powdered without the addition of diluent or preservative.

A yellowish powder having a peculiar odor; partially soluble in water.

One part represents approximately 5 parts of fresh substance.

Dose—From 2 to 5 grains (0.12 to 0.3 Gm.).

Manufactured by Lehn and Fink, Inc.

Desiccated Corpus Luteum-Armour, N. N. R.—The fresh substance from the corpora lutea from cows' ovaries, removed, dried and powdered without the addition of preservatives or diluent.

A yellowish powder, having a peculiar odor. It is partly soluble in water.

One part represents approximately 5 parts of the fresh corpus luteum substance. It contains a true lipochrome which may be extracted by alcohol, ether or chloroform.

Dose—From 2 to 10 grains (0.12 to 0.6 Gm.) twice daily.

Manufactured by Armour and Company.

Desiccated Corpus Luteum-Wilson, N. N. R.—The fresh substance from the corpora lutea of the cow, dried, freed from fat and powdered. It contains no diluent or preservative.

A yellowish powder, having a characteristic odor. It is partly soluble in water.

One part represents approximately 5 parts of the fresh corpus luteum substance.

Dose—From ½ to 2 grains (0.03 to 0.12 Gm.).

Manufactured by The Wilson Laboratories.

Lutein-H. W. & D., N. N. R.—The fully developed corpora lutea of the hog freed from foreign material, dried and powdered. One part represents approximately five parts of the fresh substance.

Dose—From 2 to 10 grains (0.12 to 0.6 Gm.), two or three times a day.

Manufactured by Hynson, Westcott and Dunning.

Corpora Lutea Soluble Extract-Wilson, N. N. R.—A sterile solution of those constituents of corpus luteum which are soluble in physiological solution of sodium chloride containing in each cubic centimeter 0.02 Gm. of soluble matter in addition to sodium chloride and chlorbutanol as a preservative.

Uses—See article on the *Ovary*.

Dose—1 cc. daily in extreme cases; less according to individual cases.

Manufactured by The Wilson Laboratories.

Corpus Luteum Extract-Lederle, N. N. R.—A sterile solution of those constituents of corpus luteum which are soluble in water containing sodium chloride 0.85 per cent., sodium citrate 1 per cent and chlorbutanol 0.5 per cent. Each cc. contains 0.02 Gm. of soluble matter in addition to sodium chloride and sodium citrate and chlorbutanol as preservative.

Dose—1 cc. intramuscularly every second day. In severe cases daily doses are said to be indicated.

Manufactured by Lederle Antitoxin Laboratories.

Sterile Solution of Lutein-H. W. & D., N. N. R.—Each cc. contains the water-soluble extractive of 0.2 Gm. of lutein, freed from protein in physiological solution of sodium chloride.

Dose—1 cc. daily, intramuscularly.

Manufactured by Hynson, Westcott and Dunning.

PARATHYROID GLAND

The use of parathyroid preparations has been recommended in the therapy of a large number of conditions. In most cases such use rests on a very flimsy foundation. Generally the reports fail to give conclusive evidence that the substance used contains the hormone of the parathyroid gland. That this gland possesses a hormone is probable. Successful substitution therapy in tetania parathyreopriva has been reported to have been accomplished by use of extracts, emulsions, nucleoproteins and dried gland. So far, no method seems to have been devised for the biologic standardization of parathyroid preparations that are available.

The knowledge that there is a disturbance of calcium metabolism in tetania parathyreopriva has led to the use of parathyroid preparations in various diseases of the bone, such as osteomalacia and rickets. Certain workers who reported successful substitution therapy in parathyroid tetany also reported successful administration of parathyroid in the treatment of gastric tetany, which does not depend on a parathyroid deficiency but on an entirely different mechanism. One must look askance at such reports until there is a preparation shown to contain the active principle of the parathyroid gland (if such exists), susceptible of successful use in substitution therapy after adequate removal of a parathyroid tissue and also of being biologically standardized.

To devote the space required to enumerate the entire list of conditions in which the use of parathyroid therapy has been proposed does not seem justifiable in view of the meager evidence of its value. There appears to be no single condition for which the use of parathyroid therapy rests upon a firm foundation, except the use of auto-transplants, in tetania parathyreopriva.

Desiccated Parathyroid Gland-Armour, N. N. R.—The exterior parathyroids of the ox freed from fat, cleaned, dried and powdered, without the addition of preservative or diluent.

A light yellow powder having a peculiar odor. Partly soluble in water.

One part represents approximately 10 parts of the fresh tissue.

Dose—$\frac{1}{15}$ grain (0.006 Gm.), four times a day.

Manufactured by Armour and Company.

Desiccated Parathyroid Substance-Wilson, N. N. R.—The exterior parathyroids of the ox freed from fat, cleaned, dried and powdered, without the addition of preservative or diluent.

A light yellow powder having a characteristic odor. One part represents approximately 5 parts of the fresh tissue.

Dose—$\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003 to 0.006 Gm.) as often as directed.

Manufactured by The Wilson Laboratories.

FIBRIN FERMENTS

The following information concerning these important new therapeutic agents is an abstract from the 1925 N. N. R.:

Preparations containing thromboplastin are said to be useful when applied locally in the treatment of hemorrhages, especially hemorrhages from oozing surfaces, scar tissues and in nose bleed, and in surgery of the bones, glands, nose, and throat. When injected subcutaneously or intravenously, such preparations are said to shorten the coagulation time of the blood for a period of about twenty-four hours, but there may be a certain danger of a negative phase setting in. Such injections are contraindicated in cases in which there is a

tendency to thrombosis or embolism; for example, in arteriosclerosis, aneurysm, heart weakness, phlebitis, certain stages of syphilis, and in varicose veins. Preparations should be standardized by testing on specimens of blood in vitro, which should be able to bring the coagulation time to about one third of its original length; they should be proved to be sterile, particularly if intended for intravenous use.

Brain Lipoid, N. N. R.—*Impure Cephalin*—Impure Kephalin—An ether extract of the brain of the ox, or other mammal, prepared according to the method of Howell (see the N. N. R.).

Dose—Brain lipoid may be smeared on gauze sponges, pledgets, or on the tissues themselves; or an emulsion may be prepared by shaking up with physiological solution of sodium chloride and used in the same way or sponged over the tissues.

For use in an office or dispensary, the ether extract suffices and can be kept ready for use for some time (several months) in a sterile dropper bottle from which an opalescent emulsion can be prepared at a moment's notice by dropping from 10 to 30 drops into an ounce of physiological solution of sodium chloride and then shaking. This solution can also be dispensed from drug stores, provided the opening in the stopper of the dropper bottle is kept slightly open to prevent the ether's blowing off when the bottle is shaken or heated.

Kephalin-Armour, N. N. R.—The hemostatic phosphatid obtained from the brain tissue of cattle. It is essentially the same as brain lipoid.

Dose—From 0.1 to 0.2 per cent suspensions of kephalin-Armour in sterile physiological solution of sodium chloride are applied freely to bleeding or oozing surfaces.

Manufactured by Armour and Company.

Solution Brain Extract, N. N. R.—*Liquor Extracti Cerebri*—Solution Thromboplastin-Hess—An extract of cattle brain in physiological solution of sodium chloride prepared by the method of Hess (see the N. N. R.).

Dose—The solution may be applied directly to the bleeding tissues or sprayed on them, or a sponge or tampon may be immersed in it and then pressed on the bleeding surface.

Thromboplastin Solution-Armour, N. N. R.—An extract of cattle brain in physiological solution of sodium chloride prepared according to the method of Hess.

Dose—See Solution Brain Extract. Thromboplastin solution-Armour is marketed in 25-cubic-centimeter vials which bear an expiration date, after which time the contents should not be used.

Manufactured by Armour and Company.

Thromboplastin-Lederle, N. N. R.—An extract of cattle brain in physiological solution of sodium chloride prepared according to the method of Hess.

Dose—For local application, see Solution Brain Extract. When local application is not possible, 10 to 20 cc. may be injected subcutaneously or intramuscularly. Thromboplastin-Lederle is marketed in 20 cc. vials which bear an expiration date, after which the contents should not be used.

Manufactured by Lederle Antitoxin Laboratories.

Thromboplastin-Squibb, N. N. R.—An extract of cattle brain in physiological solution of sodium chloride prepared according to the method of Hess.

Dose—See Solution Brain Extract. Thromboplastin-Squibb is marketed in 20-cubic-centimeter vials. It is claimed that no loss of potency could be detected in unopened specimens of thromboplastin-Squibb more than two years old.

Manufactured by E. R. Squibb and Sons.

Thromboplastin Hypodermic-Squibb, N. N. R.—A sterilized extract of cattle brain in physiological solution of sodium chloride. It complies with the description of thromboplastin-Squibb, but a longer time is required for the clotting of blood plasma.

Actions and Uses—Thromboplastin hypodermic-Squibb is intended for hypodermic and intramuscular injection to increase the coagulability of the blood.

Dose—From 10 cc. to 20 cc. every twenty-four to seventy-two hours. Thromboplastin hypodermic-Squibb is marketed in 20-cubic-centimeter vials which bear an expiration date after which time the contents should not be used. (The manufacturer reports that no loss of potency could be detected in specimens which had been kept unopened for two years.)

Manufactured by E. R. Squibb and Sons.

OTHER PRODUCTS OF ANIMAL ORGANS

Mammary Substance—The mammary gland of the sheep cleaned, dried and powdered. Used to control uterine hemorrhage and induce contraction of the uterus after labor.

Dose—2 to 5 grains (0.13 to 0.32 Gm.).

Pineal Gland (Desiccated)—The pineal gland, a small, reddish, vascular body in the posterior part of the third ventricle, of normal young cattle, cleaned, dried, and powdered. It has some influence on the growth of the body and mental development. Used in the treatment of undersized and mentally backward children.

Dose—$\frac{1}{10}$ grain (0.006 Gm.).

Thymus Gland (Desiccated)—A glandular organ in the anterior superior mediastinium (the septum of the thorax cavity). It disappears in adult life. It is prepared by drying the thymus gland obtained from healthy domestic animals. It is used much like the thyroid in the treatment of exophthalmic goiter, also in rickets, marasmus, and related diseases.

Dose—2 to 4 grains (0.13 to 0.25 Gm.).

Testicular (Orchic) Substance—The testes of the hog or cattle, cleaned, dried and powdered.

Unofficial Animal Products and Derivatives

Class Mammalia

Acidum Butyricum, $C_4H_8O_2$ Butyric Acid	A colorless liquid, having a disagreeable odor and a rancid taste. Density, 0.973
Ambra Grisea Ambergris	A morbid excretion from the intestines of *Physeter macrocephalus*, found floating on the sea. It is friable when cold, of a gray or brown-gray color. It contains 85 per cent of ambrein, etc. Used in perfumery
Argenti Lactas, Silver Lactate $Ag.C_3H_5O_3 + H_2O$	The normal silver salt of lactic acid. An astringent antiseptic, having about twice the power of mercuric chloride. It is irritating if applied in substance to wounds. Used in 1 : 100 to 1 : 2000 solutions
Argonin	Silver-casein. A white powder containing from 4 to 25 per cent of silver. Used as injection in 2 to 5 per cent solutions

Unofficial Animal Products and Derivatives—*Continued*

Sanguis Blood	The arterial fluid of the ox, *Bos taurus*. It is of a red color, opaque, and has a peculiar odor. It contains 78 per cent of water, 8 per cent of albumen, 5 per cent of fibrin, etc. The red color is due to *hæmoglobin*
Butyrum Butter	From the milk of the cow, *Bos taurus*. Obtained by allowing the cream to separate from the milk, collecting and churning. A soft, yellow, neutral substance, of a pleasant, sweet odor and a bland taste. It contains 30 per cent of olein, and about 68 per cent of palmitin and stearin, etc.
Castoreum Castor	From the preputial follicles of both the male and female animals *Castor Fiber*. They occur in pairs, are pyriform, of a brown or blackish color, a peculiar odor, and a bitter, acrid, and nauseous taste. It contains a volatile oil, and from 15 to 40 per cent of a bitterish, resinous substance, etc.
Civetta Civet	An odorous substance obtained from two animals of the genus *Viverra* which inhabit the East Indies. It is semi-solid, unctuous, yellowish, becoming brown and thicker by exposure to air; of a very strong, peculiar odor and a bitterish acrid, and nauseous taste. It contains volatile oil, and resinous and other matters. Used in perfumery
Collargolum Argentum Credé	Colloidal or soluble silver. Dose, 1 to 2 grains (0.065 to 0.13 Gm.)
Fibrin	Obtained when blood is allowed to coagulate or is whipped with a bundle of twigs. It is at first, when pure, a gelatinous mass, which changes to a white, tenacious material, consisting of minute fibrils
Hemoglobin	The coloring matter of the red blood corpuscles combined with iron. Used as a substitute for iron in the treatment of anemia. It consists of protein, globulin, and hematin. Various preparations of hemoglobin have been put on the market. These are of two classes: (1) preparations consisting essentially of oxyhemoglobin, usually sold under the name "hemoglobin"; (2) preparations derived by the action of reducing agents on the blood, such as zinc and pyrogallol. They consist of reduced hemoglobin or of some modification of it
Hemogallol (Hæmoglobin, deoxidized by pyrogallol)	A combination of iron with the hemoglobin of blood; a compound which is easily assimilated. In the form of an insoluble and tasteless red-brown powder. Given in doses of 4 to 8 grains (0.25 to 0.5 Gm.) for anemia, convalescence, etc.
Hemol	A blood preparation containing iron
Hyraceum	The product of *Hyrax capensis*, an animal of Southern Africa. It is found on the rugged sides of mountains, and is supposed to be the excrement or the dried urine of the animal. It is rather hard, tenacious, of a blackish-brown color, and of a taste and smell similar to those of castor
Keratin	The organic basis of horny tissues, hair, nails, feathers, epithelium, etc. It has been used for coating pills so as to enable them to pass through the acid juices of the stomach and be dissolved in the alkaline intestinal fluids, but has been largely discredited
Milk Casein	The most abundant of the albuminoids obtained from milk by the addition of rennet
Moschus Tonquin Musk (U. S. P. IX)	The dried secretion from the preputial follicles of *Moschus moschiferus* Linné (Fam. *Moschidæ*) Usually in small irregular granules not more than 2 mm. in thickness, blackish with a few brown fragments and becoming somewhat grayish on aging; glistening and somewhat oily. Odor peculiar, penetrating, powerful and persistent; taste somewhat bitter. Its aqueous solution is slightly acid to litmus. (See the U. S. P. IX for additional tests for purity.) Musk contains cholesterol, ammonia, an acid principle, wax, fat, albuminous and gelatinous principles, and an odorous matter not yet determined Uses—Musk is antispasmodic and stimulant. It is used in the form of suppositories as a stimulant in the exhaustion of typhoid fever. Dose, 4 to 15 grains (0.25 to 1 Gm.). The largest use of musk has been as a fixative in perfumes (see page 1218) but its scarcity and high cost necessitate many substitutes which have largely replaced it. Its use in medicine has also been largely discontinued
Neat's-foot Oil	Prepared by boiling the feet of cattle, deprived of their hoofs, with water, removing the oil which rises to the surface, and allowing it to remain for some time in warm water. Used for softening leather
Novargan Argenti Proteinas	An organic silver-albumin compound containing 10 per cent of silver. It occurs in fine yellow powder, soluble in water. It is a bactericide, and less irritating than other protein-silver compounds. Used in gonorrhea, especially as an abortive in the first stage. Dose, 8 minims (0.5 cc.) of a 15 per cent solution
Ovoferrin	A solution containing 5 per cent of an artificial protein product in which iron is present in the so-called "organic" or "masked" form (a form which does not give the iron test directly) equivalent to 0.4 Gm. of metallic iron to each 100 cc. Ovoferrin is prepared by modifying serum albumin by electrolysis and introducing ferric hydroxide into this modified protein by heating under pressure The solution has a reddish-brown color, little odor, and a flat, slightly aromatic and alcoholic taste[1] Ovoferrin is said not to be affected appreciably by the gastric juice, 0.5 per cent solution of hydrochloric acid liberating its iron very slowly and incompletely. The product ranks with the other forms of artificially masked iron, which are devoid of the local action of the soluble inorganic iron salts, and, according to some authorities, are more readily absorbed and utilized. Dose, from 2 to 4 fluidrachms (8 to 15 cc.) corresponding to from ½ to 1 grain (0.03 to 0.06 Gm.) of elemental iron, three times a day Manufactured by A. C. Barnes Company
Paraglobulin	Obtained from blood serum, lymph, chyle, etc. It is a granular substance, gradually becoming more compact
Peptones	The product of the action of gastric and pancreatic juices, or of pepsin alone, upon albuminoids during the process of digestion
Ptomaines Cadaveric alkaloids	Alkaloidal substances found in dead bodies or decomposed animal matter, as *cholines, muscarine, neurine, gadinine, tetanine, dimethylamine, trimethylamine, triethylamine, putrescine, cadaverine, saprine, neuridine, collidine, hydrocollidine, parvoline,* and *tyrotoxicon (diabenzene)*, etc.

Unofficial Animal Products and Derivatives—*Continued*

Ptyalin	A fermentative substance occurring in saliva, and having the power of converting starch into dextrin
Sodii Choleas Sodium Choleate	Prepared by evaporating fresh oxgall to one-half, and precipitating the slimy and coloring matters with an equal bulk of alcohol, treating the filtrate with animal charcoal, distilling off the alcohol, and washing the residue with ether. It occurs as a white, sticky mass, having a penetrating odor, and a peculiar, sweetish, afterwards bitter taste. (See Fel Bovis)
Sophol	A compound of silver and methylene-nucleinic acid, the silver being in organic or masked form. A bactericide used in eye affections. Use from 2 to 5 per cent solutions
Urea, Carbamide, $CO(NH_2)_2$	A hydragogue diuretic. Dose, 10 grains (0.65 Gm.) every six hours
Sperm Oil	From the cranial cavities of *Physeter macrocephalus*. It is of a yellow or brown-yellow color. Sp. gr. 0.920. On cooling, it deposits spermaceti and stearin
Whale Oil	From *Balæna mysticetus*. It has a peculiar fishy odor and unpleasant taste
Porpoise Oil	From *Delphinus Phocæna*. Prepared by heating the belly-blubber of the porpoise. It is, when fresh, of a pale yellow color
Seal Oil	From *Phoca* of various species
Dugong Oil	From *Halicore Dugong*. Habitat, waters of Eastern Australia. This oil is generally used as a substitute for cod liver oil in Australia
Class Pisces	
Eulachon Oil	From *Thaleichthys Pacificus*, a small fish found on the Pacific Coast. This oil has been proposed as a substitute for cod liver oil
Gaduol (Morrhuol)	Alcoholic extract of cod liver oil. Brownish-yellow, oily liquid of a bitter, acrid taste. Used like cod liver oil, prepared in wine or elixirs, in doses of 5 to 30 minims (0.3 to 2 cc.)
Ichthyocolla Isinglass. (U. S. P. 1890)	The swimming bladder of *Acipenser Huso* Linné, and of other species of *Acipenser* (order *Sturiones*). Used in making isinglass or court plaster
Menhaden Oil	From *Alosa Menhaden*. Habitat, Atlantic Coast. Used in dressing leather
Shark Oil	From the liver of the shark, *Squalis Carcharias*, and other species. It is of a light yellow color, and has an acrid taste. Sp. gr. 0.870 to 0.880
Skate Oil	From the liver of *Raja Batis*. Employed largely in France and Belgium. It is of a bright yellow color. Sp. gr. 0.928
Lipanin	A mixture of 100 parts of olive oil and 6 parts of oleic acid. Used as a substitute for cod liver oil. Dose, 1 to 4 fluidrachms (4 to 16 cc.)
Class Aves	
Ferratin Ferric Acid Albuminate	A reddish-brown, odorless, and tasteless powder, insoluble in water, but soluble in slightly alkaline solutions. It contains about 7 per cent of iron, and is given in eight-grain (0.5 Gm.) doses
Ingluvin	From the gizzards of *Gallus Bankiva*. Prepared by a process similar to that employed in preparing pepsin. The dried and powdered gizzards are often used as digestives
Lecithin, $C_{44}H_{20}NPO_9$ Distearin-Glycero Phosphoric-Cholin Ester	A phosphated substance, prepared from the yolk of egg, nerve tissue, blood, and bile. A colorless, crystalline compound, soluble in alcohol and ether. Used as a nerve tonic in doses of 1 to 2 grains (0.065 to 0.13 Gm.)
Vitellin	It exists in the yolk of eggs. Closely resembles fibrin
Class Insecta	
Cobweb	The web of *Tegeneria domestica*. It has been recommended in phthisis and chronic intermittents, but is most useful in controlling hemorrhage by simply applying it to the bleeding surfaces
Blatta Cockroach	The insect *Blatta orientalis*, about one inch long, oblong, flat, of a reddish-black color, odor very disagreeable. It contains fetid oil, extractive, antihydropin, etc. Used as a diuretic
Red Ant	The insect *Formica rufa*. It contains a volatile oil and formic acid
Class Reptilia	
Crotalus	Prepared from the venom of the rattlesnake (*Crotalus horridus*). While the snake is under chloroform the poison contained in the fang is pressed out and mixed with 9 parts of glycerin. Used in epilepsy
Phynin	From the glandular secretion and dried skin of the toad (*Bufo viridis* and *B. cinereus*). Similar in its effects to digitalin
Class Annelida	
Hirudo Leech (Br. 1914)	From *Hirudo medicinalis* and *Hirudo quinquestriata*. From three to six inches long, smooth, soft, round, tapering at the ends, composed of about one hundred rings; of a blackish-green color. Used for local depletion

PART VI

PERFUMERY AND COSMETICS

CHAPTER LXXVI

THE ART OF PERFUMERY

IN the cultural development of civilization one of the qualities which lifts mankind above other living things is that esthetic sense of mind and spirit which is expressed by the so-called "fine arts".

To those who will to see is given the delight of nature's glories expressed in mountain, sunset and sea, and in a thousand other beautiful pictures. Man, in sculpture, painting, textile arts, and architecture, has also learned to create beauty and to delight in it. For the ear, great artists have sung their melodious dreams, perpetuating them in music for the stirring of the human heart; for the lifting of nations into realms of sheer delight, or inspiring them to noble deeds. The epicurean artist has brought beauty and joy by his creations. Through the touch of silk and velvet, another sense has brought to man an appreciation of the beautiful. Truly it was ordained that the sense of smell should also bring its gifts; for what is more delightful than the perfume-laden air which drifts across a field of new-mown hay, or the odor of the pine woods, or the faint perfume of a rose or other fragrant flower.

The enjoyment of fine odors has not received the cultivation that is given music, or painting, or the textile arts; yet it plays an important rôle in the lives of most people, influencing actions and giving pleasure, or perhaps distress.

Piesse records the historic fact that in 1770 an act was introduced into English Parliament which read:

> "That all women of whatever age, rank, profession, or degree, whether virgins, or widows, that shall, from and after such Act, impose upon and betray into matrimony any of his Majesty's subjects, by the scents, paints, cosmetic washes, artificial teeth, false hair, Spanish rouge, iron stays, high-heeled shoes, bolstered hips, shall incur the penalty of the law now in force against witch craft and like misdemeanors, and that the marriage, upon conviction, shall stand null and void."

What one has not felt the power of that distinctive perfume which means a presence or a precious memory? What woman does not know the advantage of associating romance with a pleasing perfume and then perpetuating its memory by allowing the capture of a glove or lacy handkerchief which bears the perfume?

Some one has said that no sense brings so vividly to mind its associations as that of smell; most individuals can bear testimony to this truth.

Those who cater to the feminine taste in perfumes should know these facts. It is the distinctive odor, obtainable in every form, suitable for use among the lingerie, for perfuming the bath, or perhaps ready to delicately permeate a room with its sweetness, that will please "milady".

For this is needed the artist's touch, imagination, and the product of the master perfumer.

Perfumes are associated in the earliest records with religious ceremonies. It is but natural that the nations of the East, even in remote antiquity, should have offered the sweet-smelling woods and resins of their native land as gifts to their gods. Thus did they show their homage and respect.

Upon the Egyptian Sphinx which formed the end of a temple, is pictured the king burning incense and offering a libation of oil or ointment.

In Greek mythology men are pictured as obtaining their knowledge of perfumes through the indiscretion of a nymph of Venus.

The early use of perfumes in the worship of the Hebrews is indicated by many passages of the Bible, and in the thirtieth chapter of Exodus, Moses is directed to burn perfumed gums and woods upon an altar, and Aaron to "Burn thereon sweet incense every morning"; Moses is directed also to "take sweet spices, stacte and onycha, and galbanum, these pure spices with frankincense", and to "make perfume, a confection, after the art of the apothecary, tempered together, pure and holy", and "whosoever shall make like unto that, to smell thereto, shall even be cut off from his people".

India and Arabia have traditionally been the lands of perfumes, and the Greeks, and later the Romans also became devotees of the perfumer's art, soon adapting it to their personal use and carrying the practice to an extreme never since attempted.

In Greece the perfumer's shop was the common meeting place for gossip, and a Greek poet of 350 B.C. wrote:

> "For he t' annoint himself,
> Dipped not his finger into alabaster,
> The vulgar practice of a former age;
> But he left fly four doves, with unguents drenched,
> Not of our sort, but every bird a perfume bore.
> Peculiar, and, differing from the rest;
> And they hov'ring around us, from their heavy wings
> Showered their sweets upon our robes and furniture,
> And I—Be not too envious, gentlemen,—
> I was bedewed with violet odours".

In the Roman amphitheater during a spectacle the air was constantly refreshed by the playing of fountains of perfumed waters.

Perfumed ointments were kept in highly ornamented boxes usually made of alabaster or onyx, and a treatise on the perfumer's art, written by Apollonius, is still extant and gives the sources of supply and the uses of the various odors.

A perfume invented by Frangipanni, one of the earliest Roman nobles, is yet used and bears his name. It is a sachet composed of equal parts of "every known spice", to which is added a weight of orris root equal to the whole, and one per cent of musk and civet.

It is supposed that the Crusaders brought the perfumer's art to England from Eastern Lands, and by the Elizabethan period it had been developed to a high degree of perfection.

Beau Brummel, the arbiter of English fashion, did not believe in men of fashion using perfumes, and recommended that they send their linen to be washed on Hampstead Heath.

At the close of the nineteenth century, the manufacture of perfumery had been well established; immense laboratories were built in France and England, and their products sold throughout the world.

Source of Natural Perfumery Materials—The raw materials available at that time were all from natural sources. A number of *animal products* had come into use, not for their value as perfumes, but to perform a necessary function

in the perfume, namely to retard the lavish expenditure of odor which the plant or product would otherwise freely give until exhausted.

This class of products are termed "*fixatives*", and include such substance as musk, ambergris, civet, and castor. These materials are still used, although musk and ambergris are scarce and expensive, and other products have successfully replaced them in many instances.

Natural *perfumed woods or flowers* represent another class of natural products used throughout the centuries, and still employed for sachets. The most important available today are sandalwood, orris, rose petals, cassie flowers, orange flowers, and vertivert.

The oleoresins of Siam benzoin, of oak moss, Peru balsam, tolu, galbanum, orris, styrax, etc., constitute another type of preparations which are still used.

Volatile Oils—The perfume of flowers, fruit, and other natural products is due chiefly to a substance called *volatile oil*. This oil exists in the cells of the plant, and its extraction is accomplished by one of several ways. Some oils, notably those of the citrus group, including orange and lemon, are found in comparatively large cells, near the surface of the rind, and may be readily removed by one of the processes described on page 952.

Other volatile oils may be obtained by what is termed "steam distillation". The oil-bearing portion of the plant, whether fruit, seed, flower, or herb, is placed in a basket in a still. Water is added and the mixture heated, the vapor being condensed and collected in a Florentine receiver. This vessel is so arranged that the lighter oil may separate and rise to the surface for collection, while the saturated water is drawn off at the bottom (see page 215). The water thus obtained is sometimes of commercial value, as orange flower water and rose water, but, if not salable, it is returned to the still for the next operation, and thus the loss of oil is avoided. Today vacuum stills are usually employed in the manufacture of volatile oils (see Fig. 142).

The more important volatile oils made by this process, and of value to perfumery are rose, neroli, lavender flowers, bay, cardamom, cinnamon, rose-geranium, orris, palmarosa, petit-grain, sandalwood, ylang-ylang (see also the chapter on Volatile Oils, page 950).

Pomades—Some volatile oils, especially the more delicate flower perfumes, cannot be obtained successfully by steam distillation, either because the oil exists in quantities too small to distil or it is injured by the process, through oxidization or hydrolysis.

Other processes have therefore been devised. One of these is termed "*enfleurage*" or the "*absorption method*". A mixture of specially selected and highly purified lard and beef fat is spread in a thin layer on linen in a frame, and the fresh flowers, each morning for thirty days, are sprinkled on the fat, the frames being stacked on each other for the intervening time, that the odor may be absorbed. The odorous fat or "*pomade*" as it is termed is later washed with alcohol to remove the perfume, and these *essences* or alcohol washings were, for many years, the most important perfume material available.

The flowers best extracted by the enfleurage process are: jasmine, tuberose, jonquil, lily of the valley (muguet), and mignonette (reseda), and pomades of rose, cassie, violet, orange flowers, lilac, and heliotrope are also obtainable.

The maceration or *infusion process* is also employed for this same group, the fresh flowers, each day, being tied in linen bags and macerated in the warmed fat for twenty-four hours, the flowers being afterward separated from the fat by centrifuging. The fat should be macerated with at least fifteen different lots of flowers. The pomades, especially jasmine, are used particularly to cover the so-called "chemical odor" of synthetics.

Concretes and Absolutes—The group of flowers, which cannot be distilled, are also extracted by cold, *volatile-solvents*, chiefly ether or benzin (petroleum ether), and after extraction the solvent is removed by vacuum distillation. By this cold extraction process are formed what are called "*concretes*". The flowers satisfactorily treated by this method are: rose, Parma violets, victoria violets, orange blossoms, jasmine, tuberose, jonquil, cassie, mignonette, and sometimes carnations, lily of the valley, heliotrope, elder flowers, narcissus, and mimosas.

The volatile-solvent method of extraction removes not only the volatile oil, but also the flower waxes and other inert constituents. If these are now removed by alcohol washing and freezing, a still more concentrated product results, commercially sold under various names such as "*hyperessences*", "*absolutes*", etc., and these are the most expensive perfumery materials now available, the current price for jasmine absolute being $600 a pound. A dilution of this absolute which corresponds exactly in concentration to the concrete is known commercially as a *liquid absolute*. These are made by diluting absolutes to the proper concentration, using an appropriate solvent such as benzyl benzoate or diethylphthalate. Perfumers who use this class of raw materials, obtainable only from the fresh flowers, are apparently justified in the high price asked for their products.

Synthetic Perfumery Material—The cost and variability, in both quality and price, of perfumery products from natural sources, has stimulated the organic chemist to search for synthetic products which would either replace or augment natural perfumes.

The painstaking efforts which have been made to determine the physical characteristics and chemical constituents of important volatile oils and other odorous products, that standards for pure products might be established, and the careful analysis of many other products, in pure research and for commercial purposes, has made available a vast amount of knowledge covering the constituents of these perfumes. With an exact record of the pure chemicals composing the perfume and the proportion in which they exist in nature, the organic chemist theoretically is only required to prepare the various pure chemicals, mix them in the proportion indicated, and produce artificially a rival of nature, which is always uniform in quality and odor-value, and at a price subject to little fluctuation.

This dream of the synthetic chemist has today been partly realized. Many natural oils have been almost completely duplicated in the laboratory, and the chemist has also discovered chemicals which possess odors practically identical with those in nature, but entirely unrelated chemically. Artificial musk admirably illustrates this type (see page 1218).

The perfume chemist has also been able to reproduce many flower odors, which it has not been possible to extract from the flowers because of the minute quantity present; such odors as arbutus and sweet pea are illustrations.

It must not be thought, however, that synthetic perfumes always fully duplicate nature's odors. Often there are minute quantities of constituents which are so elusive that they escape the most careful analysis and others have defied reproduction, but sufficient has been done to fascinate and awe those who make even a casual study of modern laboratory creations, and to very largely replace natural perfumery products.

Aromatic Chemicals Employed in Perfumery—The following section includes the more important of the chemical substances synthetically produced or isolated from natural sources and available today for the preparation of synthetic perfumes. By consulting the advertising pages of a journal like

The American Perfumer, available manufacturers or distributors of these products will be noticed. The various constituents of volatile oils and of flower odors represent many classes of organic compounds and for convenience they are grouped according to their chemical affiliations. For a more complete study of the chemistry of these products see *The Chemistry of Essential Oils* by Ernest J. Parry.

ACIDS

Benzoic Acid—(See page 832). This is used as a fixative in sachets and fumigating pastiles, especially the natural acid separated from *benzoin*. The Siam variety of benzoin is preferred for this purpose. For making *benzoin lotion*, however, the Sumatra benzoin, which contains more gum, is better.

Cinnamic Acid—It is obtained chiefly from storax. White, odorless crystals, melting at 133° C. It is used chiefly as a fixative, especially in its natural combination in storax, benzoin, or tolu.

Phenylacetic Acid—White, flake-like crystals, melting at about 76.5° C. and boiling at 141° C.; soluble in water. It is used chiefly to produce its alcohol or esters but has a honey-like odor and is used to perfume soaps. It is an excellent fixative, replacing indol and civet in perfumes which must be colorless, and in lotions and toilet waters. Use small amounts as it is very powerful.

ALCOHOLS

Alcohol-C_8 (octyl alcohol)—A normal alcohol having a peculiar, fatty odor resembling rose pomade. It is used in toilet water, perfumes, and skin creams, and in fancy floral perfumes of the rose type to get the pomade effect.

Alcohol-C_9 (nonyl alcohol)—A liquid having an odor suggesting oil of tuberose, cassie, mimosa, and jonquil. It is sometimes used to give a special note to rose perfumes or to Cologne water.

Alcohol-C_{10} (decyl alcohol)—A liquid, which when used in small quantities, improves and gives distinctive characteristics to perfumes. Its own odor suggests tuberose or cassie, but is not as strong as Alcohol-C_9. It is also a valuable fixative.

Alcohol-C_{11} (undecylic alcohol)—A liquid occurring naturally in oil of rue but also prepared synthetically. Its odor suggests flowers, principally fresh reseda, cassie, or violet. It is sometimes used in Cologne water.

Alcohol-C_{12}—A solid substance at normal temperature having a weak, fatty, and mellow odor, not very distinctive, but used sometimes to impart the pomade character to floral synthetic odors.

Benzyl alcohol—A colorless liquid, having a slight balsamic odor when pure. It boils at about 295° C. and has a specific gravity of about 1.05 at 15° C. It occurs naturally in the oils of jasmine, neroli, ylang-ylang, cassie, and others, but is prepared synthetically by heating benzyl chloride with potassium carbonate. It is largely used as a solvent and fixative in synthetic perfumes such as jasmine, tuberose, chypre, ylang-ylang, etc. It is also used as a solvent for synthetic musk. Protect from light and air.

Borneol—An alcohol naturally existing in and the characteristic constituent of pine needle oils. It forms a white, crystalline mass which, when pure, melts at 203° C. It is usually found in the form of its esters of which *bornyl acetate* is the most important.

Cinnamic alcohol—Usually a white solid mass when melted, boiling at 117° C. (5 mm.). Soluble in all proportions in alcohol. It occurs naturally as esters, in balsam of Peru and in storax. It possesses a very sweet odor resem-

bling hyacinth or lilacs. It is used chiefly as a fixative in such perfumes as rose, lilac, hyacinth, etc. It is also used as a fixative in creams and in fine soaps.

Citronellol (*roseol, reuniol*)—A colorless liquid, isomeric with rhodinol and geraniol. It boils between 113° and 115° C. (15 mm.); specific gravity 0.86 at 15° C. Soluble in alcohol in all proportions. It occurs naturally in the oils of geranium and rose and the odor is suggestive of both oils. It is used in all rose and geranium perfumes, whether for extracts, soaps, or creams.

Geraniol—A colorless liquid, boiling between 110° and 111° C. (10 mm.); specific gravity 0.88 at 15° C.; an isomer of linaloöl. It is soluble in alcohol in all proportions. It occurs naturally in the oils from palmarosa, citronella (Java), lemon grass and many other oils. Its odor is very sweet and rose-like and it may be used in soaps, as it is not decomposed by free alkali. It is used in many perfumes besides rose, such as geranium, cassie, hawthorn, lily, honeysuckle, neroli, ylang-ylang, etc.

Linaloöl (*linalol*)—A colorless liquid, boiling between 70° and 71° C. (4 mm.); specific gravity 0.87 at 15° C.; an isomer of geraniol. It is soluble in alcohol in all proportions. It occurs naturally in the oils of jasmine, ylang-ylang, bois de rose, rosewood, etc., the latter being the commercial source. The odor resembles rosewood and is used in the preparation of synthetic oils of orange flowers, rose, lily of the valley, lilac, honeysuckle, wallflowers, cyclamen, and other bouquets. The odor is fine but not very lasting.

Nerol—An isomer of geraniol occurring in the free state or as an ester in the oils of neroli, rose, ylang-ylang, wallflower, etc.

Phenylethyl alcohol—Boiling point 99° C. (6 mm.); specific gravity 1.020 at 15° C. A colorless liquid occurring naturally in rose flowers. The odor is honey-like. As it is readily soluble in water, it is found in rose water and only in small quantities in the distilled oil of rose. It is a constituent, however, in rose absolutes and concretes and is the distinctive odor of white rose. It is suitable for perfuming soaps and is employed in the preparation of synthetic oils of rose, lilac, hyacinth, jasmine, narcissus, neroli, lily of the valley, etc. It is also a valuable fixative.

Rhodinol—This alcohol is isomeric with citronellol and geraniol. It is a colorless liquid, boiling between 110° and 120° C. (10 mm.); specific gravity 0.87 at 15° C. The commercial product is usually distilled from geranium oil. It has a strong rose-like odor and is one of the most important constituents in natural oil of rose and oil of geranium and the chief dependence in making artificial oil of rose. It is especially valuable in perfuming toilet soaps.

Terpineol—A colorless liquid, boiling between 104° and 105° C. (10 mm.); specific gravity 0.94 at 15° C. This alcohol possesses an odor resembling the perfume of lilac flowers, and is largely used as a cheap soap perfume, as it is not decomposed by alkali. It is an important addition to the preparation of the cheaper synthetic perfumes of lilac, lily of the valley, sweet pea, violet, carnation, narcissus, etc. It readily dissolves in fats and is therefore much used in toilet creams.

ALDEHYDES

Aldehyde-C_8 (*octyl aldehyde*)—A natural aldehyde in the oils of lemon, rose and neroli. It possesses a strong fatty and waxy odor and must be used only in small amounts. It furnishes a distinctive shade to the odor of fine perfumes, especially of the rose type.

Aldehyde-C_9 (*nonyl aldehyde*)—An aldehyde occurring in the oils of rose, cinnamon and orris. It is of value in preparing synthetic oils of rose and neroli. Only a small amount is to be used, not more than 1 per cent, dissolved in alcohol. It is a good fixative.

Aldehyde-C_{10} (decyl aldehyde)—This is an oily liquid of an intensely sweet odor and used in minute amounts to perfect many synthetic oils including violet, neroli, cassie, rose, jasmine, wallflower, etc.

Aldehyde-C_{11} (undecylic aldehyde)—A liquid having a powerful, undefinable odor. Only traces must be used to modify floral oils.

Aldehyde-C_{12} (lauric aldehyde)—When of full strength it possesses a strong fatty odor but when diluted suggests violet leaves and orris. Traces only are to be used in jasmine, tuberose, lily of the valley, and violet.

Aldehyde-C_{12} (methylnonylacetic aldehyde)—This is the most important of the aldehyde series. When highly diluted it has the odor of the fresh peel of oranges and lemons and gives a freshness and originality to perfumes.

Anisic aldehyde (aubepine)—A colorless liquid, boiling at 91° C. (10 mm.); specific gravity 1.13 at 15° C. This liquid possesses the odor of hawthorne blossoms and is the basis for that odor. It is also used in the preparation of synthetic acacia, wallflower, new-mown hay, sweet pea, orchid, lotus, elder flower, etc. It dissolves in alcohol, oils, or glycerin and blends well with terpineol, linaloöl and terpinyl acetate.

Cinnamic aldehyde—A yellowish liquid, boiling at from 118° to 120° C. (10 mm.); crystallizing at −7° C.; specific gravity 1.06 at 15° C. It is the most important constituent of the oils of cinnamon. It is used to perfume soaps and hair washes, and is employed in various oriental type perfumes.

Benzaldehyde (see page 990).

Citral—This is an unsaturated aldehyde and occurs naturally in the oils of lemon, lime, verbena, lemon grass, etc. It is more soluble in water or dilute alcohol than oil of lemon and, when pure, is often used in place of *terpeneless oil of lemon*. In perfumery it imparts a fresh lemon odor to perfumes producing the so-called lemon soaps and creams.

Citronellal—A colorless liquid, boiling at from 72° to 73° C. (6 mm.); specific gravity 0.86 at 15° C. It occurs naturally in citronella oil from which it is extracted. The odor suggests citral. It is used in cheap soaps, but they must be neutral, or they will decompose it.

Heliotropine (piperonal)—White crystals, melting at from 36° to 37° C. and boiling at about 135° C. (10 mm.). This is one of the most important synthetic perfumery products, having the distinct odor of heliotrope and being an excellent modifier and fixative. It is used in perfuming soaps, sachets, powders and in the preparation of most synthetic perfume oils. Sometimes heliotropine is said to discolor. In reality, if properly used it does not discolor. Being an aldehyde, it is sensitive to alkali and certain metals, such as iron, and these must therefore be avoided.

Hydroxy-citronellal (laurine)—A thick, oily liquid, boiling at 116° C. (2.5 mm.) and having a specific gravity of 0.93 at 15° C. It has a sweet and powerful odor suggesting flowers such as lily of the valley, honeysuckle, cyclamen, linden blossoms, etc. It is possible to use it in many sweet flower perfumes and it also serves as a fixative. As much as 25 per cent may be used in lilac, from 10 to 40 per cent in lily, about 15 per cent in magnolia, etc. It is one of the most valuable developments of recent perfumery chemistry.

Phenylacetic aldehyde (jacinthe)—A colorless liquid, boiling at from 74° to 75° C. (6 mm.); specific gravity from 1.03 to 1.05 at 15° C. Its odor strongly resembles hyacinth and is valuable in the production of synthetic hyacinth, rose, narcissus, lilac, sweet pea, jonquil and other related odors. It should be kept in 50 per cent alcoholic solution as the pure aldehyde quickly polymerizes and becomes odorless. It is a fixative and increases the bouquet of perfumes. It should not be used in soaps unless they are perfectly neutral.

Phenylpropylic aldehyde (*hydrocinnamic aldehyde*)—The odor suggests hyacinth and must be used only in small amounts as it is very persistent. About 1 per cent may be used in lilac perfumes.

Salicylic aldehyde—This is an aromatic liquid, occurring naturally in several oils of the Fam. *Rosaceæ*. It is prepared synthetically and is the starting point in the making of coumarin. It is used in the preparation of some violet perfumes.

Vanillin—A white, crystalline product having the odor of vanilla (see page 977). It is used in many perfumes because of its sweet odor and excellent fixative qualities. As it turns brown with alkali or when in contact with metallic substances. It should be used carefully in white creams or soaps and it is unsuited for other soaps unless they are neutral.

KETONES

Acetophenone (*hypnone*)—A colorless liquid, crystallizing at low temperatures. It boils at about 79° C. and melts at 20° C. It occurs naturally in labdanum and the odor is flowery and is used in new-mown hay, crab-apple, lilac, syringa and other perfumes.

Carvone—A constituent of caraway oil, used in tooth pastes, mouth washes, etc.

Ionone (*irisone, iralol, ional, rhodione, atonone, etc.*) (a mixture of alpha and beta varieties)—This is the universally used violet odor. It is prepared through the condensation of citral with acetone in the presence of an alkali. The mixed ketones are used chiefly in the perfumery of soaps, 10 Gm. being sufficient for 100 kilos of soap.

Ionone-alpha (known under many names as *alefol, irisone-alpha*, etc.)—It is the most valuable product for preparing fine violet perfumes but must be skilfully blended with other substances such as orris concrete, and the oils of ylang-ylang, santol, bergamot, clarysage, cassie, etc., to develop "body".

Ionone-beta—This ketone is used about the same way as the other ionones but mostly in oriental bouquets to produce a very heavy odor.

Ionone-gamma—A third isomer of ionone having the characteristic odor resembling Russian leather and particularly valuable in oriental odors.

Methyl acetophenone—A colorless liquid, boiling at 223° C.; specific gravity 1.01 at 15° C. It possesses a fine flowery odor resembling mimosa and is largely used in perfuming soaps and in flavoring tobacco. It is also used as the basis for synthetic mimosa and as a modifier in synthetic cassie, hawthorne, lily, violet, heliotrope, etc.

ESTERS

Amyl acetate—A colorless liquid, boiling at about 139° C. It has a very fruity odor suggesting pears and gives sweetness to many perfumes, notably hyacinth. It is used as a solvent for pyroxylin.

Amyl benzoate—A colorless liquid having an odor suggesting ambergris. It is an excellent fixative.

Amyl butyrate—This liquid has a fruity odor and is sometimes used in synthetic jasmine.

Amyl salicylate (*trefoil, orchidea*)—A colorless liquid, boiling at from 151° to 152° C.; specific gravity 1.05 at 15° C. Its odor resembles some orchids and is the basis for clover perfumes. It is used in various cheap and powerful perfumes. It is used as a modifier in chypre, new-mown hay, carnation, etc. It is used in soaps.

Amyl valerate—The odor of this ester suggests apples and it is used as the basis for crab-apple perfume.

Benzylacetate—A colorless liquid, boiling at 216° C., specific gravity 1.06. It possesses an ethereal and fruity odor and is one of the principal constituents in the natural oils of jasmine, ylang-ylang, cassie, etc. It replaces natural jasmine in cheap perfumery and especially in soaps.

Benzyl benzoate—It has a slightly balsamic odor and is used chiefly as a solvent for musk and other non-alcohol soluble perfumes and also as a fixative. It may be used in soaps (see also page 837).

Bornyl acetate—The crystal product melts at 29° C. and boils at 98° C. (10 mm.). It has the odor of pine needles and is especially used to cover disagreeable odors in hospitals, theaters, etc. It is combined with other perfumes to make spray perfumes, toilet waters, bath crystals, etc.

Ethyl acetate (*acetic ether*)—A liquid having a pleasant and fruity odor, much used in fruit essences. It gives a refreshing odor to toilet waters, toilet vinegars, and other perfumes such as magnolia, cyclamen, ylang-ylang, but traces only must be used.

Ethyl benzoate—A colorless liquid, boiling at 213° C. The odor resembles methyl benzoate but is softer and more aromatic. It is used in artificial ylang-ylang, new-mown hay, niobe and peau d'Espagne.

Ethyl butyrate (*butyric ether, pineapple oil*)—The odor recalls that of rose and traces are sometimes used in synthetic rose. It is chiefly used to produce artificial pineapple essence.

Ethyl cinnamate—This ester boils at 271° C. and occurs naturally in storax. It has a balsamic and fruity odor, and is an excellent fixative for Cologne water and other toilet waters. It is also used in oriental perfumes, in fancy bouquets, and in soaps.

Ethyl formate—The odor and uses are very similar to those of ethyl acetate.

Ethyl laurinate—It has a pleasant but not a powerful odor, used as a fixative in tuberose and fancy perfumes.

Ethyl nonylate—A liquid having an odor suggesting roses. It is chiefly used in flavoring beverages.

Ethyl phenylacetate—The odor is distinctly that of honey, also suggesting rose and musk. It is used in synthetic rose, lily and sweet pea perfumes but chiefly to produce an artificial honey flavor. It is much used in perfuming tobacco.

Ethyl salicylate—A liquid having an odor much like methyl salicylate or wintergreen but finer. It is used in making synthetic cassie.

Ethyl valerate—It has a flowery and also a fruity odor and is chiefly used in fruit essences and fancy perfumes.

Geranyl acetate—A colorless liquid, boiling at from 128° to 129° C.; specific gravity 0.92 at 15° C. The commercial product contains about 92 per cent of the ester. It occurs naturally in the oils of lavender and spike and may be used in perfumes, soaps, and creams. It is used in preparing artificial tuberose, wallflower, neroli and gives freshness to the perfume.

Geranyl butyrate—Prepared only synthetically. It possesses a heavy and rose-like odor, also suggests apples. It is used for apple essence and in preparing perfumes like rose and geranium wherein it also serves as a fixative.

Geranyl formate—Its odor suggests roses and is a component of many synthetic rose and neroli perfumes.

Geranyl propionate—The odor is suggestive of roses and is used in some artificial rose oils and also in making bergamot oils. It has excellent fixative qualities.

Isobutyl salicylate—A colorless liquid, boiling at 260° C. It has a very sweet odor and is especially suited for use in perfumes of the clover type. Also used in such perfumes as orchid and cassie.

Isobutyl acetate—It has an odor suggesting hyacinth and roses and is especially used as a rose modifier, particularly to produce the Maréchal Niel type.

Isobutyl benzoate—A liquid having a pleasant odor suggesting lilies. It is a valuable fixative and is also used as a modifier in artificial oils of neroli, sweet pea, clover, acacia, etc.

Isobutyl phenylacetate—Its odor is sweet and suggestive of sweet briar rose. It is used to give a note of sweetness to flower perfumes, especially carnation, rose, tuberose, sweet pea, honey, etc.

Linalyl acetate—A colorless liquid, boiling at from 79° to 80° C.; specific gravity 0.91 at 15° C. Soluble in all proportions in alcohol. The commercial product contains from 90 to 92 per cent of the ester, the remainder being linaloöl. It occurs naturally in the oils of bergamot, jasmine, ylang-ylang, and is the principal substitute for oil of bergamot, especially in Cologne water and also in artificial lily of the valley, jasmine, lilac, linden blossoms, ylang-ylang, lavender, azurea, etc.

Linalyl benzoate—A liquid having a heavy odor; useful in perfumes of the oriental type.

Linalyl cinnamate—Much like linalyl benzoate.

Methyl anthranilate—This ester is crystalline, melting at about 24° C. It has an odor strongly resembling orange blossoms and is used as the basis for artificial neroli or to replace natural neroli oil.

Methyl benzoate (*niobe oil*)—A liquid having a strong, balsamic odor. It is combined with vertivert, oak moss or labdanum in the making of the base peau d'Espagne. It is much used in perfuming soaps, but only traces should be used in perfumes.

Methyl cinnamate—A liquid having a heavy, fruity odor suggesting strawberry. It is a valuable fixative for lilac, oriental bouquets, fancy compounds, bath salts, etc.

Methyl heptine carbonate—This is often called *"vert de violette, artificial"*. By itself the odor is offensive but used properly it produces the leafy odor often desired in violet perfumes.

Methyl anthranilate (*Di-methylanthranilate*)—A yellowish liquid crystallizing at 15° C. It boils at from 130° to 131° C. It is present in natural *petit-grain Mandarine oil* to the extent of 50 to 60 per cent, but differs from the natural oil in odor. It gives a distinct novelty to perfumes.

Methylphenylcarbinol acetate—This ester is sometimes sold as *gardeniol*, having an odor suggesting gardenias. It may be used in producing an artificial perfume sold under that name and to give a fresh odor to lilac and other floral odors.

Naphthol (*beta*) *ethyl ether* (*bromelia*)—The odor of this crystalline compound suggests orange blossoms but it is crude and very powerful. It is used only in soaps in very minute amounts.

Naphthol (*beta*) *methyl ether* (*nerolin, yara yara*)—This crystalline product possesses the distinct odor of neroli but is suited only for soap perfumery as it must be highly diluted.

Phenylethyl acetate—It has an odor suggestive of peaches or other fruits. It produces leafy effects in floral odors.

Phenylethyl butyrate—Its odor suggests roses and it is used in jasmine perfume, especially in creams.

Phenylethyl formate—Its odor suggests the white or eglantine rose and has been used in rose, lilac, lily, and orchid perfumes, but is not stable.

Phenylethyl propionate—The odor is very sweet, suggesting dried rose petals. It is used as a modifier in sweet perfumes.

Phenylmethyl butyrate—A liquid having a powerful fruity odor. Sometimes used in artificial rose, but it must be used sparingly.

Rhodinol acetate—A colorless liquid boiling between 110° and 120° C. (10 mm.). It is miscible in all proportions with alcohol. It has a distinct rose odor and is used in many artificial rose perfumes. It may be used in creams and in toilet soaps.

Rhodinol butyrate—A liquid having a rose odor; especially valuable in obtaining the moss rose effect and as a fixative.

Rhodinol formate—A colorless liquid having an odor suggesting wild roses. It is used in making artificial carnation or rose.

Terpinyl acetate—A colorless liquid, boiling between 90° and 94° C. (10 mm.); specific gravity 0.96 at 15° C. It is miscible with alcohol in all proportions. The commercial product contains about 92 per cent of ester. Its odor suggests bergamot and lavender and it is chiefly used in the perfumery of soaps as a cheap substitute for lavender or bergamot.

PHENOL ETHERS

Anethol—A white, crystalline product obtained from the oil of anise, star-anise, and fennel (see page 969). By oxidation it yields anisic aldehyde (aubepine) (see page 1213).

Carvacrol—A phenol obtained from the oils of thyme and origanum. It is used in soap perfumery.

Eugenol—(See page 974).

Isoeugenol—A thick, yellowish liquid crystallizing at low temperatures. It boils between 111° and 113° C. (10 mm.); specific gravity 1.09 at 15° C. Its odor is similar to eugenol but sweeter. It is used in the preparation of synthetic carnation perfumes. It also becomes a component in artificial lilac, ideal, jonquil, night scented stock, oriental soaps, etc. It is especially adapted for soap perfume.

Safrol—This phenol occurs naturally in sassafras oil and is the main constituent of synthetic sassafras oil. It is largely used as a perfume in cheap soaps.

MISCELLANEOUS SYNTHETIC PERFUMERY COMPOUNDS

Brom-styrol (hyacinthin)—This halogenated hydrocarbon is a yellowish liquid boiling between 219° and 221° C.; specific gravity 1.43 at 15° C. It has a powerful but crude odor suggesting hyacinth but is useful in soaps, especially those to be perfumed with rose, hyacinth, lilac, heliotrope, etc. It is alkali proof.

Coumarin—A white, crystalline lactone melting between 67° and 69° C. and boiling at about 154° C. It is the odorous substance occurring naturally in tonka beans, or many grasses and is the basis for the perfume known as new-mown hay. The commercial product is prepared synthetically. It is also used as soap perfume and is a valuable fixative.

Diphenylmethane—This hydrocarbon has an odor suggesting geraniums and is important as a soap perfume because it is alkali proof.

Diphenyl-oxide—This liquid has an intense odor of geranium and being very stable in soaps is much used in that industry.

Indol—A white, crystalline body melting at about 52° C. and boiling at 254° C. and soon darkening on exposure to light. It has a powerful and dis-

agreeable odor unless highly diluted when it becomes jasmine-like. It occurs naturally in the oils of jasmine and neroli, and body secretions.

Musk ambrette (100 per cent)—Yellowish crystals, melting at 85° C. Its solubilities are as follows: 20 Gm. in 1000 cc. of ethyl alcohol (95 per cent); 161 Gm. in 1000 cc. of benzyl alcohol; 290 Gm. in 1000 cc. of diethylphthalate; 450 Gm. in 1000 cc. of benzyl benzoate. This substance is largely used as a fixative to replace natural musk but differs distinctly in odor, having the agreeable character of ambrette seed. It is employed as a fixative, usually dissolved in benzyl benzoate, in such perfumes as acacia, carnation, lily, ylang-ylang, magnolia, mimosa, narcissus, jonquil, clover, violet, etc. It is a valuable fixative for soaps on account of its strength.

Musk ketone—Yellowish crystals, melting at about 135° C. Its solubilities are as follows: 15 Gm. in 1000 cc. of ethyl alcohol (95 per cent); 134 Gm. in 1000 cc. of benzyl alcohol; 155 Gm. in 1000 cc. of diethylphthalate; 205 Gm. in 1000 cc. of benzyl benzoate. This artificial musk most nearly resembles natural musk in its odor. It is therefore used when musk odor is desired and also as a fixative in many perfumes, soaps, and creams.

Musk xylol (musk xylene)—Yellowish crystals, melting at about 112° C. Its solubilities are as follows: 7 Gm. in 1000 cc. of ethyl alcohol (95 per cent); 85 Gm. in 1000 cc. of benzyl alcohol; 135 Gm. in 1000 cc. of ethyl phthalate; 280 Gm. in 1000 cc. of benzyl benzoate. The musk-like odor of musk xylol is not so powerful as the other synthetic musks, hence the others are more often used. It is, however, a valuable fixative.

Skatol—In concentration this nitrogenated product has a very disagreeable odor suggesting civet, but when well-diluted the odor is not unpleasant and it is used as a fixative in flower-like odors. It becomes red when long exposed to the air.

Fixatives—The proper fixing of a perfume is one of the most important problems before the perfumer. Most floral odors so lavishly expend themselves, actual physical particles being volatilized, that unless this process is retarded the finest perfume will prove unsatisfactory to the user because of the lack of lasting qualities. The earliest records of perfumery indicate that this was understood thousands of years ago and some of the fixative agents used today were employed by the Egyptians and Greeks as set forth in the writings of Theophrastus (370 B. C.).

Some fixatives do not of themselves possess pleasant odors and some are even disagreeable, as civet, castor, indol, and valerian. Others are pleasantly aromatic as benzoin, olibanum, musk, ambergris, vanillin, coumarin, heliotropine, etc., and still others have little or no odor, as benzyl benzoate and ethyl phthalate.

Fixatives from animal sources—Some of these products were used by the earliest perfumers but are largely being replaced today by vegetable or synthetic products of high boiling point.

Musk—This is the dried secretion from the preputial follicles of the male musk deer (*Moschus moschiferus*) found only in the Himalayan and Atlas mountain ranges. The most important variety is known as *Tonquin musk* which comes from Tibet. The musk pods consist of a round sack about one and a half inches in diameter, on the exterior side covered with coarse hair, arranged about the central orifice. *Grain musk* consists of the dried secretion, carefully removed from the pod, and is especially subject to adulteration with dried blood, or earth, and must be carefully tested (see the U. S. P. IX tests). For the finest perfumes of a floral type genuine musk is considered indispensable.

Substitutes in the form of artificial musk have been considered elsewhere (see page 1217).

Castor—This fixative consists of the dried preputial follicles and their secretions, obtained from the beaver (*Castor fiber*). The follicles are obtained from both the male and female beavers. The odor is strong and disagreeable.

Civet—This consists of a yellowish-white fatty mass obtained as a glandular secretion from the civet cat (*Viverra civetta*) which is domesticated and raised in Abyssinia and in the Indian archipelago for the secretion.

Ambergris—This valuable fixative is a secretion obtained only from the sperm whale and is usually found floating on the sea or on the sea shore. It varies greatly in color and odor and its value is correspondingly dependent upon the quality. Its odor is sweet and possesses marvellous fixative properties.

Fixatives from vegetable sources—These have also been used from the earliest times, the most ancient writers referring to members of this group which are all volatile oils, resins, gum resins, oleoresins or balsams. Most of these substances are also used in medicine and have been described elsewhere. The most important are *benzoin, galbanum, orris, labdanum, oak moss, myrrh, olibanum, opoponax, patchouli, balsam of Peru, santal oil, storax, tolu, vertivert,* and *vanilla.* They are sometimes used as tinctures, having been made by extraction with alcohol, but many of them today are available as concentrated oleoresins, having been extracted by volatile solvents.

Fixatives from synthetic chemicals—This group represents the development of the modern organic chemist and its representatives are some of the most valuable fixatives available today. The pleasant odors in some instances add merit to the fixative while in other cases the absence of all side odors is exactly what is required. The high boiling point of many of these products explains in part their efficiency as fixatives.

These products have been described individually and attention called to their specific uses (see page 1218). Among the most outstanding representatives are *coumarin, heliotropine, hydroxycitronellal, ionone, artificial musks, santalol, vanillin,* etc.

A comprehensive study of the application of various fixatives is given in a recent publication by W. A. Poucher, called *Perfumes and Cosmetics* and the reader is referred to this book for the details.

Dyes Suitable for Perfumes—Practically all colors used today in perfumes, soaps, or creams are of coal-tar origin. Such dyes may be purchased from the manufactureres in powder form and if water-soluble may be dissolved by boiling water. The solution should then be filtered to remove any undissolved particles. Other dyes are oil-soluble only and are used in fatty creams. Colors used in face powders are called "lakes" and are completely insoluble in water since a water-soluble dye would be objectionable.

For soaps or for alkaline solutions only such dyes must be used as are alkali-fast.

Dealers in perfumery supplies usually offer dyes suitable for every purpose, either in liquid or powder form.

The coloring matter in toilet water and other liquid perfumes must not be sufficient in quantity to produce a stain when used upon the handkerchief or clothing.

Many medicinal dyes can be used such as methylene blue for blue, scarlet red sulphonate for reds, acriflavine for yellow, proflavine for brown, and mixtures of the yellow and blue for green and of red and blue for lilac and violet shades. Scarlet red is soluble in oils, including petrolatum, and can therefore be used in creams.

From these few basic colors almost any desired shade or tint may be obtained through diluting or combining the colors.

No colors should be used which might be irritating or poisonous when applied to the skin, and for tooth powders or tooth washes only the certified food colors should be employed (see page 841).

THE STRUCTURE OF A PERFUME

The perfumery chemist finds it unsatisfactory to create a finished odor by using natural perfumes alone. He finds it equally undesirable to prepare an acceptable perfume by using only synthetic products. Therefore, both the natural and the synthetic products must be drawn upon and skilfully blended to produce the fine quality of perfumes of today.

The compounding of a perfume requires the consideration of a number of factors.

In creating a new odor, the perfumer must first determine the type of perfume desired. A large number of specialties are today available from dealers in perfumery supplies, giving, either alone or in combination, almost every variety of odor that could be ordinarily wanted. If it is preferable to build the odor from pure chemicals and volatile oils, it will be necessary to first produce an equivalent of the commercial specialties and it should be borne in mind that all the successes in modern perfumery are based upon specialties, which have required years of research for their development. This basic product, which determines the character of the perfume, is known as the "*body*".

The next step is to select from the different fixatives those which are in harmony with the determined type of odor. Practically all fixatives have an odor, for without odor they would dilute and have a tendency to "flatten" the perfume. Suppose an odor resembling "chypre" is desired. The base "chypre" will probably be obtained from a reliable perfume house and a drop of this will be placed on a blotter. After smelling it, the blotter will be set aside for twenty-four hours and then again smelled. If it is not sweet and lasting enough some coumarin, vanillin, musk ambrette, opoponax, or ambre synthetic, will be used in balanced proportion, to obtain the desired effect.

When the fixative has been adjusted it may be found that the perfume does not contain enough *aromatic*. This may be corrected by using the proper proportion of orris concrete, oak moss oleoresin, or such products as the fluid preparations of tolu, galbanum, opoponax, olibanum, etc.

When the perfume is lasting and sweet enough, it is time to add the "*top note*". This is obtained with absolute flower oils, from the concentrated washings of the pomades of jasmine, rose, tuberose, etc., or from such volatile oils as neroli and ylang-ylang.

Finally, to give *freshness* to the perfume, the perfumer will use such volatile oils as bergamot, orange, cedrat, lime, etc.

The natural fixatives, such as ambergris, Tonquin musk, and civet do not sensibly modify the odor, and can be added in small proportion when the perfume is finished. No exact proportion can be predetermined as the amount depends upon the type of the perfume and the limit of cost.

To recapitulate, the scientific preparation of a perfume requires:

1. The selection of the "body" or base, to give the general character.
2. Fixation.
3. Finishing (incorporating the top odor, to furnish the bouquet or "fleuri" to the finished perfume).
4. Dilution of the perfume with the proper solvent for the proper concentration.

Floral odors—On the following pages a few of the more important floral odors used in modern perfumery will be discussed and typical formulas given. These formulas are only suggestive but give a fair conception of the make-up of commercial products. They have been largely supplied through the kindness of Philip E. Chaleyer, director of the perfumery laboratory of the Burton T. Bush Company and it will be gratifying for many to know that through an arrangement between Mr. Burton T. Bush, and the French firm of L. Givaudan and Company, a large factory has been established at Delawanna, N. J., where aromatic chemicals and many other basic perfumery materials are manufactured on a large scale. The assistance of Mr. Chaleyer and the use of the physical factors given in the section on aromatic chemicals have been with the approval of Mr. Bush. The factors given constitute the standards of the "Givaudan-Delawanna" products by whom they are rigidly maintained. These do not always indicate one hundred per cent purity, as this is often impracticable, but it is to the credit of the Givaudan organization that it has been willing to establish physical factors and definite degrees of purity for these products heretofore unstandardized. This insures a uniformity of product which establishes the perfumery industry upon a more satisfactory basis than has been heretofore possible.

Carnation—The natural product is very seldom used as it is expensive and unsatisfactory. The synthetic carnation is known as *œillet, dianthus, dianthine,* etc. The main constituents of this perfume are rose, isoeugenol, linaloöl, ionone, neroli, vanillin, heliotropine, and benzyl acetate.

A typical formula made from basic ingredients would be as follows:

CARNATION

Natural oil of rose	10
Isoeugenol	15
50 per cent phenylacetaldehyde	10
Linaloöl	10
Ionone (pure)	10
Benzyl acetate	10
Neroline	5
Heliotropine	10
Vanillin	10
Benzyl acetate	10
To make	100 parts

Cassie—(Oil of Cassie must not be confounded with Oil of Cassia or Cinnamon Oil).

This oil from *Acacia farnesiana* (Fam. *Leguminosæ*), a shrub cultivated in Southern France and in Syria, possesses an odor resembling the violet. It is obtainable, for perfumery, chiefly in the form of cassie absolute, cassie liquid absolute, cassie concrete, and cassie pomade. It is mostly used for making synthetic violet, and also is a constituent in oriental bouquet. The chemical constituents of cassie are mainly geraniol, linaloöl, farnesol, benzyl alcohol, methyl salicylate, decylic aldehyde, cuminic aldehyde, 10 per cent of anisic aldehyde, and also a ketone of a violet-like odor.

Cyclamen—The cyclamen flowers (*C. persicum*) grow mostly in certain mountainous districts of France (more especially in Savoy), and the fresh flower loses most of its odor after having been picked. When cultivated it has no odor, but the wild flower has an extremely sweet odor as fine as that of violet but with a distinct character of its own. In preparing an artificial oil the following are chiefly used; ionone, linaloöl, terpineol, hydroxy-citronellol, and

phenylacetic aldehyde. By means of a new chemical body recently discovered, a more true imitation of the odor of this flower has been produced.

Heliotrope—Heliotrope odor is based upon heliotropine, which is the main odor, but to it are added terpineol, vanillin, eugenol, benzyl acetate, ylang-ylang and small quantities of the oil of tuberose and jasmine.

A typical formula is as follows:

HELIOTROPE

Terpineol	20
Heliotropine	20
Vanillin	10
Coumarin	10
Benzyl acetate	10
Ylang-ylang (Bourdon)	5
Rose, absolute or synthetic French rose	5
Tuberose absolute (liquid)	5
Jasmine (synthetic)	15
To make	100 parts

Good bases for making fine heliotrope extract are sold as *heliotrope liquid, heliotrope concrete, heliotrope blanc* (not discoloring for creams), *heliotrope amorphous* (small crystals to be used for powder and rouge).

Hyacinth (*Jacinthe*)—It is nearly impossible to obtain a natural odor product from the hyacinth flowers, so that a synthetic product is used. The main constituent of synthetic hyacinth is phenylacetaldehyde. The main objection to this product is that it polymerizes quickly by action of air and light and must be used in creams only in minute quantity because it has an irritating action on the skin. To obviate this difficulty a 50 per cent mixture of phenylacetaldehyde with benzyl benzoate, benzyl alcohol or cinnamic alcohol is usually offered the trade. The chief constituents of a hyacinth formula are: rose absolute, heliotropine, cinnamic alcohol, phenylacetic aldehyde, phenylethyl alcohol, terpineol, geraniol, linaloöl and oil of bergamot.

A typical formula is as follows:

HYACINTH

Rose (synthetic, French)	10
Heliotropine	10
Cinnamic alcohol	20
Bergamot oil	10
Phenylacetaldehyde (50 per cent)	25
Jasmine (synthetic)	10
Terpineol	15
To make	100 parts

For a cheaper hyacinth, used largely in soap perfume brom-styrol is generally used to obtain the hyacinth effect. This odor is very stable.

Jasmine—Natural Jasmine is made mostly by the volatile solvent method and is available as absolute or concrete. A small amount is made into pomade.

Jasmine is the most important of all perfumery products since it enters almost every floral odor. An analysis shows the following more important constituents: 65 parts of benzyl acetate, 7.5 parts of linalyl acetate, 6 parts of benzyl alcohol; 15.5 parts of linaloöl; 2.5 parts of indol; 3 parts of jasmine (a ketone), and 0.5 parts of methyl anthranilate.

An artificial jasmine oil may be prepared as follows:

JASMINE

Benzyl acetate	30
Linalyl acetate	5
Linaloöl	10
Hydroxy-citronellol	10
Oil of Ylang-ylang (Bourbon)	5
Jasmine absolute	5 to 10
Aldehyde C_{10}	2
Phenylethyl alcohol	10
Rhodinol	10
Heliotropine	10
Benzyl alcohol, sufficient,	
To make	128 parts

Lilac—There is no natural oil of lilac or other natural product obtainable directly from the lilac flowers for the use of the perfumer. Fortunately this very popular odor has been very satisfactorily reproduced synthetically.

The alcohol terpineol possesses a lilac-like odor and is extensively used for creams and soaps where a cheap perfume is demanded but the better artificial lilac odors are prepared by blending other constituents. A typical formula is as follows:

LILAC

Heliotropine	10
Anisic aldehyde (aubepine)	5
Phenylethyl alcohol	20
Cinnamic alcohol	10
Phenylacetaldehyde (50 per cent)	10
Phenylpropylaldehyde	2
Rhodinol	5
Jasmine absolute	5
Benzyl acetate	10
Hydroxy-citronellol	10
Linaloöl	10
Terpineol, sufficient,	
To make	100 parts

Lily of the Valley (*muguet*)—Practically no floral oil is extracted directly from the flowers, a synthetic product being almost universally used for this odor. The following typical formula well illustrates the usual combination.

LILY OF THE VALLEY

Cinnamic acetate	5
Hydroxy-citronellol	15
Phenylethyl alcohol	10
Linaloöl	10
Benzyl acetate	15
Ionone	10
Rhodinol	10
Rose absolute	5
Jasmine absolute	5
Terpineol, sufficient,	
To make	100 parts

Orange Flowers—This delightful odor is a dominant factor in the making of Eau de Cologne. Two classes of products are offered in the trade: 1st, an oil made by steam distillation of the flowers. 2nd, a product extracted by the volatile solvent method called, "orange flower absolute, concrete, or liquid". Oil of petit-grain, distilled from the leaves and twigs of the orange tree, is also

used for making synthetic neroli. A by-product from the steam distillation of the flowers is orange flower water, used in pharmacy. Oil of neroli is the product generally used for the making of Eau de Cologne. Poucher gives the following formula to use to reproduce the absolute flower oil of Fleur d'Orange:

ORANGE FLOWERS

Nerol or geraniol, pure	35
Linaloöl	10
Methyl anthranilate	10
Indol	0.5
Methyl naphthyl ketone	10
Aldehyde C_9	0.5
Geranyl formate	2
Lily of the valley (synthetic)	6
Jasmine (synthetic)	3
Rose (synthetic)	3
Linalyl acetate	10
Benzoin resin	10
To make	100 parts

Rose—A description of this odor has already been given (see page 1220), and typical formulas are as follows:

BULGARIAN ROSE (Oriental)

Natural oil of rose (Bulgarian)	20
Geraniol	20
Citronellol	10
Phenylethyl alcohol	10
Phenylacetaldehyde (50 per cent)	5
Rhodinol, sufficient,	
To make	100 parts

FRENCH ROSE

Rose, absolute	20
Phenylethyl alcohol	10
Citronellol	15
Phenylpropyl alcohol	10
Isoeugenol	5
Rhodinol	14
Aldehyde C_8 (10 per cent)	1
Geraniol, sufficient,	
To make	100 parts

A more elaborate formula known to give much satisfaction is as follows:

WHITE ROSE EXTRACT

Rhodinol	14 cc.
Citronellol	14 cc.
Geraniol	42 cc.
Phenylacetic aldehyde	3 cc.
Phenylethyl alcohol	15.75 cc.
Decyl aldehyde (10 per cent in alcohol)	2 cc.
Eugenol	0.25 cc.
Cinnamic alcohol	2 cc.
Ionone	5 cc.
Linaloöl (from bois de rose)	6.25 cc.
Rose absolute	20.25 Gm
Oil of rose (Bulgarian)	3.50 cc.

Oil of patchouli	3 cc.
Oil of geranium (African)	10 cc.
Oil of bergamot	10 cc.
Vanillin	5 cc.
Oil of ylang-ylang (Manila)	2 cc.
Phenylethyl acetate	2 cc.
Methyl anthranilate	5 cc.
Oleoresin of oak moss	3 cc.
Musk ambrette (20 per cent solution in benzyl benzoate)	50 cc.
Tincture of Siam benzoin (25 per cent in alcohol)	129 cc.

Mix and age before filtering.

Violet—Natural violets are seldom used because of their high cost, but violet absolute and violet concrete are obtainable and these are made exclusively by the use of a volatile solvent. A product extracted from the leaves of the violet plant is also used to obtain a violet odor. Ionone, however, is mainly depended upon in perfumery for a violet odor but this must be skilfully blended with the extract from violet leaves and other modifiers such as methylheptine carbonate, orris absolute or concrete, cassie absolute or concrete, heliotropine, etc. The following is a typical formula:

VIOLET

Ionone (alpha)	50
Violet leaves, absolute	2
Cassie, absolute	5
Orris, liquid, absolute	5
Methylheptine carbonate	3
Heliotropine	15
Jasmine, synthetic, sufficient,	
To make	100 parts

Other Floral Odors—Other floral odors are of less importance than those already referred to but many have been synthetically produced and typical formulas may be found in the more extensive treatises on this subject, such as *Perfumes and Cosmetics* by W. A. Poucher. They include such odors as *acacia blossoms*, *gardenia*, *hawthorne* (*May blossoms* or *cratægus*), *honeysuckle*, *jonquil*, *lavender flowers*, *magnolia*, *mimosa*, *mignonette* or *reseda*, *narcissus*, *new-mown hay* (the basic odor of this perfume is coumarin which exists naturally in many grasses and other plants), *orchids*, *palmarosa*, *trèfle* (*clover*), *tuberose*, *wallflower*, *ylang-ylang* (the volatile oil).

Approximate Solubility of a Few Aromatic Chemicals in Various Strengths of Alcohol*

One part of a product is completely dissolved in X parts (smallest quantity necessary) of alcohol of X per cent.

		Alcohol by volume
Acetate, Benzyl	soluble in 1.5	parts of 70 per cent
Acetate, Bornyl	soluble in 2.5–3.5	parts of 70 per cent
Acetate, Geranyl	soluble in 7–8.5	parts of 70 per cent
Acetate, Linalyl	soluble in 3–5	parts of 70 per cent
Acetate, Terpinyl	soluble in 4.5	parts of 70 per cent
Alcohol, Benzylic	soluble in 1	part of 50 per cent
Alcohol, Cinnamic	soluble in 3.5–4.5	parts of 50 per cent
Alcohol, Phenylethylic	soluble in 2	parts of 50 per cent
Alcohol, Phenylpropylic	soluble in 3	parts of 50 per cent
Aldehyde, Cinnamic	soluble in 1.5–2.5	parts of 70 per cent
Aubepine	soluble in 6–6.5	parts of 50 per cent
Benzaldehyde	soluble in 1–1.5	parts of 70 per cent
Benzoate, Benzyl	soluble in 7.5	parts of 80 per cent
Benzoate, Ethyl	soluble in 6–7	parts of 60 per cent
Benzoate, Methyl	soluble in 3.5	parts of 60 per cent
Cinnamate, Ethyl	soluble in 4–6	parts of 70 per cent
Cinnamate, Methyl	soluble in 1.5	parts of 70 per cent
Citral	soluble in 7	parts of 60 per cent
Citronellal	soluble in 5	parts of 70 per cent
Citronellol	soluble in 4	parts of 60 per cent
Eugenol	soluble in 4.5–5	parts of 50 per cent
Geraniol, Pure	soluble in 2.5–3.5	parts of 60 per cent
Hydroxy-Citronellol	soluble in 6.5–7	parts of 30 per cent
Irisone, Pure	soluble in 2.5–3	parts of 70 per cent
Isoeugenol	soluble in 4.5–5	parts of 50 per cent
Jacinthe absolute	soluble in 2.5	parts of 70 per cent
Linaloöl	soluble in 4–5.5	parts of 60 per cent
Methyleugenol	soluble in 3.5	parts of 60 per cent
Salicylate, Amyl	soluble in 2.5	parts of 90 per cent
Salicylate, Ethyl	soluble in 3	parts of 80 per cent
Salicylate, Methyl	soluble in 4.5–6	parts of 70 per cent
Terpineol	soluble in 3–5	parts of 60 per cent

*Supplied by the Burton T. Bush Company.

CHAPTER LXXVII

MANUFACTURED PERFUME PRODUCTS

IN SUBMITTING formulas no attempt has been made to exhaustively cover this field, as manufacturers have access to other books which contain a large selection of formulas. The object has been to supply a few formulas for such preparations as are more within the scope of manufacture by the retail pharmacist and especially such as he would be able to sell under his own label.

The attention of the prospective perfumer or of those who desire more information in this field is called to the list of books at the end of this chapter.

Concentrated Perfume Extracts

These consist of strongly alcoholic solutions, containing at least four fluid-ounces of a concentrated perfume oil in each gallon.[1] Some floral odors are always popular such as rose, violet, heliotrope, lilac, lily of the valley, and others, but the tendency is to offer bouquets and blends under fancy names such as *corylopsis, chypre, ideal, l'origan,* etc.

Illustrative formulas for concentrated perfume oils will be found under *Floral odors* (page 1220) and many other formulas are available from modern

---

[1] **Alcohol for Perfumery**—Specially denatured alcohols are the only forms of alcohol permitted to be used, in the production of a perfumery product. Authority to use these alcohols must be obtained by application to the office of the Prohibition Administrator of your District, the request being made upon the special form provided and accompanied by the proposed formulas. Samples of the finished product must also be furnished.

For rendering toilet preparations unfit for beverage purposes.

The following alternative substances are used in *bay rum, hair tonic, and toilet waters.*

Tartar emetic, ¼ grain per fl. oz.,
or quinine, salt or alkaloid, 2 grains per fl. oz.,
or cinchonidine, salt or alkaloid, 2 grains per fl. oz.,
or salicylic acid, 5 grains per fl. oz.,
or resorcinol, 5 grains per fl. oz.,
or sodium salicylate, 5 grains per fl. oz.

It is understood that these modifying agents are not sufficient of themselves to render the preparations unfit for beverage purposes but that they must contain other medicating ingredients and each formula must be judged upon its own merits.

Formula 38—For use in *mouth washes* and *dentifrices*
10 lbs. oil of wintergreen (or methyl salicylate) or either of the following: 10 lbs. of oil of cassia, 10 lbs. oil of clove, 10 lbs. oil of peppermint in addition to 5 gal. of water containing 60 oz. of zinc chloride in 100 gal. of pure ethyl alcohol.

Formula 38-*A*—For use in *liquid dentifrices*
5 oz. menthol (crystals), 9 oz. emetine hydrochloride, and 16 lbs. benzoic acid, in 100 gal. of pure ethyl alcohol.

Formula 39—For use in manufacturing *barbers' supplies*
9 lbs. (av.) sodium salicylate (or, as an alternative, 9 lbs. of salicylic acid may be used), 1¼ gal. fluidextract of quassia, and 1 gal. acetone or isopropyl alcohol in 100 gal. of pure ethyl alcohol.

Formula 39-*A*—For use in *barbers' supplies*
60 oz. (av.) of any of the following alkaloids or salts: quinine, quinine bisulphate, quinine hydrochloride, cinchonidine, or cinchonidine sulphate, and 1 gal. acetone or isopropyl alcohol in 100 gal. of pure ethyl alcohol.

Formula 39-*B*—For *perfumes, barbers' supplies, toilet waters,* and *lotions*
2½ gal. diethylphthalate in 100 gal. of pure ethyl alcohol.

Formula 39-*C*—For *high-grade perfumes* and *toilet waters,* containing not less than 2 per cent by weight of essential oils, or their equivalent in perfume materials. (Granted only under special conditions). 1 gal. diethylphthalate in 100 gal. of pure ethyl alcohol.

Formula 39-*B*—For *bay rum* and *lotions* for external use
50 oz. (av.) quinine sulphate, or 200 oz. (av.) sodium salicylate in 100 gal. of pure ethyl alcohol.

Formula 40—Used for manufacturing perfumes and high grade toilet preparations
3 oz. (av.) brucine sulphate, and ½ gal. of acetone in 100 gal. of pure ethyl alcohol.

books on perfumery. Perfume oils may also be purchased from many sources, ready for dilution with alcohol or for use in many other products.

The quantity of oil to be added to each gallon, mentioned above, is the minimum, but many of the more expensive perfumes are much more concentrated and such perfumes must be used in proportionally smaller amounts. After dilution in alcohol the mixture should be allowed to age or blend, in glass containers, in a cool and dark place, for as long a time as possible.

Most extracts are of the natural color, being yellowish or amber, and artificial colors are rarely employed.

TOILET WATERS

These preparations are simply weaker "extracts". They should contain at least one fluidounce of the perfume oil to the gallon. Their alcoholic strength is also slightly less than extracts although the term "water" is anomalous since they are strongly alcoholic, usually from 60 to 75 per cent, by volume.

When the perfume oil has been added to the alcohol in the proportion suggested, distilled water may then be added, in small amounts, at the first indication of cloudiness, that the alcoholic strength may be of the minimum to carry the added oil.

The toilet water is then colored by the use of an aniline dye, in solution, but the amount added must be carefully adjusted so that the toilet water will not stain the skin or clothing. Usually the color is only suggestive, a lilac tint for lilac water, a green or violet for violet water, pink for rose, etc.

A small amount of talc is then added and the water set aside in glass, in a cool place to age or blend. It must finally be filtered and should be brilliantly clear when bottled and used.

COLOGNE WATER

Cologne Water for several hundred years has justly occupied an important place among perfumes. It had its origin in the city of Cologne, Germany, and has been prepared by the same firms for a long period. It is essentially an alcoholic solution of citrus oils, among which oil of neroli is the most important.

A special form of cologne water in which menthol is dissolved has been largely sold under the name of *Headache Cologne*. These products are delightfully refreshing and possess genuine therapeutic value. The plain cologne waters are especially acceptable when used in a sick-room. The headache cologne when applied to the forehead is both refreshing and stimulating. Similar preparations have been made under the name of Lavender Water, Florida Water, etc. Typical formulas are given below and many other formulas will be found in books on perfumery.

SPIRITUS ODORATUS. N. F. V. **Perfumed Spirit (Cologne Water)**

(See page 313)

Cologne Water (Scoville)

	Metric	Alternative
Oil of Bergamot	**12 cc.**	3 fl. dr.
Oil of Lemon	**6 cc.**	1½ fl. dr.
Oil of Neroli	**4 cc.**	1 fl. dr.
Oil of Orange	**2 cc.**	30 min.
Oil of Rosemary	**2 cc.**	30 min.
Tincture of Siam Benzoin	**8 cc.**	2 fl. dr.
Orange Flower Water	**100 cc.**	3 fl. oz.
Alcohol, sufficient, to make	**1000 cc.**	2 pints

Dissolve the oils in the alcohol, add the tincture and finally the water. Allow to blend and filter.

Cologne Water (Blackwood)	Metric	Alternative
Oil of Lavender Flowers	2 cc.	1 fl. dr.
Oil of Lemon	8 cc.	4 fl. dr.
Oil of Neroli	1 cc.	30 min.
Alcohol, sufficient, to make	1000 cc.	4 pints

Headache Cologne

Add to any good cologne water from two to three drachms (120 to 180 grains) of menthol for each pint. Ten grains or more of camphor is sometimes added.

Florida Water

Oil of neroli	5 cc.
Oil of lavender flowers	5 cc.
Oil of bergamot	30 cc.
Oil of clove	2 cc.
Oil of cinnamon	3 cc.
Oil of rose	5 cc.
Orange flower water	100 cc.
Alcohol, sufficient, to make	1000 cc.

Lavender Water	Metric	Alternative
Oil of Lavender Flowers	25 cc.	6 fl. oz.
Rose water	500 cc.	1 pint
Alcohol, sufficient, to make	2000 cc.	4 pints

SACHETS

In modern perfumery there is a limited application for natural materials. A class of products known as "sachets" are still prepared largely from natural odorous substances. These had their origin, doubtless, through the instinctive practice of gathering and drying such flowers as the rose, lavender, orange flowers, and similar blossoms.

Among the natural perfume products entering sachets are found ambrette seed (musk seed), angelica seed, Canada snakeroot, cardamom, lavender flowers, oak moss, orange flowers, orris, patchouli leaves, red rose petals, sandalwood, tonka, vanilla, and vertivert root.

The perfume known as "Frangipanni", already referred to, is still found in modern books. A typical formula is given on page 1230.

A general combination of flowers is known under the title "potpourri". This is intended to be typical of the gathered flowers from the garden and it possesses a delightfully refreshing aroma. See formulas, page 1230.

Such odors as lavender and rose can be readily procured by using the flowers, but others, equally popular, such as violet, lilac, and heliotrope can only be simulated. One suggestion has been the artificial coloring of granulated orris and the perfuming of this with compound oils. Formulas of this kind are also presented.

A fixative is an important part of the sachet, otherwise the odor is rapidly dissipated. Orris root offers a valuable constituent to all sachet because of its sweet odor and also because of its fixative qualities. Such substances as powdered Siam benzoin or the added tincture of Siam benzoin, also sandalwood, and even musk in small amounts, or tincture of ambergris or civet may be added to the formula. Other fixatives also find application. See section on *Fixatives,* page 1218.

Potpourri (a)	Parts by weight
Lavender flowers	1750
Orris root, powdered	1750
Rose petals	1750
Clove buds, powdered	440
Cinnamon bark, powdered	440
Benzoin (Siam)	440
Pimento	440
Sodium chloride	880
Vanilla	330
Musk (or equivalent in 10 per cent solution of artificial musk)	100
Oil of bergamot	30
Oil of lemon	30
Oil of lavender flowers	15
Oil of sandalwood	15
Oil of rose geranium	15
Oil of rose	2
Tincture of ambergris	30

Mix the drugs, which should be in coarse particles, and then drop the oils and tincture on the drugs and mix thoroughly. Keep the product in a tightly-closed container.

Potpourri (b)	Parts by weight
Lavender flowers	3500
Rose petals	1750
Vanilla	60
Clove buds, powdered	60
Storax resin, powdered	60
Benzoin (Siam), powdered	60
Ambergris, powdered	20
Oil of rose	20

Prepare as directed for No. 1.

Frangipanni Sachet	Parts by weight
Orris, coarsely ground	3840
Rose petals	3840
Vanilla (or vanillin, $\frac{1}{16}$ as much)	240
Powdered benzoin (Siam)	240
Oil of sandalwood	120
Oil of neroli	60
Oil of lavender flowers	60
Oil of bergamot	60
Oil of cinnamon	24
Oil of pimento	40
Oil of rose	32

Carnation Sachet	Parts by weight
Orris, coarsely ground	3500
Lavender flowers	1750
Patchouli leaves	880
Clove buds, powdered	440
Tonka beans, powdered	440
Pimento, powdered	220
Musk	8
Oil of rose	40
Oil of lavender flowers	40
Oil of neroli	48
Oil of sandalwood	80

Heliotrope Sachet	Parts by weight
Tonka, coarsely ground	3500
Orris, coarsely ground	3500
Rose petals	3500
Powdered benzoin (Siam)	550
Vanilla	60
Heliotropin	180
Oil of rose geranium	20

Lavender Sachet	Parts by weight
Lavender flowers	3500
Powdered benzoin (Siam)	440
Oil of bergamot	30
Oil of lavender flowers	50

Rose Sachet (a)	Parts by weight
Rose petals	440
Oil of rose	2
Oil of rose geranium	2
Tincture of musk	1
Tincture of civet	1

Rose Sachet (b)	Parts by weight
Rose petals	1750
Orris root	1750
Sandalwood	150
Patchouli leaves	75
Tincture of civet	20
Oil of rose geranium	3
Oil of rose	2

Violet Sachet (a)	Parts by weight
Orris root, coarsely ground	528
Oil of bergamot	2
Oil of bitter almond	2
Oil of rose	2
Tincture of musk	30

Violet Sachet (b)	Parts by weight
Orris root, coarsely ground	1320
Powdered benzoin (Siam)	440
Spirit of bitter almond	2
10 per cent solution of ionone	15

Violet Sachet (c)	Parts by weight
Dark violet orris[1]	100
Powdered benzoin (Siam) (add 1 part in 60)	

Mix lightly and add violet oil, 1 part in 300, more or less.

[1] If ground or "granulated" orris is colored appropriately it increases the attractiveness of the sachet. To accomplish this an aqueous solution of the aniline dye is prepared, usually 1 in 1000, although a lighter or darker shade may be wanted when more or less of the dye may be taken. 100 cc. of this solution is added to each 200 Gm. of the coarsely ground orris, the whole mixed thoroughly and then dried in warm air. In this way orris may be colored to resemble ground violets, or rose petals, or lilac flowers, etc., and small quantities of green may be added to suggest stems.

Ylang-ylang Sachet	Parts by weight
Orange peel	2640
Orris, coarsely ground	2200
Rose petals	2200
Coumarin	1
Vanillin	2
Tincture of civet	10
Tincture of musk	5
Oil of ylang-ylang	15
Oil of rose	10
Oil of bergamot	5
Oil of rose geranium	300

Lilac Sachet	Parts by weight
Lilac colored orris (see footnote page 1231)	100
Powdered benzoin (Siam) (1 part in 60)	

Mix lightly and add lilac oil, 1 part in 40, more or less.

SMELLING SALTS

Dry Type—Ammonia in some form is the basis for all smelling salts and they are usually perfumed with lavender. When glass stoppers are used for smelling salts bottles, the stoppers should be greased with petrolatum to prevent sticking. Small fancy bottles containing smelling salts are frequently carried by women in their purses, to be used for the stimulating or refreshing effect of the salts. These are called *vinaigrettes* and are usually filled with a mixture made by triturating together equal parts (say one drachm each) of granular ammonium chloride and dry potassium carbonate, and adding a little oil of lavender flowers (two drops to the above quantity).

The attractiveness of these salts is increased if they are colored with alkali-fast aniline dyes. They may be colored green, pink, red, yellow, lavender, etc.

Liquid Type—Fill two ounce, wide-mouthed, glass-stoppered, green glass bottles, made specially for smelling salts, with small cubes (¼ inch size) of translucent ammonium carbonate (sometimes large crystal potassium sulphate is used) and pour over them the following liquid:

Oil of lemon	1 fl. dr.
Oil of lavender flowers	30 min.
Oil of clove	10 drops
Stronger ammonia water	1 fl. dr.
Alcohol	3 fl. oz.

Color this liquid if desirable, preferably with alkali-fast aniline green.

Solidified Smelling Salts—Dissolve 1.35 Gm. of sodium hydroxide in 40 cc. of 95 per cent alcohol in a flask, warm the solution on a water bath and then add 2 cc. of stronger ammonia water and 1 cc. of oil of lavender.

Add sufficient alkali-fast aniline dye solution to suitably color and then quickly introduce 8.5 Gm. of stearic acid previously dissolved in 50 cc. of hot, 95 per cent alcohol.

Rotate the mixture in the flask on a water bath until a clear solution results and pour this at once into suitable bottles, the bottles having been warmed. In pouring, use a long-stemmed funnel to avoid touching the sides of the bottles during filling. Stopper at once, greasing the stoppers.

BATH SALTS

The basis for bath salts is large crystal sea salt (sodium chloride). To this may advantageously be added varying amounts of sodium borate, in large crystals, for the softening of water.

Coloring—A suitable alcoholic solution of the color desired is either sprayed on the crystals or they are dipped in the solution, drained and dried. Suitable dyes are:

Auramine for yellow	Methyl violet for purple
Tartrazine for lemon yellow	Safranines for pink
Acridine orange for orange	Methylene blue for blues
Phenylene brown for terra-cotta	Basic green for emerald

Perfuming—Having colored and dried the crystals they may then be perfumed by spraying on the appropriate perfume oil. This should contain ample resinous material, such as from 10 to 25 per cent of the oleoresins of benzoin, olibanum, etc. Readily oxidizable oils or those decomposed by alkali are not suitable. Terpeneless oils only should be used if perfumes of that type are desired.

FACE POWDERS

A satisfactory face powder should possess the following qualities:

Freedom from all harmful ingredients such as lead or bismuth salts.
Adhesion to the skin.
Absorbent qualities.
Uniform and extreme fineness.
Opacity or covering properties.
Suitable color, evenly distributed and not water-soluble.
Uniform mixing of all ingredients.

Among the ingredients used in face powders are the following:

Precipitated chalk—Absorbent and adhesive.
Talcum—Use the "air-floated" variety, pure white and fluffy.
White clays—Adhesive
Zinc oxide—Mild therapeutic action, having a tendency to overcome roughness of the skin. It has great opacity.
Light magnesium carbonate—Gives lightness to powder.
Zinc stearate—Very adhesive. Adds smoothness to the finished powder.
Magnesium stearate—Especially valuable as an adhesive.
Starch—(rice and corn)—Use only powder of the greatest fineness. Use small quantities as it has a tendency to clog the pores of the skin during excessive perspiration.
Orris—As a fixative.

To Color Chalk and Talc for Face Powders and Tooth Powders—*For Flesh Tint*—Use aniline lakes which are absolutely insoluble in water. A water soluble dye would run and stain from perspiration or tears. Carmine is not satisfactory; Venetian red is sometimes used.

A suitable dry, red dye	1 Gm.
Alcohol	250 cc.

Mix them in a bottle, allow to stand for twenty-four hours, filter, and add alcohol to make 1000 cc.

Mix 8 cc. of this solution with 100 Gm. of precipitated chalk or talc, adding only a small quantity of the powder at first, and triturating; gradually add the remainder of the powder, and sift the product several times through a No. 30 sieve. Then dry on paper.

Mix this colored talc with uncolored face powder in the proportion of 1 to 10 or more if desired.

The following mixture is also suitable for "flesh tint".

Flesh 5173[1]	4 parts
Pink 5172 Z[1]	1⅛ parts

Mix and dissolve 40 grains of the mixture in 4 fl. oz. of water and add this amount to each pound of powder.

[1] From National Aniline, Dye and Chemical Company.

Brunette—Thoroughly triturate 1 part of burnt sienna, or of Spanish brown, or a mixture of these, to give the desired tint, with 9 parts of precipitated chalk. Sift the mixture several times through a No. 100 sieve.

The following mixture may also be used for brunette:

Brown "R"[2]	3 parts
Brunette[2]	1 part

Mix and dissolve 40 grains of the above mixtures in 4 fl. oz. of water and add to each pound of chalk.

Use this colored chalk to replace white chalk in formulas, as necessary to produce the desired shade.

High Brown—Add more of the same color used for brunette. This is for the use of negroes.

Other Shades—Care must be taken to select only harmless colors such as yellow ochre, Armenian bole, and for *blue*, which is sometimes applied around the eyes, use ultramarine or cobalt blue. For other shades such as orange, mauve, mauresque, etc., suitable aniline dyes are largely depended upon, often in combination, to produce the desired shade.

The Perfume—Avoid odorous substances which are readily oxidized—Terpene-containing oils are especially objectionable, as they rapidly deteriorate. The presence of fixatives, as musk and usually the oleoresins, is important.

The so-called Oriental or Far Eastern odors are very popular, in which the oils of patchouli and vertivert play an important part. Flowery odors are, however, much used, especially combinations under coined names, usually consisting of blends of such odors as rose, jasmine, tuberose, heliotrope, patchouli, carnation, etc. The perfume is first combined with a portion of the powder, usually the dry magnesium carbonate, because of its absorbent properties and then uniformly mixed with the other ingredients. There are machines available in which the perfume oil is sprayed on the powders during mixing and bolting, the entire process being conducted within a dust-tight mixer.

Perfumed Powder—The perfumed powder may be prepared as follows:

Powdered Florentine orris	40 parts
Magnesium carbonate, dry	40 parts

Mix by trituration and bolt through a silk sieve. Then add 2 to 4 parts of perfume oil, by trituration, adding it first to a small quantity of the powder, triturating thoroughly, then adding more powder and triturating until all is mixed. Finally sift again through silk.

Face Powder—White (a)

Precipitated chalk (bolted)	10 parts
Fluffy talc	10 parts
China clay (or kaolin)	10 parts
Magnesium carbonate	5 parts
Zinc oxide	5 parts
Zinc stearate	5 parts
Perfumed powder (see above)	7½ parts

Mix the first six powders, pass through bolting cloth several times and then incorporate the perfumed powder and again bolt.

Face Powder—Flesh or Naturelle (b)

Replace one-half of the white precipitated chalk in the above formula with *pink chalk* (see page 1233) and proceed as directed above.

[2] From Barrett Manufacturing Company.

Face Powder—Medium Grade (c)

Talc	32 parts
Kaolin	20 parts
Magnesium carbonate	4 parts
Precipitated chalk	5 parts
Zinc stearate	10 parts
Perfumed powder	7 parts

All ingredients but the zinc stearate must be bolted, then mixed in a mixer. Bolting would take out the zinc stearate. The color and perfume may be incorporated with the chalk.

Face Powder—Good Grade (d)

Talc	40 parts
Kaolin	20 parts
Zinc stearate	10 parts
Magnesium carbonate	10 parts
Precipitated chalk	5 parts
Colored chalk	5 parts
Zinc oxide	5 parts
Powdered orris	5 parts
Jasmine oil	0.56 parts
Musk ambrette (in the proportion of 2 grains in 10 pounds)	

Liquid Face Powder

(*a*)	Distilled water	9 fl. oz.
	Glycerin	1 fl. oz.
	Alcohol	1 fl. oz.
	Trisodium phosphate	⅛ oz. av.
	Agar-Agar	⅛ oz. av.
(*b*)	Zinc Oxide	4 oz. av.
	Precipitated chalk	1 oz. av.

Dissolve the agar-agar in the water with the aid of heat. When completely dissolved, add the trisodium phosphate, and when cold, the alcohol, glycerin, and the mixture marked (*b*). Shake well before using.

TALCUM POWDERS

Use only light fluffy talc, free from earthy odor and dead white.

Avoid a "silky sheen" variety of talc. Talcum powder may be 100 per cent talc. If the powder is to be "borated" use at least 5 per cent of boric acid (impalpable type). Orris root is desirable as a fixative. Zinc stearate adds adhesive qualities. Talcum powders may be colored as already described under *Face powders*, by the use of colored talc.

Talcum Powder (White, Borated)

Talc	18 lb. av.
Boric acid	5 per cent
Orris root	5 lb. av.
Perfumed oil (as desired)	4 oz. av.

Mix and bolt.

Talcum Powder (Pink, Violet)

Use the above formula, replacing sufficient talc with pink-colored talc as desired and perfuming with violet perfume oil.

Talcum Powder (With Zinc Stearate)

Ten per cent of the talc may be replaced with zinc stearate in any of the above formulas but such mixtures must not be bolted as it will separate the stearate.

HAND LOTIONS AND CREAMS

Undue exposure to winds and sun, or the frequent use of soap and water, as in the housework of the home, frequently causes a roughness of the skin which may often be relieved by the application of one of the so-called "hand lotions".

These are usually slightly mucilaginous preparations, mildly antiseptic or healing, and attractively colored and perfumed. The following formulas are typical:

Tragacanth Cream

Powdered tragacanth	5 drachms
Alcohol	12 drachms
Glycerin	6 fl. oz.
Water	24 fl. oz.

Color and perfume as desired.

Mix the tragacanth, alcohol, and perfume in a mortar and add the water, with brisk trituration. Set aside overnight and strain.

Benzoin Lotion

Tincture of Sumatra benzoin	3 fl. oz.
Glycerin	4 fl. oz.
Rose water, to make	1 pt.

Mix the glycerin and rose water in a bottle and shake well. Then very carefully pour the tincture on the mixture and slowly invert the bottle without shaking, until the benzoin is incorporated.

Tragacanth Hand Lotion

Tragacanth (preferably whole)	2 dr.
Boric acid	4 dr.
Glycerin	4 fl. oz.
Alcohol	4 fl. oz.
Water	24 fl. oz.

Color and perfume as desired.

Dissolve the acid in the water, with heat, add the tragacanth, and macerate with frequent stirring until uniformly mixed. Then strain through muslin or cheesecloth, add the glycerin and alcohol, and color and perfume.

Quince Seed Lotion

Quince seed[1]	4 drachms
Sodium borate	1½ drachms
Boric acid	1½ drachms
Glycerin	4 fl. oz.
Alcohol	4 fl. oz.
Water	24 fl. oz.

Perfume and color as desired.

Macerate the quince seed with one pint of water overnight, and strain. Dissolve the sodium borate and boric acid in the remainder of the water, add it to the mucilage and incorporate the other ingredients, including the color and perfume.

[1] Quince seed is frequently dirty and should be carefully but quickly washed in cold water before maceration.

Toilet Cream (a)

Quince seed	30 gr. in 5 fl. oz. of water
Ivory soap flakes	10 gr. in 2 fl. oz. of water
Stearin-borax emulsion (see below)	2 drachms
Glycerin	4 drachms
Alcohol	3 drachms
Water, sufficient to make	8 fl. oz.

Add the quince seed to five ounces of hot water in a bottle, and shake frequently during twenty-four hours. Then strain. Dissolve the soap in two ounces of water, then add the stearin-borax emulsion (see next page) and stir until thoroughly mixed. Add the quince seed mucilage to which the glycerin has been added and stir again until mixed. After cooling somewhat add the alcohol to which the perfume has been added, and then sufficient water to make eight fluidounces.

Stearin-Borax Emulsion

Sodium borate	1¼ oz. av.
Stearic acid	2 oz. av.
Water	1 pt.

Dissolve the sodium borate in hot water, add the stearic acid, heat and stir until they have combined. It takes only a short time (10 to 15 minutes), using a "double boiler" or other form of water bath throughout the whole operation.

Toilet Cream (b)

(*a*)	Stearic acid	1400 gr.
	White beeswax	600 gr.
	Water	1 pt.
	Melt on a water bath and mix thoroughly.	
(*b*)	Neutral soap	1400 gr.
	Sodium borate	600 gr.
	Sodium benzoate	280 gr.
	Boric acid	280 gr.
	Water	4 pt.

Form a solution and add to *a*, producing an emulsion.

(*c*)	Quince seed	10 oz. av.
	Water	3½ gal.

Make a mucilage and add *d*, then incorporate with *a* and *b* and finally add *e*.

(*d*)	Glycerin	1 pt. 14 fl. oz.
(*e*)	Alcohol	1 pt. 14 fl. oz.
	Tincture of Sumatra benzoin	4 fl. oz.
	Perfume	1 fl. oz.
	Water to make 5 gallons of finished product (2 pt. 15 fl. oz. needed)	

Part I

Almond Cream (a)

Lard	12 oz. av.
Expressed almond oil	4 oz. av.
Potassium hydroxide	2 oz. av.
Stearic acid	8 oz. av.
White wax	1 oz. av.

Warm the lard and almond oil in a porcelain dish, on a water bath, until uniformly melted. Dissolve the alkali in 20 fluidounces of water, add to the melted fats and heat on the water bath for two hours, with constant stirring.

Then add 8 fluidounces of boiling water to the soap and afterwards a melted mixture of the stearic acid and white wax. The soap solution must be on a

bath of boiling water when the stearic acid mixture is added and the whole actively stirred until perfectly smooth, while the heat is continued.

Part II

Sodium borate	1 oz. av.
Boric acid	0.5 oz. av.
Sodium benzoate	0.5 oz. av.
Hot water	80 fl. oz.

Dissolve the salts in the hot water, on a bath of boiling water and keep hot until ready to mix with part I.

Part III

Quince seeds (selected)	8 oz. av.
Boiling water	160 fl. oz.
Glycerin	12 oz. av. (by weight)

Add the quince seeds to the water and heat on a bath of boiling water for one-half hour, then strain through muslin and add enough boiling water to restore the 160 ounce volume. Now add the glycerin, mix well, and again strain to remove any brown particles.

Now add part I to part II, stirring until uniform, and thoroughly incorporate the quince seed solution (part III), and beat in an emulsion machine until cold.

When cold add the perfume dissolved in 25 fluidounces of alcohol, and enough water to make 4 gallons, stir again, set aside for one-half hour, beat up again, very thoroughly, in the emulsion machine, and bottle.

Perfume—Use any desired perfume as lilac, jasmine, lily, rose, etc., in the proportion of 0.5 oz. to 1 oz. per (5 gal.) 640 oz.

Mixture I **Almond Cream (b)**

Flake tragacanth	6 lb. av.
Water	20 gal.

Macerate for four days and strain. Then add:

Boric acid	5 lb. av.
Glycerin	3 gal.
Denatured alcohol (Formula 39)	8 gal.
Benzaldehyde	5 fl. oz.
Oil of rose geranium	5 fl. oz.
Water	40 gal.

Beat this mixture for two hours in a mechanical mixer.

Mixture II

Expressed oil of almond (or oil of persic)	6½ pt.
Powdered acacia	7½ lb. av.

Mix thoroughly in an emulsion machine, then add 1 gallon and 3½ pints of water and heat for one-half hour. Now add 1 gallon of mixture I, beat for one-half hour, and then slowly add the remainder of mixture I, running the beater slowly. Finally strain.

Toilet Lotion

Quince seed	2 oz. av.
Boric acid	11 dr.
Liquefied phenol	60 min.
Glycerin	1 pt.
Starch glycerite (U. S. P.)	1 pt.
Alcohol	8 fl. oz.
Triple extract violet	2 fl. oz.
Water to make	1 gal.

Macerate the quince seed in one pint of water overnight and strain. Dissolve the boric acid in one-half gallon of boiling water and add the quince seed solution. After macerating for twenty-four hours, strain through Canton flannel, and add the glycerite of starch, previously mixed with the glycerin and liquefied phenol. Mix the extract of violet with the alcohol and add in small portions, agitating briskly after each addition to prevent precipitating the starch. Lastly, add sufficient water to make one gallon, and strain through flannel.

Quince Jelly Hand Lotion

Quince seeds	4 dr.
Boric acid	2 dr.
Glycerin	8 fl. oz.
Orange flower water	4 fl. oz.
Tincture of benzoin	2 fl. oz.
Alcohol	4 fl. oz.
Water, sufficient to make	2 pt.

Macerate the quince seeds in 8 fluidounces of water overnight, strain, add the other ingredients and enough water to make 2 pints.

SKIN CREAMS

Three outstanding types of skin creams are in use today although each may be further subdivided into many other special varieties. They are *fatty creams*, *vanishing creams* and *rolling creams*.

Fatty Creams—The term "cold cream" is often commercially applied to a cream without its being a true cooling cream, simply because of the value implied by the name to the buying public. A true "cold cream" is one made from an absorbable oil and one in which water has been incorporated through emulsification. Such a product has been known and used for centuries, in fact, its origin is attributed to Galen and it is sometimes called "Galen's Cerate". This formula, with little change, is still official in the Pharmacopœia under the title "Ointment of Rose Water" and is typical of the best cooling and healing cream. A few years ago because of the cost of the expressed oil of almond from which the official cream is made and also because of its tendency to become rancid, someone prepared a cream somewhat similar in character but replacing the almond oil by liquid petrolatum. This was originally called "theatrical cream" as it was used almost exclusively to remove the grease paint used in theatrical make-up.

Before long, however, the name "cold cream" was applied to this petrolatum product and it is largely sold today under that label. The petrolatum cream is an excellent cleansing cream to use after motoring or when exposed to dust or dirt and finds a valuable place in the toilet, but it is not a cooling cream since the petrolatum is not absorbed as are the vegetable oils.

If the pharmacist wishes to market a true cold cream for general use which will give splendid satisfaction to customers who suffer from sunburn in summer or chapped hands or face in winter, the Pharmacopœial formula may be taken as a basis for the product but the almond oil may be replaced by expressed oil of peach or apricot kernels (commercially known as *oil of persic*) and the rose water may be replaced by distilled water and an appropriate perfume added. A smaller amount of wax and spermaceti is also desirable for toilet purposes as the official cream is too firm. A final necessity if the cream is to give satisfaction, is to market the product in pure tin collapsible tubes. If sold in a jar, the water will quickly evaporate and the fat become rancid but in a tube it will retain its softness and will not readily deteriorate. A typical formula is as follows:

Toilet Cold Cream (True)

Spermaceti	100 Gm.
White wax	100 Gm.
Oil of persic	560 Gm.
Sodium borate	5 Gm.
Distilled water	190 cc.
Perfume, as desired.	

Melt the spermaceti and white wax together on a water bath, add the oil, and, when uniformly melted, slowly incorporate the warmed solution of sodium borate in the water, stirring constantly. Finally add the perfume oil (such as rose, jasmine, lilac, carnation, trefle, arbutus, or such other as may be acceptable to the trade), remove the heat and stir continuously until cold. Then pour into collapsible pure tin tubes and close with a stiff metal clip. Preferably use a tube with the label embossed upon it, if it is to be sold successfully as a toilet cream.

Avoid the use throughout of all iron vessels or utensils.

Theatrical Cold Cream (a)

White wax	150 Gm.
Heavy liquid petrolatum	650 cc.
Distilled water	240 cc.
Sodium borate	9.6 Gm.
Perfume, as desired.	
To make	1000 Gm.

Melt the wax with the petrolatum in a porcelain or enameled dish on a water bath. Dissolve the sodium borate in the water, warm it to the same temperature as the fats, and add to the fats with constant stirring. Then add the perfume and immediately pour into ointment jars or tubes. Avoid all contact with iron.

Theatrical Cold Cream (b)

"Snow white mineral jelly—No. 15"[1]	8 lbs. av.
White wax	2 lbs. av.
Sodium borate	1½ oz. av.
Water	1 gal.
Perfume, as desired.	

Prepare as directed for Theatrical Cold Cream (a).

Theatrical Cold Cream (c)

Anhydrous wool fat	10 Gm.
Paraffin	10 Gm.
White wax	25 Gm.
Heavy liquid petrolatum	105 Gm.
Distilled water	50 cc.
Sodium borate	1.25 Gm.
Pink color (oil), a sufficient quantity.	
Perfume, as desired.	

Melt together the wool fat, paraffin, wax, and liquid petrolatum, in a porcelain or enameled dish on a water bath. Heat the water almost to boiling and dissolve the sodium borate in the solution. Add the perfume and color to the melted oils and wax mixture and then pour the hot water solution into the oil mixture, stirring constantly while heating until it is perfectly emulsified (about 10 minutes), using no iron apparatus unless tinned.

Then withdraw the heat and stir until cold enough to pour into jars or tubes.

[1] Obtainable from the Oil Products Company, New York.

Theatrical Cold Cream (d)

Heavy liquid petrolatum	80 cc.
Paraffin	10 Gm.
White wax	30 Gm.
Sodium borate	2 Gm.
Distilled water	80 cc.

Prepare as directed under Theatrical Cold Cream (a). Stir the emulsified mixture one minute before pouring.

Skin Food

White wax	4 oz. av.
Spermaceti	3 oz. av.
Hydrous wool fat	5½ oz. av.
Expressed oil of almond	1 pt.
Rose water	6 fl. oz.
Borax	40 gr.
Oil of rose	30 min.
Oil of ylang-ylang	30 min.

Prepare as directed under Toilet Cold Cream (true), page 1239.

Vanishing or Disappearing Creams—Creams of this character are primarily mixtures of potassium, ammonium, or sodium stearate and water with the addition of more or less glycerin and some free stearic acid, also a suitable perfume. The larger percentage of these creams being water they dry quickly, and to retard this, glycerin is usually added in amounts not exceeding 15 per cent.

Vanishing creams are used primarily as a base upon which to apply face powder. When rubbed upon the skin they disappear but leave a surface to which face powder will adhere. All ingredients should be of the highest grade. It is particularly important that the stearic acid be pure and cold pressed; the consistence being such that it may be crumbled to a powder between the fingers. Vanishing cream should be marketed in jars which can be tightly closed or preferably in pure tin, collapsible tubes. *All vessels or utensils of iron must be avoided,* only porcelain or enamel dishes being used.

Vanishing Cream (a)

Stearic acid	50 Gm.
Oleic acid	10 Gm.
Potassium hydroxide	2.5 Gm.
Distilled water	200 cc.
Perfume, as desired 1 cc. (more or less).	

Melt the stearic acid on a water bath, heated to a temperature of 85° C. Dissolve the alkali in the water, warm the solution to 85° C. and gradually pour the warm solution into the melted acid, stirring briskly. Continue the same temperature and active stirring for ten minutes to insure a complete saponification and absence of free alkali. Then remove the heat but continue the stirring until cold, at the same time incorporating the perfume. The cream should afterwards be beaten for several hours, preferably by mechanical means, and then placed in jars or tubes.

Vanishing Cream (b)

Stearic acid	1 oz. av.
Glycerin	1 oz. av.
Distilled water	4 fl. oz. 6 fl. dr.
Sodium borate	8 gr.
Potassium carbonate	16 gr.
Perfume, as desired	45 min.

Prepare as directed under vanishing cream (a), mixing the glycerin and water together.

Vanishing Cream (c)

Powdered boric acid	20 oz. av.
Sodium benzoate	2 oz. av. 126 gr.
Tragacanth (whole)	12½ gr.
Sodium bicarbonate	4¼ lb. av.
Stearic acid	138 lb. av.
Heavy liquid petrolatum	75 oz. av.
Glycerin	75 oz. av.
Lilac perfume oil	1 lb. av.
Water	11 gal.

Macerate the tragacanth in 6 gallons of the water for twelve hours or overnight. Dissolve the boric acid, sodium benzoate, and the sodium bicarbonate in the tragacanth solution and add 5 gallons of hot water.

Melt the stearic acid, add the glycerin, and the liquid petrolatum and then incorporate the aqueous solution already prepared, stirring constantly. Stir with a mechanical stirrer for one-half hour, add the perfume, again stir for a half hour and finally pass it through an ointment mill.

Rolling Creams—These are preparations of freshly precipitated casein from milk, usually colored pink. They must contain a preservative such as formaldehyde to prevent decomposition and should be marketed in jars which close tightly to prevent evaporation.

Their distinctive feature is their apparent disappearance when rubbed on the skin, followed immediately, on further rubbing, by rolling into small particles which carry with them the dust and dirt which has collected in the skin pores.

A typical formula is as follows:

Rolling or Massage Cream

Fresh rich milk	128 cc.
Solution of formaldehyde	0.125 cc.
Liquid perfume color (red)	0.2 cc.

Mix thoroughly, warm gently to 50° C. on a water bath and stir in quickly a solution of 2 Gm. of powdered sodium borate in 10 cc. of distilled water. Warm the mixture to 55° C. and strain through unbleached muslin, previously wetted.

Now prepare a hot solution of 4 Gm. of powdered alum in 16 cc. of distilled water, strain through cotton and add to the milk while boiling hot, stirring it in slowly, keeping the temperature at about 55° C. When cool, and the supernatant liquid is colorless, collect the precipitate on a strainer. Allow the precipitate to drain, wash thoroughly with water, again drain, and then press until the product is of proper consistence.

Finally, incorporate 0.3 per cent of finely powdered sodium bicarbonate, 1.5 per cent of finely powdered sodium benzoate, 3.5 per cent of impalpable boric acid and sufficient of the selected perfume (about 40 grains per pound).

DEPILATORIES

Depilatories are usually caustic applications, in which barium sulphide, calcium sulphide, or strontium sulphide enter into the composition of the preparation. They act by dissolving the cellular structure of the hair and are always more or less irritating to the skin.

They are usually marketed in a combination set consisting of a bottle of the sulphide mixture, which is kept dry and tightly-stoppered; a shallow

glass dish and a mixing spoon of horn or celluloid are included in the package. The directions suggest the adding of sufficient water to a small amount of the powder, in the dish, to form a paste and the spreading of this on the surface from which the hair is to be removed. The paste is allowed to remain for from three to five minutes and then scraped off bringing the hair with it. Cold cream is then to be applied to prevent any irritation and a box or tube of this usually accompanies the outfit when sold.

Typical formulas are as follows:

I

Barium sulphide (yellow)	20 Gm.
Powdered soap	5 Gm.
Powdered talc	32 Gm.
Wheat flour	32 Gm.
Benzaldehyde, enough to perfume.	

Mix.

II

Barium sulphide (yellow)	15 Gm.
Starch	5 Gm.

Mix.

III

Barium sulphide (yellow)	10 Gm.
Zinc oxide	5 Gm.
Wheat flour	5 Gm.

Mix.

IV

Best shaving powder (dry)	6 Gm.
Barium sulphide	8 Gm.

V

Shaving powder (dry)	5 Gm.
Calcium sulphide	5 Gm.

Depilatories in the form of pastes are now being offered. The decomposition of the sulphide is much more rapid in this form, however, and they are of doubtful practicability.

Books on Perfumery

Chemistry of Essential Oils (Parry).
The Volatile Oils (Gildemeister and Hoffman).
The Art of Perfumery (Piesse).
Perfumes and Cosmetics (Poucher).
Perfumes and Their Preparation (Askinson).
Manual for the Essence Industry (Walter).
Die Moderne Parfümerie (Mann).
Perfumes and Cosmetics (Askinson).
Cyclopedia of Perfumery (Parry).
Preparation of Perfumes and Cosmetics (Durvelle).

PART VII

THE RESPONSIBILITY OF THE PHARMACIST UNDER THE LAW

CHAPTER LXXVIII

COMMERCIAL LAW

FOR his own protection, and the protection of the community which he serves, the pharmacist should have a general knowledge of certain features of the law. Not only must he be familiar with the Federal and State statutes concerning the possession and dispensing of certain commodities in which he deals, such as poisons, drugs, opiates and alcoholic liquors, but he finds that many rules of the "common law", either as applied directly or as incorporated in the statute law of his State, seriously concern him in the management and development of his business.

Business Laws—The pharmacist should understand the general principles of the laws of contract, so that he will realize his responsibility when he undertakes a business obligation. The law of agency concerns him in the management of his employees. In deciding on the proper methods of conducting his business, raising capital, etc., he should know the fundamental principles of partnership and corporation law. As he is a dispenser of compounds which are highly dangerous when taken unadvisedly, he should be familiar with the law of negligence.

It is impossible in a general treatise of this kind to lay down in detail the legal subjects upon which the pharmacist should keep posted. All that can be attempted is a general outline.

Diversity of Laws—The American Union is composed of forty-eight distinct and separate sovereignties, each supreme within its own territory, excepting only so far as the American people by their Constitution have granted certain powers to the Federal Government. Most of the laws above referred to are governed entirely by State enactment, so that when it comes to examining details and niceties there are as many sorts of such laws as there are States. These are difficulties in the way of presenting a general treatment of this subject. There are however fundamental principles upon which the laws of nearly all the States agree. These are the principles of the "common law" of England, brought to this country by our forefathers, and either consciously or unconsciously followed since by the lawmakers of the several States as they sought to enact legislation to meet the changing needs of their communities. Therefore it is possible for the business man, by a study of the "common law" as it affects his business, to acquire, with a little help from a lawyer of his own State, a thorough grasp of the rules of law which must govern him in the management of his own affairs.

The Contract—In looking into the operation of the "common law" on this subject, it is found that first:

A Promise is not a Contract—It is difficult for the layman to grasp the idea that the law will not necessarily enforce a promise. Originally, only those promises which were written down and "under seal"—attested by the solemnity of a waxen or written seal—could be enforced. Later, the idea became established that if the person to whom the promise was made, lost something because of that promise, then it was not fair that the other party should break his word: so it became the law that if "consideration" passed—if value passed

from the promisee because of the promise made to him—then the contract should be as binding as though it had been made in writing and under seal.

Size of Consideration is not a Factor—The law is not interested in the value of the consideration. If there is consideration, the contract stands. One who has made a bad bargain may not invoke the law to escape from the consequences of that bargain. Contracts are supposed to be made by men "standing at arm's length" so that each one is required to use his wits to see that he makes the best terms possible for himself.

Fraud, However, May Make a Contract Void—A man may not profit by a contract into which he has induced another to enter by direct fraud or misrepresentation. Not every falsehood, however, is a fraud. The law on this point is undergoing some interesting changes; therefore the law of the State, where the contract is sought to be enforced, must be consulted.

Parties—The parties to a contract should be of full age and of sound mind; and the contract itself, to be enforceable, must be for the doing of a thing which is lawful.

Written Contracts—It is not necessary that contracts—save in a few excepted cases—be in writing. They may be made by action, or by word of mouth. If, however, the parties elect to put their agreement in writing, they must be careful to make the writing express the entire contract. Should there be a dispute later about its terms, they would each be relegated to whatever rights they held under the written instrument. Oral testimony of an understanding, enlarging or changing the terms of the contract as written down, would not be permitted to be presented at a trial to enforce rights under the contract. Ignorance of this principle has often led to serious loss.

What Contracts Must be in Writing—There are certain contracts, however, which the law requires to be expressed in writing. These are, generally speaking, contracts to guarantee or stand surety for another, contracts dealing with rights in real estate, and contracts for the sale of goods over a certain figure. The local State laws would have to be consulted on this point.

Remedies for Breach of Contract—If a contract is broken, the party wronged may in nearly all cases sue the other in a court of law, asking money damages as compensation for loss sustained. In some cases, however, where money damages would not compensate, he has the right to go into a court of equity and ask that the other party be compelled to carry out his agreement.

The contract most frequently dealt with, is that of

Agency—It is necessary for every business man to transact a great part of his work through agents. These may be general agents, with full power to act for their principals, or special agents, whose authority is limited by the contract of employment.

Duty Toward Agent—The principal owes to the agent the duty of payment for services rendered and remuneration for expenses properly incurred. If the agent is an employee, he has other obligations toward him, looking to his safety and health. These obligations are generally defined in the various workmen's compensation laws which are in force in practically every State. Under these laws, the principal is required to pay the employee compensation for injuries resulting from accidents suffered while engaged in the employer's business, such payment being made according to a schedule set forth in the law. The amount of payment depends upon the severity of the injury and the earning power of the employee. The principal is further required to take out insurance against the risk of liability for such payment.

Duty Toward Employer—The agent owes to the principal the duty of loyalty and service. He may not make a profit out of his employment, unless such profit is known to the employer; he may not "serve two masters".

Duty Toward Third Parties—The principal is bound by contracts made by the agent, within the scope of his *apparent* authority—even though such contracts be in direct violation of the agent's instructions—unless of course such violation be known or should be known by the person with whom the agent is dealing.

Agency by Estoppel—Even though an agent had no authority whatever, yet there may be a duty on the principal to speak out when he learns of the unauthorized act. If he fails to speak, and a third party by his silence is led to believe that the agent had authority, then the principal may be responsible on the "principle of estoppel".

Liability for Torts and Crimes—The principal is further liable to third parties for torts (wrongs) committed by the agent while seeking to further the employer's business, and this is also true whether or not such wrongs were committed in violation of instructions. A principal, however, is not criminally responsible for crimes committed by the agent, unless he instructed the agent to commit the crimes and thereby was a party to them.

The Partnership—The simplest form of doing business is that of personal ownership, which has few complications. If however, a partnership is formed, the law calls each partner both a principal and an agent—each partner is agent for all the others, within the scope of partnership business. It follows, therefore, that each partner can bind the partnership by contract; further, that each partner is responsible for all contracts made by the partnership or all debts incurred by it. This is true, irrespective of the size of the interest of the partner in the business—he is responsible for every cent of the firm's debts, no matter what that interest is, so long as he is a partner.

The Limited Partnership—If this liability is sought to be avoided, the device of a limited partnership may be employed. This is brought about by making application to the proper authority of the State, naming the contribution of each partner toward the business capital. Upon permission being received to operate as a limited partnership, the word "Limited" must be added to the firm name, to give notice to the world that there is limited liability on the part of certain partners. There must always be at least one general partner in a limited partnership, whose liability is unlimited.

The Corporation—The corporation is formed by authority of the state, which, upon application grants a charter to the incorporators. This charter states the powers of the corporation. It has no authority whatsoever outside of such powers.

Capital Stock—The capital stock of the corporation is divided into shares, and each stockholder holds a certain number of shares, evidenced by certificates of stock issued to him. The stockholders elect a board of directors and certain other officers, who conduct the affairs of the corporation.

Stock is either common or preferred. Common stock is the ordinary voting stock of the company. Its holders are permitted to share in the profits of the company, whenever dividends are declared by the directors. Preferred stockholders are entitled to receive their dividends before any payments whatever are made to the holders of common stock. The rights of all stockholders, so far as receipt of dividends is concerned, are printed on the certificates of stock issued to them.

Liability of Stockholders—In case a corporation becomes insolvent, stockholders are liable for only the amount of stock subscribed for by them, with certain exceptions with regard to banking corporations, etc., where the State law must be consulted.

Bonds—Bonds of corporations are evidences of debt, showing that money

has been borrowed. The terms of payment, the nature of the security, all questions of priority, etc., are stated on the bond. Bondholders of course must be paid in accordance with these terms, before any money is paid to stockholders.

Commercial Paper—Practically every State has enacted the "Uniform Negotiable Instruments Law". Its provisions state that "negotiable paper"—*i.e.*, bills of exchange, checks, promissory notes, etc., shall be negotiable by endorsement or delivery, so that a person who holds such paper for value before maturity shall have the right to proceed against prior parties on the paper without regard to any defences to payment which such prior parties might have. This of course would be true only when the holder did not have actual notice of such defences when he took the paper.

Notice of Dishonor—Formal "notice of dishonor" must be given to all prior parties on the note in order to hold them responsible. This notice must be given by a Notary Public, in a form called a "protest", and such protest must be made at or immediately after the actual dishonor of the note. Consult local statutes for manner and time for such notice. Unless such notice is given in strict accordance with the statute there can be no recovery under the law.

If one desires to endorse commercial paper without incurring any chance of liability thereunder, he should place over his signature the words "without recourse".

Negligence—A druggist is responsible, if anyone is injured by the negligent act of himself or his agent, provided such act is done within the scope of the agent's apparent authority. Negligence is the absence of proper care. What is proper care is a question depending on the facts in each case.

Liability for Error in Filling Prescriptions—If a pharmacist fills a prescription according to its terms, ordinarily he is not responsible if the medicine fails to cure or even does harm to the person taking it. Cases, however, may arise where a pharmacist is under a special duty to guard his customer from harm. Where unusual circumstances show that the physician giving the prescription could not have been aware of the toxic value of the ingredients prescribed, a duty rests upon the pharmacist to refuse to fill the prescription; and a failure to so refuse, in extreme cases, might make the pharmacist as well as the physician liable. The pharmacist, however, is under no compulsion to know the therapeutic value of the drugs prescribed.

A prescription should be filled by a registered pharmacist or a certified assistant personally, or by an employee under the direct personal supervision of the pharmacist or certified assistant. Violation of this rule may result in severe liability.

Preservation of Prescriptions—Prescriptions for *narcotic* and for *alcoholic liquors*, when once filled, become the property of the State. The pharmacist is merely their custodian. He is not allowed to destroy them nor part with them. He is required to keep them on a special file, subject to state inspection, for a specified time—generally five years.

Poisons—It is held, that a violation of a statute concerning the care or use of the thing which does the damage, is in itself negligence. It therefore is proper at this place to consider the special statutes concerning the sale of poisons. *A poison has been defined as any drug known to the pharmaceutical or medical profession, which is liable to be destructive to adult human life if taken in quantities of 60 grains or less.*

Forbidden to Send by Mail—Under Federal law the pharmacist is prohibited from transmitting poisons through the mails without special authority from the Postmaster-General.

Labels—There is a regulation in every State that whenever a preparation sold or delivered by a druggist is a poison, then the bottle, package or other carrier of the prescription must bear a label containing the name of the article, the word "poison" and the name and place of business of the seller. A druggist is further forbidden to sell any poison to a person without satisfying himself that the person understands the nature of the poison and intends to put it to proper use.

Deadly Poisons—In many jurisdictions special laws regulate the sale of poisons destructive to adult human life when taken in quantities of five grains or less. As to these, the druggist is obliged to keep a record of each sale in a "Poison Record", stating the name and address of the purchaser, the nature and quantity of the drug, the date when sold, and the purpose for which it is to be used. This record must be preserved, and be open to inspection by proper authority.

Other Special Legislation—Stringent laws govern the possession and sale of opiates and alcoholic liquors. These laws will be covered by other articles published herewith. The Federal Pure Food and Drugs Law of 1906, which prohibits adulteration or misbranding, will also be treated in a separate article.

Abortifacients—By virtue of a United States law, it is forbidden to send through the mails any drug or device tending to produce abortion or prevent conception. State laws provide, in most cases, that the same may not be advertised for sale or sold. An exception exists in the case of bona fide medical books and proper advertisements to the medical profession.

Advertisements—Recent laws have made the prohibition against wrongful advertisement more comprehensive and the penalty more stringent. Such legislation forbids any advertisement of drugs or wares "which shall be false or misleading in any particular".

CHAPTER LXXIX

SPECIFIC LAWS GOVERNING THE PRACTICE OF PHARMACY

THE legislature of every State has recognized the necessity of regulating the conditions under which a pharmacist may enter and subsequently practice his profession. *Such laws are police regulations, and are based upon the necessity of protecting the public against fraud in the handling of poisons, and potent or possibly harmful drugs and medicines.* The statutes dealing with the practice of pharmacy in the specific State under consideration should be consulted by those who desire exact information on this point.

These various State laws differ so materially among themselves, that it would be impossible in a treatise of this character to indicate their scope in other than the most general terms. The subject of a model pharmacy law has, however, been given careful study by a Committee of the A. Ph. A.[1], and a draft of such a law, embodying many conditions believed to be ideal, has been published[2]. This draft is not the law of any State, but that it may be readily available for consideration in the drafting of any proposed legislation and that it may serve as an ideal for future laws, it is copied here in full. It furthermore presents the principles embodied in all pharmacy laws.

In presenting this draft of a model pharmacy law, the A. Ph. A. Committee wishes it to be understood that it is intended only as a model and that it is realized that all sections may not be applicable everywhere. It embodies, however, many ideal features such as,

(*a*) The majority of the board of pharmacy to be graduates in pharmacy.

(*b*) That the pharmacy board shall be charged with the enforcement of all laws pertaining to pharmacy.

(*c*) That all who compound, sell or distribute potent drugs and poisons shall be required to prove qualification and also their place of business shall be registered by the board.

(*d*) The determination of the status of the physician, the veterinarian, and the "assistant pharmacist", in relation to dispensing potent drugs and the requirement that they prove their qualification.

(*e*) The law does not prevent the physician, dentist, or veterinarian from dispensing drugs in emergency.

(*f*) Adequate education and experience is required of registered pharmacists.

(*g*) The power to revoke a certificate for cause is granted the board, with the right of appeal.

(*h*) The act defines poisons and establishes regulations for their sale.

(*i*) Potent or poisonous drugs or medicines must be labeled to indicate the contents, and with the word "Poison", except when dispensed on the order of a physician, dentist, or veterinarian.

(*j*) The model law also covers the necessary regulations for the sale or dispensing of narcotic drugs and for the establishment of a standard of strength and purity in the drugs and medicines dispensed.

When a pharmacist has registered in one State it is frequently possible to then register in other States without a new examination. This privilege is granted through agreements of reciprocation which have resulted from the excellent service rendered by the National Association of Boards of Pharmacy. Reciprocity is now in force between the following States:

[1] The Committee consisted of Wm. C. Anderson, J. H. Beal, George M. Beringer, F. E. Stewart, F. H. Freericks, Chairman.

[2] J. A. Ph. A., 1922, page 568.

Alabama	Iowa	Montana	South Carolina
Arizona	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	Nevada	Tennessee
Colorado	Louisiana	New Hampshire	Texas
Connecticut	Maine	New Mexico	Utah
Delaware	Maryland	North Carolina	Vermont
D. of Columbia	Massachusetts	North Dakota	Virginia
Florida	Michigan	Ohio	Washington
Georgia	Minnesota	Oklahoma	West Virginia
Idaho	Mississippi	Oregon	Wisconsin
Illinois	Missouri	Pennsylvania	Wyoming
Indiana			

For information write to the Secretary of the National Association of Boards of Pharmacy, 130 North Wells Street, Chicago, Ill.

An Act to Regulate the Practice of Pharmacy and to Control and Regulate the Manufacture, Sale, and Distribution of Drugs, Chemicals, Poisons, and Potent Drugs

Be it enacted by the General Assembly of————————————

Section 1—Definitions: (*a*) the term "pharmacist" when not otherwise limited means a person licensed by the State Board of Pharmacy, to prepare, compound and dispense physicians' prescriptions, drugs, medicines, and poisons; (*b*) the term "pharmacy" when not otherwise limited means a place registered by the State Board of Pharmacy in which drugs, chemicals, medicines, prescriptions and poisons are compounded, dispensed, and retailed; (*c*) the term "drug dealer" means one who conducts a fixed place of business and who is registered by the Board of Pharmacy to distribute and sell drugs, chemicals, medicines and poisons in original packages only, as prepared by or under the supervision of a licensed pharmacist; (*d*) "chemicals" where not otherwise limited means the chemical materials of medicine; (*e*) "drugs" where not otherwise limited means all substances used as medicines or in the preparation of medicines; (*f*) "medicines" where not otherwise limited means drugs or chemicals or preparation thereof, in suitable form for the prevention, relief and cure of disease, when used either internally or externally by man or for animal; (*g*) "Pharmacopœia" when not otherwise limited means the latest edition of the Pharmacopœia of the United States of America; (*h*) "National Formulary" means the latest edition of that work as published by the "American Pharmaceutical Association"; (*i*) "Board" or "Board of Pharmacy" wherever used in this Act, unless otherwise specifically indicated, shall mean the State Board of Pharmacy of this state.

Section 2—There shall exist and be maintained within the state a State Board of Pharmacy with duties and powers as hereinafter defined and provided. The State Board of Pharmacy shall consist[1] of five (5) members, and the now existing State Board of Pharmacy heretofore appointed shall continue in office and act as the State Board of Pharmacy with all the duties and powers as herein provided until the terms of its present members, respectively, expire, the vacancies as they annually occur to be filled in keeping with the requirements of this Act. Hereafter in making appointments to the State Board of Pharmacy the appointees shall have been licensed Pharmacists under this or some former law of the state, for a period of at least five (5) years, and at the time of their appointment a majority of them shall be engaged in retail pharmacy. At least a majority of the members of the State Board[2] of Pharmacy shall be graduates of a college or school of pharmacy, and if the now existing State Board of Pharmacy is not so constituted the first occurring vacancies of the Board shall be filled with appointees meeting such qualification, except in the case of re-appointment of present members, and such qualification for at least a majority of the Board shall thereafter be maintained. Members of the State Board of Pharmacy to be appointed under this Act, shall be appointed by the Governor and shall serve for a term of five (5) years, or until their successors are appointed, and have duly qualified. Vacancies occurring in the Board other than by expiration of term shall be filled for the unexpired term only. The members of the Board shall be paid ten ($10.00) dollars per diem, and their necessary expenses while actually engaged in the performance of the duties of the Board. Annually, the State Pharmaceutical Association may from among its membership nominate five (5) candidates for the next occurring vacancy on the Board of Pharmacy, who shall meet the requirements as herein provided and from among the nominees when regularly submitted and certified by the president and secretary of the State Association, or from others having the necessary qualification, the Governor shall make his appointment for

[1] This number may be increased when deemed to be expedient.
[2] Where all members are desired to be engaged in retail pharmacy it can be so provided.

vacancies occurring in the Board of Pharmacy. Appointees to the Board of Pharmacy shall within thirty (30) days after their appointment take and subscribe an oath or affirmation before a properly qualified officer, that they will faithfully and impartially perform the duties of their office, which oath or affirmation shall be filed with the Secretary of State.

SECTION 3—The State Board of Pharmacy shall organize by electing a president, vice-president, secretary and treasurer all of whom shall be elected annually, and all but the secretary shall be members of the Board. The officers of the existing Board shall continue to so act until the term for which they have been elected shall expire. The Board shall have power to make rules and regulations for the proper performance of its duties, and the duties of its officers and employees and to carry out the provisions of this Act. The president of the Board shall preside at all of its meetings and in his absence or inability to preside the vice-president shall so act. The treasurer at stated periods as ordered by the Board shall receive and receipt for all moneys turned over to him by the secretary which are then to be paid by him into the State Treasury on or before the ——— day of every month, to the credit of a fund for the use of the State Board of Pharmacy, and he shall file with the Auditor of State a detailed verified statement of such receipts and payments. The compensation and expense of the members, officers and employees of the Board including the State Drug Commissioner shall be paid out of this fund, and out of such necessary appropriations toward said fund as shall be provided by the state. All disbursements on account of the Board shall be made upon requisition signed by its president and secretary and the warrant of the Auditor of State. The treasurer of the State Board of Pharmacy shall receive a compensation of $——— per annum, and shall be required to give a bond to the state in the sum of $——— with surities approved by the Board, conditioned upon the faithful discharge of his duties. The secretary of the State Board of Pharmacy shall be its executive officer, and shall be in charge of its offices. He shall make, keep and be in charge of all the records and record books required to be kept by the Board. He shall receive all fees to be collected under this Act and also collect, receive and receipt for all fines imposed under this Act in prosecutions brought by the State Board of Pharmacy, or under its direction, and at regular intervals, as ordered by the Board, shall pay the same over to the treasurer of the Board and take the treasurer's receipt therefor. He shall keep a register of all who under this Act are required to be licensed, and also of all places of business required to be registered hereunder, shall attend to all correspondence of the Board and shall perform such other special secretarial duties which the Board may charge him to perform, in keeping with the office of secretary. The officers, including the secretary of the State Board of Pharmacy, shall be empowered to administer oaths in connection with the duties of the Board. The secretary shall receive a salary to be fixed by the Board and all his necessary expenses incurred while in the performance of his official duties. He shall give a bond to the state in the sum of $——— otherwise similar to the bond required from the treasurer. The bonds required to be given by the treasurer and by the secretary and by employees under regulation of the Board, shall be deposited with the Secretary of State, and kept in his office. The books and registers of the Board as made and kept by the secretary or under his supervision, subject to the direction of the Board, shall be *prima facie* evidence of the matter therein recorded, in any court of law. The Board shall as an Examining Board meet at least four times each year in the city of ————————, or at such other place within the state as it may designate at any regular session.

SECTION 4—There is hereby created the office of a State Drug Commissioner who under the control and supervision of the State Board of Pharmacy, and in its name is directly charged with the enforcement of all laws coming within the jurisdiction of the Board. The State Drug Commissioner shall be appointed by the State Board of Pharmacy for a term of ——— years at a salary of $——— per annum. The State Drug Commissioner for at least five (5) years prior to his appointment shall have been licensed to practice pharmacy, and he shall be a graduate of a college or school of pharmacy. Vacancies in the office of the State Drug Commissioner shall be filled by the Board for the unexpired term. The State Drug Commissioner shall employ all necessary chemists, agents and clerical help for the proper conduct of his office, as may be from time to time determined by the State Board of Pharmacy, and all of his appointments shall be passed upon and approved or disapproved by the State Board of Pharmacy at its next regular session after the appointments are made. The State Drug Commissioner shall report upon his official duties to the State Board of Pharmacy at all its regular sessions, and at such other times as it may direct.

SECTION 5—It shall be the duty of the State Board of Pharmacy through the State Drug Commissioner and through its officers and employees appointed under its supervision for that purpose, to enforce all laws of the state, now or hereafter enacted which pertain to the practice of pharmacy, the manufacture, production, sale or distribution of drugs, chemicals and poisons, and to their standard of strength and purity. All fines and fees imposed and recovered under this Act shall be collected by and paid to the secretary of the State Board of Pharmacy, to be by him turned over to the treasurer of the Board, by whom the same are to be paid into the State Treasury. As an Examining Board it shall examine all persons in the art and science of pharmacy and its allied branches, who meet the necessary qualifica-

tion as herein provided and who make application for a license as Pharmacist, Assistant Pharmacist, Medical, Dental or Veterinary Dispenser, and Drug Dealer.

SECTION 6—The compounding and manufacture of drugs and medicines and their sale and distribution at retail or to consumers, when of potent or poisonous character as defined in this Act, shall be limited, exclusively to persons who are licensed for that purpose under the provisions of this Act, or under the supervision of such, provided that all persons now licensed within this state as Pharmacists or Assistant Pharmacists shall have all the rights which are granted to Pharmacists and Assistant Pharmacists, under this Act, when complying with the requirements thereof as hereinafter set out; and, provided further, that nothing contained in this Act shall be construed to prevent the personal administration of drugs and medicines carried or kept for emergencies, by licensed dentists, physicians, and veterinarians, in order to supply the immediate need of their patients. For the purpose of this Act, there shall be and are hereby made provisions for the licensing of Pharmacists, Assistant Pharmacists, Medical, Dental and Veterinary Dispensers, and Drug Dealers, each having the right hereinafter provided, and being subject to the limitations and restrictions as respectively made.

(*a*) A Pharmacist shall have the right to conduct a pharmacy for the compounding of medicines upon physicians' prescriptions, and for the manufacture, sale and distribution of drugs, medicines and poisons.

(*b*) An Assistant Pharmacist shall have the right to do all things that may be done by a Pharmacist, when in a pharmacy or place of business conducted under the supervisions of a pharmacist.

(*c*) Medical, Dental and Veterinary Dispensers, who must also be by this state licensed physicians, dentists, or veterinarians, shall have the right only to compound and dispense medicines which they prescribe for persons or animals under their medical treatment and such compounding and dispensing shall be strictly incident to the practice of medicine; dentistry or veterinary medicines.

(*d*) Drug Dealers, when conducting fixed places of business at least ———— miles distant from a pharmacy, shall have the right to distribute and sell potent drugs and medicines, and poisons as compounded and prepared under the supervision of Pharmacists licensed in this or other states, when properly labeled under the name of a licensed Pharmacist, known wholesale dealer, or manufacturer of drugs and chemicals.

SECTION 7—(*a*) Every applicant for a license as a Registered Assistant Pharmacist shall be not less than eighteen (18) years of age, and shall have at least three (3) years of practical experience in a pharmacy where physicians' prescriptions are compounded, and shall have successfully completed not less than one (1) year of instruction in a recognized college or school of pharmacy, for which credit shall be given as practical experience covering the time of college course pursued. Every applicant shall furnish proof of preliminary education equal to graduation from a high school of this state.

(*b*) Every applicant for a license as a Registered Pharmacist shall be not less than twenty-one (21) years of age, and shall be a graduate of a recognized college or school of pharmacy; shall have at least two (2) years of practical experience as a registered Assistant Pharmacist in a pharmacy where physicians' prescriptions are compounded, provided not more than one (1) of said two (2) years may be credited for a course successfully completed at a recognized college or school of pharmacy; shall furnish proof of preliminary general education equal to graduation from a high school of this state. It is hereby provided that a graduate of a recognized college or school of pharmacy lacking the required practical experience shall be permitted to take an examination on theoretical subjects at any regular examination of applicants and at any time after graduation, a record of the credits secured being made and kept by the State Board of Pharmacy, the practical examination in such case to be taken at the end of the required five (5) year period.

(*c*) Every applicant for registration as a licensed Medical, Dental or Veterinary Dispenser shall give proof of registration under the laws of the state, as a physician, dentist, or veterinarian.

(*d*) Every applicant for registration as a Drug Dealer shall be not less than twenty-one (21) years of age, and shall give proof of having attained at least a common school education, entitling to entrance of a high school in the state.

SECTION 8—Every applicant for registration as licensed Pharmacist and Assistant Pharmacist shall, to prove respective requisite knowledge, be examined to a proper varying degree in the subjects of chemistry, botany, materia medica, toxicology, and the theory and practice of pharmacy. Every applicant for a license as Medical, Dental or Veterinary Dispenser shall be examined for fitness to compound and dispense drugs and medicines to patients. Every applicant for a license as Drug Dealer shall be suitably examined for fitness to distribute and sell drugs and medicines; provided, however, that all licensed physicians, dentists and veterinarians of this state, who, when this Act takes effect, have been accustomed to compound and dispense medicines which they prescribe for their patients, may on application to the Board of Pharmacy within ninety (90) days from that date, upon

affidavit, setting out such fact, become licensed without examination, as such Medical, Dental or Veterinary Dispenser; and Drug Dealers who prior to, and at the time that this Act takes effect, have been engaged as such within the state, may within ninety (90) days from that date become licensed as such without examination, upon application to the Board of Pharmacy, giving satisfactory proof.

Section 9—Every person who hereafter desires to engage in pharmacy, with a view of becoming licensed as Assistant Pharmacist and as Pharmacist, shall, upon entering employment in a pharmacy register as an Apprentice with the State Board of Pharmacy, and for every such person the requisite practical experience shall be determined from the date of registration. A fee of fifty (50) cents shall accompany an application for registration as Apprentice, and a certificate shall be issued by the Board to such applicant. A person who before or after this Act takes effect may have served part of his apprenticeship in some other state not requiring such registration shall give proof of such service satisfactory to the Board. Persons who immediately prior to the time when this Act becomes effective have been employed in a retail pharmacy, with a view of becoming licensed as an Assistant Pharmacist or as a Pharmacist, shall for that purpose be given credit for the time so spent, in becoming registered as Apprentice.

Section 10—It shall be unlawful for any person to impersonate an applicant before the State Board of Pharmacy applying for registration or license under the provisions of this Act. Any person violating this Section shall be guilty of a misdemeanor, and upon conviction shall pay a fine of not more than one hundred ($100.00) dollars, or be imprisoned for not more than six (6) months or either, or both, in the discretion of the court.

Section 11—Persons desiring to enter a college or school of pharmacy shall give proof of the required general education prior to admittance thereto. The necessary proof of an entrance examination shall consist either of a certificate issued by the proper school authorities, or in successfully passing an examination before an Entrance Examiner, appointed by the Board for that purpose, at suitable compensation, to be allowed by the Board. The Entrance Examiner, under the authority of the Board, shall issue to such persons, properly qualifying and applying therefor, a certificate of preliminary education.

Section 12—The Board of Pharmacy shall make and promulgate the requirements for recognition of colleges and schools of pharmacy, subject to changes as may be deemed necessary by it. The requirements shall include provisions for a course of instruction, equipment and professorial staff.

Section 13—Every applicant for examination as Pharmacist shall pay an examination fee of ten ($10.00) dollars; every applicant for examination as Assistant Pharmacist, Medical, Dental or Veterinary Dispenser, or as Drug Dealer, shall pay an examination fee of five ($5.00) dollars. Certificates of registration and license shall be issued to Pharmacists on payment of a fee of five ($5.00) dollars, and to Assistant Pharmacists, Medical, Dental or Veterinary Dispensers, and Drug Dealers, on payment of a fee of three ($3.00) dollars. Certificates of Preliminary Education shall be issued at a fee of three ($3.00) dollars. Every applicant for reciprocal registration as Pharmacist, in addition to the fee covering cost of investigation, shall pay a fee of $——— and Assistant Pharmacist a fee of $———. All fees shall be paid to the State Board of Pharmacy, and by it covered into the State Treasury, to the credit of the State Board of Pharmacy.

Section 14—The State Board of Pharmacy may in its discretion grant certificates of registration as licensed Pharmacist or Assistant Pharmacist, to persons who furnish proof that they have been licensed as such, by examination in some other state, and that they are of good moral character, provided that such other state in its examinations require the same general degree of fitness as is required by examination in this state, and that the applicant qualifies in all other respects as is required for licensing by examination in this state, excepting that persons who have become licensed by examination in other states, prior to the time that this Act takes effect, and who have continuously, thereafter, been engaged in pharmacy, shall be required to meet only the requirements which existed in this state at the time when they became licensed in such other state, and, provided also, that such other state or states in like manner grant reciprocal licensing to Pharmacists and Assistant Pharmacists of this state. Applicants for reciprocal licensing in this state shall defray all necessary expense for making an investigation of their character, general reputation and pharmaceutical standing, in the state where they resided, such expense not to exceed the sum of ten ($10.00) dollars.

Section 15—The State Board of Pharmacy, in order to be informed and to determine the status of Boards of Pharmacy of other states desiring reciprocal licensing and in order also to be advised regarding the progress of pharmacy throughout the country, shall annually select one of its members to meet at the expense of the Board, with like representatives from other State Boards of Pharmacy. At such meetings, when arranged, there shall be discussed the degree of fitness which is required by the several State Boards of Pharmacy for granting licenses. Such representatives of the several State Boards of Pharmacy may adopt rules and regulations which shall guide the several Boards in the matter of reciprocal licensing, but abidence therewith shall be optional and at the discretion of the State Board of Pharmacy.

The State Board of Pharmacy through its representatives may with like representatives from other State Boards of Pharmacy join in creating and maintaining an association of representatives of the several State Boards of Pharmacy, to be engaged in the general advancement of pharmacy and in the keeping of records pertaining to the reciprocal licensing of Pharmacists, and at its discretion the Board may give to such association information which it possesses relative to such aims. The State Board of Pharmacy at an expense not to exceed one hundred ($100.00) dollars, per annum, may subscribe for and secure the service of an association engaged in the compilation of pharmaceutical information, knowledge and progress, specially adapted to secure efficiency in the work of the Board.

Section 16—The license of any Pharmacist, Assistant Pharmacist, Medical, Dental or Veterinary Dispenser or Drug Dealer, may be suspended or revoked by the Board of Pharmacy, when the license is proved to the Board to have been obtained by fraudulent means, or when the licentiate has been convicted of felony or is found by the Board to be guilty of gross immorality, or to be addicted to the liquor or drug habit to such a degree as to render him unfit to compound, sell or distribute drugs and medicines. Suspension or revocation of a certificate shall be only after due notice and hearing and for the purpose of such hearing the Board or any member thereof or its secretary is authorized to examine witnesses under oath and to take oaths or affirmations, and to reduce the testimony given in any such case to writing. Within thirty (30) days after the suspension or revocation of a license the licentiate may take an appeal to any court of record of the state, of competent jurisdiction, and pending such appeal the decision of the Board shall be suspended until the court renders judgment which shall be final in the case, and if the decision of the Board is not sustained, the licentiate shall be reinstated.

Section 17—There shall be kept in every Pharmacy and in every Medical, Dental or Veterinary Dispensary, a copy of the latest revision of the United States Pharmacopœia, and the latest revision of the National Formulary, and if homeopathic remedies are compounded and dispensed, a copy of the latest revision of the Homeopathic Pharmacopœia of the United States, which books must be open to the inspection of the Board of Pharmacy, the Drug Commissioner and their properly authorized agents and employees. Any person violating this Section shall, upon conviction, be fined the sum of ten ($10.00) dollars and the cost of prosecution.

Section 18—All certificates as Pharmacist and Assistant Pharmacist, Medical, Dental or Veterinary Dispenser, and Drug Dealer, shall at all times be conspicuously displayed in the place of business or dispensary where the licentiate is engaged as such. Any licentiate violating this Section, upon conviction, shall be fined the sum of ten ($10.00) dollars and the cost of prosecution.

Section 19—Every place in or from which drugs, chemicals, medicines, prescriptions or poisons are compounded, dispensed or sold at retail shall (except as otherwise provided by law) be a pharmacy or drug store in charge of and under the supervision of a licensed Pharmacist; a dispensary conducted for the need of patients only by a licensed Medical, Dental or Veterinary Dispenser; or a store conducted by and under the supervision of a licensed Drug Dealer. Every such place shall be annually registered in the month of January with the Board of Pharmacy, on application forms provided for that purpose by the Board, on request, and the Board shall thereupon issue a suitable certificate of registration which shall be conspicuously displayed in the respective place of business. Applications for registration as a pharmacy or drug store shall include information regarding the names of all pharmacists, assistant pharmacists and registered apprentices who are employed therein. Only places in charge of a licensed Pharmacist may use the title "Pharmacy", "Pharmacist", "Apothecary", or "Drug Store", and each must be under the separate management of a licensed Pharmacist who shall not engage to manage or supervise more than one such place, but nothing contained in this Section shall prevent a person from owning and conducting more than one pharmacy, provided each be under the separate supervision of a licensed Pharmacist. For the registration of every place herein required to be registered there shall be paid an annual registration fee of one ($1.00) dollar by the person desiring its registration. Any person failing to register his place of business as herein required, failing to have in charge of each pharmacy a licensed Pharmacist, who does not manage or supervise more than one pharmacy, or who otherwise fails to comply with the provisions of this Section, shall upon conviction be fined the sum of not less than ten ($10.00) dollars, nor more than fifty ($50.00) dollars for each separate offense.

Section 20—The Board of Pharmacy shall make from time to time uniform rules and regulations, which are to govern it and its officers, and the Drug Commissioner and all employees in the enforcement of this Act. It shall prescribe, publish and furnish all application forms for license or registration, which are required under this Act.

Section 21—It shall be unlawful for any person who is not a licensed Pharmacist, licensed Assistant Pharmacist, licensed Medical, Dental or Veterinary Dispenser, or Drug Dealer, or who is not under the direct and immediate supervision of either of such licentiates operating within their lawful spheres, to compound, manufacture, sell or distribute at

retail, or advertise to do so, any potent drugs or poison as hereinafter defined, or any other chemical, drug, or medicine, intended for internal or external use, excepting only that this provision shall not apply to the personal administration of drugs and medicines by physicians, dentists, and veterinarians, in keeping with Section 6 of this Act. It shall be unlawful for Medical, Dental or Veterinary Dispensers to compound, sell and distribute potent drugs, or poisons, except for use by bona fide patients, who are under their medical treatment. It shall be unlawful for any Drug Dealer to compound or manufacture potent drugs, poisons or preparations containing the same, and it shall be unlawful for such Drug Dealer to sell or distribute potent drugs and poisons, except in original packages as prepared by and under the supervision of a licensed Pharmacist of this or some other state, territory or the District of Columbia, properly labeled to meet all requirements of the law, and bearing the name of the original distributor or manufacturer. Any person violating the provisions of this Section shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not less than ten ($10.00) dollars, nor more than five hundred ($500.00) dollars, or sentenced to imprisonment for not more than one (1) year, either, or both, in the discretion of the court.

Section 22—The term "Poison" shall mean to include all articles enumerated and defined in Schedule "A" and Schedule "B" hereinafter set out. The term "Potent Drug" shall mean all drugs and chemicals and their compounds and preparation which are not in Schedules "A" and "B", specifically, or by general inclusion defined as poison, but of which the adult medicinal dose is stated in standard works of medicine, materia medica, or toxicology, to be less than one fluidounce if liquid, and one avoirdupois ounce if solid.

Schedule "A" Poison

Arsenic and the compounds and chemical derivatives of arsenic, corrosive sublimate and other poisonous compounds and derivatives of mercury, phosphorus and its poisonous compounds, and derivatives, tartar emetic or other poisonous salts or compounds of antimony, hydrocyanic acid, prussic acid, potassium cyanide, other cyanides and prussiates or other poisonous compounds and derivatives of cyanogen, oil of bitter almonds containing hydrocyanic acid, opium and its preparations and derivatives, aconite and its preparations, belladonna and its preparations, calabar bean and its preparations, scopola and its preparations, strophanthus and its preparations; the following organic principles: aconitine, apomorphine, atropine, brucine, cantharidin, cocaine, codeine, coniine, digitalin, emetine, eucaine, gelsemine, homatrophine, hyoscine, hyoscyamine, morphine, diacetyl-morphine or heroin, ethyl-morphine or dionin, physostigmine or eserine, scopolamine, strophanthin, strychnine, veratrine or any of their chemical compounds, salts, or derivatives, or any other drug, chemical substance, or preparation which according to standard works on medicine, materia medica, or toxicology, is liable to be destructive to adult human life in doses of five grains or less.

Schedule "B" Poison

Cannabis, cantharides, Chinese blistering beetle, cocculus indicus, colchicum, cotton root bark, digitalis, ergot, gelsemium, hellebore, henbane, ignatia amara, phytolacca, nux vomica, veratrum, stramonium, savin, chloroform, ether, wood or methyl alcohol, white precipitate, red precipitate, silver nitrate, copper salts, salts of barium, lead salts, oxalic acid, mineral acids, arsenical solutions, iodine, tincture of iodine, carbolic acid, creosote, croton oil, oils of pennyroyal, rue, savin, or tansy, or any other drug, chemical, substance or preparation which according to standard works on medicine, materia medica or toxicology, while not considered as toxic in doses of five grains or less, is nevertheless liable to be destructive of adult human life in doses of sixty grains or less.

It is hereby provided that compounds and preparations containing poisons as defined in Schedules "A" and "B" in quantities of less than one adult medicinal dose to one-half fluidounce, if liquid, or one-half avoirdupois ounce, if solid, according to standard books on medicine, materia medica, or toxicology, shall not be regarded to be poisons and also that the provisions of this Act governing the sale and distribution of poisons unless otherwise provided by law, shall not apply to the sale or distribution of preparations or remedies which do not contain more than two grains of opium or more than one-fourth grain of morphine, or more than one-eighth grain of heroin, or more than one grain of codeine, or any salt or derivative of any of them in one fluidounce, or if solid or semi-solid preparations, in one avoirdupois ounce; or to plasters, liniments, ointments, or other preparations which are prepared for external use only, and when sold or distributed for use as medicines.

Section 23—Whoever knowingly sells or delivers to any person otherwise than in the manner prescribed by law, any poison as defined in this Act, or sells or delivers in the manner otherwise prescribed by law any poison as defined in this Act to a minor under sixteen (16) years of age, but without the written order of an adult, shall be fined not less than ten ($10.00) dollars, and not more than fifty ($50.00) dollars for each offense.

Section 24—Whoever sells or delivers to any person a poison as defined in this Act without having first learned by due inquiry that such person is aware of the poisonous charac-

ter thereof, and that it is desired for a lawful purpose or without plainly labeling the word "Poison" and the names of two or more antidotes therefor upon the box or package containing it, or if included in the list of Schedule "A" Poisons, delivers such poison without recording in a book kept for that purpose the intended use thereof, the date of its delivery, and the name and address of the purchaser, and the name of the dispenser, or fails to preserve said book for five (5) years and submit it at all times for inspection to proper officers of the law, shall be fined not less than ten ($10.00) dollars nor more than fifty ($50.00) dollars for each offense. Provided, that when poisons are dispensed in keeping with a written record made by a licensed physician, dentist or veterinarian and such written record is filed and retained by a pharmacist, physician, dentist or veterinarian for at least one (1) year, the requirements herein shall be satisfied when the container of the poisons so dispensed bears a number or mark corresponding with a number or mark on the written record, so that it may be readily identified, unless the prescribing physician, dentist or veterinarian directs that the label shall bear the word "poison".

SECTION 25—The violation of any provision of this Act for which penalties are not specifically prescribed shall be subject to a fine of not more than ———— dollars for each separate offense.

SECTION 26—All Acts or Sections heretofore enacted and now in force in this state, which are in conflict with this Act or any of its Sections are hereby repealed, provided that nothing herein contained shall be construed to amend or repeal any Acts or Sections which govern the manufacture, sale or distribution of narcotics.

The Harrison Narcotic Law and Regulations

The Act of December 17, 1914 (known as the Harrison Narcotic Law), as amended by Sections 1006 and 1007 of the Revenue Act of 1918 (these sections reënacted in the Revenue Acts of 1921 and 1924), controls the importation, manufacture, production, compounding, selling, dealing in, dispensing, and giving away of opium and coca leaves and all compounds, manufactures, salts, derivatives and preparations thereof. Every person engaged in any of the foregoing activities is required to register with the collector of internal revenue for his district and pay tax as provided in the Act. Classes of registrants with the special taxes imposed are as follows:

Class 1. The tax is at the rate of $24 per annum. It covers importers, manufacturers, producers, compounders and chemists.

Class 2. The tax is at the rate of $12 per annum. It covers persons buying and selling stamped packages of narcotic drugs or preparations produced by others.

Class 3. The tax is at the rate of $6 per annum. It includes persons selling narcotic drugs from the original stamped package, *i.e.*, prescription pharmacists.

Class 4. The tax is at the rate of $3 per annum. It applies to physicians, dentists, veterinary surgeons, and other practitioners lawfully entitled to distribute, dispense, give away, or administer narcotic drugs to patients, upon whom they in the course of their professional practice are in attendance.

Class 5. The tax is $1 per annum or any fractional part of a year. It covers manufacturers of and dealers in narcotic preparations and remedies not subject to stamp tax.

How to Register—Persons first engaging in any narcotic business must file application for registry and special tax stamp on Form 678 a with an inventory on Form 713 for each class in which registration is desired except classes 1 and 2. Blank forms are procurable from the collector for the district. Application on form 678 a must be made within the month within which business is commenced. Persons already registered must *on or before July 1* of each year file application for registry and special tax stamp on *Form 678* with an inventory on Form 713 for each class, forms being procurable in like manner. Collectors will mail blank forms to all registered persons annually between May 15 and May 25 without request. Failure of any person to receive these blank forms will be no excuse, however, for failure to make application for

reregistry and special tax stamp within the required time. Address the collector of internal revenue for the district if blank forms are not received.

Inventories—An Inventory on Form 713 is required for each class except classes 1 and 2. Ordinarily druggists will have no stock of taxable narcotic drugs in class 5. No inventory whatever is required of non-taxable (exempt) narcotic preparations and remedies. A single Form 713 may be used for classes 3 and 5 by listing the taxable narcotic drugs and preparations on hand with the notation "No taxable narcotic drugs on hand in class 5" written at the bottom of the list. Any date from January 1 to June 30 of the current year will be acceptable for the inventory required on Form 713.

How to Procure Narcotic Drugs—Every registered person, except dealers in non-taxable or exempt narcotic preparations and remedies only, is qualified to buy blank official order forms from the collector of internal revenue at a price of ten cents per book of ten, requisition therefor to be made on blank Form 679, obtainable from the collector for the district without charge. Only one book will be furnished at a time except to persons registered in class 1 to 2. Official order forms for the purchase of narcotic drugs may be filled only by persons qualified as manufacturers or wholesale dealers, except an order form calling exclusively for a one ounce quantity of an aqueous narcotic solution which may be filled by a druggist qualified in class 3. Order forms must be made out according to the instructions printed on the back of each form. They may be returned by the manufacturer or wholesale dealer if not properly prepared in every detail. The duplicate copy of every order form issued must be kept on file for a period of two years. The original of all order forms for one ounce quantities of aqueous solutions must be kept on file by retail dealers likewise for two years.

How Retail Pharmacists May Dispose of Narcotics—Pharmacists qualified only in class 3 may dispose of narcotic drugs only upon properly prepared prescriptions with the exception of one ounce quantities of aqueous narcotic solutions as above stated. Prescriptions for taxable narcotic drugs or preparations must be issued by registered physicians, dentists, veterinarians or other practitioners, and each prescription must be dated as of the date on which signed, shall be signed by the issuing physician, dentist, veterinary surgeon or other practitioner, and shall bear the full name and address of the patient, and the name, address, and registry number of the issuing practitioner. A physician may sign prescriptions for narcotics in the same manner as he would sign a check or legal document, as, for instance, J. H. Smith, John H. Smith, or John Henry Smith. Prescriptions for narcotics must be written with ink or indelible pencil or typewriter; if typewritten they must be signed by the practitioner with ink or indelible pencil. The pharmacist upon filling the prescription must preserve it in a separate file for a period of two years from the date indicated thereon. A narcotic prescription for taxable narcotic drugs or preparations must not be refilled and such prescription must not be filled in part. Neither is it permissible for a pharmacist to supply narcotics pursuant to telephone advice from practitioners without prescriptions whether or not prescriptions covering such telephone requests are subsequently received.

Each package of drugs or preparations put up in pursuance of a narcotic prescription must bear a label showing the name and registry number of the pharmacist, the serial number of the prescription, the name and address of the patient and the name, address and registry number of the practitioner writing the prescription. It is preferable not to use the stamped container in which drugs are purchased from the manufacturer or wholesale dealer for filling a prescription. However, it is permissible to use such a container provided the stamp thereon is so obliterated as to prevent its further use and a label is attached thereto bearing the foregoing data.

A narcotic prescription may be filled only if issued for legitimate medical purposes. If the pharmacist to whom the prescription is presented for filling has any knowledge or entertains any suspicion which would cause him to believe that the drugs will not be used for such purposes, he should not fill it. The mere presentation of a prescription issued by a registered physician or other practitioner does not compel the pharmacist to whom it is presented to supply the drugs requested. A prescription issued to a person for a narcotic drug for the purpose of satisfying his craving for the drug and not for any legitimate medical purpose does not come within exception (b) of section 2 of the law and must not be filled. Any pharmacist who fills such a so-called prescription may be held correspondingly liable with the physician who issued it. Prescription pharmacists should carefully guard against the filling of prescriptions issued for addiction purposes.

Public officials, such as officials of the United States, District of Columbia, the various States and cities, who, in the exercise of their official duties, dispense or handle narcotic drugs, are not thereby required to register and pay special tax. Prescriptions issued by such officials for narcotics for official patients must be prepared on blanks provided by the Government or Department of which the issuing practitioner is an official, or, if no special blanks are provided, such prescriptions must be prepared on official stationery. Each prescription must show the name and title of the officer by whom executed.

Non-Taxable (Exempt) Narcotic Preparations—Narcotic preparations and remedies exempt from the full requirements of the law under the provisions of Section 6 of the Act, as amended, may be sold without a prescription but a record thereof must be kept as follows:

Date of Sale	Name of Purchaser	Address	Name of Preparation	Quantity
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

Preparations and remedies which do not contain more than two grains of opium, or more than one-fourth of a grain of morphine, or more than one-eighth of a grain of heroine, or more than one grain of codeine, or any salt or derivative of any of them in one fluidounce, or, if a solid or semi-solid preparation, in one avoirdupois ounce, and which are designed for internal use, are under certain conditions exempt from tax and the provisions relating to the purchase, sale or distribution of taxable narcotic commodities. These conditions consist primarily in confining remedies and preparations to standard or recognized medicines. The regulations provide that the exemption applies only to ready-made preparations and remedies compounded in accordance with the United States Pharmacopœia, the National Formulary, or other recognized or established formula usually carried in stock by a dealer and sold without a prescription. The regulations guard against authorizing the sale as in exempt preparations of a simple dilution of a narcotic drug made by admixture with inert or nearly inert substances. Druggists will be held responsible for the sale of any so-called preparations which do not have distinct medical use, or which are sold for other than strictly medicinal purposes.

A person registered in class 3 must also be registered in class 5 in order to dispose of exempt preparations although the payment of the $1 tax is not required if tax in class 3 or any other class is paid at the same location. Exempt preparations may be dispensed on prescriptions and such prescriptions may be refilled. But the quantity of exempt preparations so disposed of must be

entered on the above record in the same manner as if no prescription is present. The Government does not furnish blanks for the keeping of records of exempt narcotic preparations.

There is no specified limit as to the quantity of exempt preparations which may be sold by a retail druggist to a consumer. However, such preparations may be sold as medicines only, and if there is any possibility of a requested quantity of such a preparation being used for other than legitimate medicinal purposes sale should not be made. A pharmacist would be liable to the penalties imposed by Section 9 of the Act if he sold any quantity of an exempt preparation knowing that it would be consumed for other than legitimate medical purposes, *i.e.*, for addiction purposes.

Classes 1 and 2—A pharmacist must be registered in class 2 if he desires to fill order forms of other registered persons for stamped packages of narcotic drugs and preparations purchased from manufacturers or wholesale dealers. The stock of stamped packages maintained for the purpose of sale on order forms must be kept separate from the class 3 stock. Daily entry of the purchase of every package for either the class 2 or 3 stock must be kept on Form 811a. Daily entry of the purchase of every package for the class 2 stock must be kept on form 811a. Daily record of the sale of each such package by a class 2 registrant must be kept on form 811b, and all packages contained in the class 2 stock, needed in prescription work by a druggist registered in classes 2 and 3 must be recorded likewise on form 811 b as transferred to class 3. A wholesale monthly return on the same Forms, together with a statement of stock and totals of receipts and dispositions on Form 811 must be sworn to and transmitted to the collector of internal revenue for the district on or before the 15th of the month subsequent to that for which rendered in the manner provided in the instructions and regulations printed on Form 811.

Retail pharmacists desiring to fill order forms of other registered persons with packages of their own manufacture, production, or packing must be registered in class 1 as manufacturers. Each package manufactured, produced or packed must be separately stamped. The tax is at the rate of one cent per ounce or fraction thereof on the gross contents of the package. The stamps are procurable only by class 1 registrants. Requisitions therefor on Form 786 should be made to the collector for the district. Stocks of narcotic drugs used for class 1 purposes must be kept separate from all other stocks. Manufacturers must keep daily records on Form 810 a of all receipts for the class 1 stock and of all narcotic drugs and preparations produced. They must also keep a daily record of all dispositions and all drugs used for production on Form 810 b. Monthly returns on these forms with a summary on Form 810 must be made to the collector of internal revenue similarly as monthly returns are required from wholesale dealers but in accordance with the instructions and regulations printed on Form 810.

Inquiries Concerning Narcotics—Inquiries relative to registration or reregistration under the law and the payment of taxes thereunder should be addressed to the collector of internal revenue for the district in which the taxpayer is located. Inquiries dealing with the filling of individual prescriptions should be addressed to the Narcotic Agent in Charge of the division in which the druggist is located, or to the Commissioner of Internal Revenue, Washington, D. C. All other questions pertaining to the Harrison Narcotic Law, as amended, or the regulations thereunder, should be addressed to the Commissioner of Internal Revenue, Washington, D. C. All questions pertaining exclusively to the importation into, the exportation from, or the transhipment of narcotic drugs through the United States from one country to another should be addressed to the Federal Narcotics Control Board, Washington, D. C.

Narcotic Drugs Import and Export Act—The Narcotic Drugs Import and Export Act, improved May 26, 1922, as amended by the Act of June 7, 1924, limits importations of narcotic drugs to crude opium and coca leaves in sufficient quantities to meet medical and legitimate requirements only. No opium may be imported for manufacturing heroine. Permits to import are issued only to manufacturers having apparatus or equipment for producing drugs or medicines from opium or coca leaves. Permits to export are issued only to duly qualified manufacturers and wholesale dealers. All the permissive features of the Act are administered by the Federal Narcotics Control Board.

Obligation of the Retail Pharmacist Under the National Prohibition Act

A pharmacist, before using or selling liquor, must file application on Form 1404,[1] and bond when required (no bond is required for using 60 gallons of alcohol per annum, or using and selling 60 gallons of alcohol and 480 pints of bottled-in-bond spirits per annum). The application must state the kind and quantity of liquors to be used or sold in each quarterly period and the manner and purpose of such use or sale.

A duly licensed retail pharmacist, or a retail druggist through a duly licensed retail pharmacist in his employ, who holds a permit to use and sell, may sell liquor to a qualified permittee on approved purchase "Form 1410–A", when such sale is in ordinary trade practice considered a sale at retail. He may also make sales of liquor on properly executed official prescription "Form 1403". Such liquor must be labeled according to regulations, and the prescription canceled and filed as required. The pharmacist is held responsible for the authenticity of these prescription forms and should become thoroughly acquainted with the genuine form. A retail pharmacist selling intoxicating liquor as such is required to pay special tax as retail liquor dealer under the internal revenue laws.

A retail pharmacist holding permit to use intoxicating liquor may use intoxicating liquor for compounding medicinal preparations on physicians' prescriptions or otherwise, in quantities not exceeding 5 gallons in 90 days, provided such preparations contain no more alcohol than is necessary for extraction, solution or preservation, and must be unfit for beverage use. The pharmacist is to use his individual judgment as to the sufficiency of the medication, and is held strictly accountable as to the non-potability of such prescriptions or medicinal compounds. Such medicated prescriptions are not required to be written on "Form 1403", but must contain the patient's name and address and be filed on a separate file or with the prescriptions written on "Form 1403".

Retail pharmacists holding permits may sell alcohol, medicated according to one of the formulas in Regulations 60, in quantities not exceeding one pint without physicians' prescriptions to persons who do not hold permits. Each container of such medicated alcohol must bear a "poison" label.

A retail pharmacist holding a permit may use alcohol and wine in the manufacture of U. S. P. and N. F. preparations considered fit and unfit for beverage use. However, the U. S. P. and N. F. preparations considered fit for beverage purposes can only be sold subject to purchase "Form 1410–A" or official prescription "Form 1403". They may be used for compounding medicinal preparations on physicians' prescriptions or otherwise, medicated sufficiently to insure unfitness for beverage use.

Retail pharmacists who purchase and sell intoxicating liquor are required

[1] All forms mentioned may be procured from the Prohibition Administrator in your District, or upon application to the Prohibition Unit, Treasury Department, Washington, D. C.

to keep a record on "Forms 1455 and 1455–A", showing detailed entries of all intoxicating liquor received and sold by them, each transaction to be entered at the time of receipt or sale. A carbon copy or transcript of this record form must be forwarded to the Administrator before the 10th of each month succeeding the month for which the report is rendered.

Retail pharmacists holding basic permits must also render a report each month on "Form 1421" showing all information called for on this form, even though no liquor was received, possessed, sold or used during the month. This report must be made in triplicate, two copies being sent to the Administrator, as indicated in the preceding paragraph, and one copy retained by the permittee.

Obligation of the Physician Under the National Prohibition Act

A physician before prescribing, using or administering intoxicating liquor must file application on "Form 1404", stating specifically the privileges and quantities of liquor desired, and may receive a permit on "Form 1405", granting authority to prescribe intoxicating liquor on "Form 1403". He may also have the privilege of administering liquor to patients upon whom he is in attendance, and may also use the same for compounding, and may use alcohol for sterilizing purposes. All privileges desired may be requested in the same application form.

A physician holding a permit with the privilege of prescribing may secure from the Administrator a serially numbered book of 100 authorized prescription blanks on "Form 1403". Not more than one book to be issued in 90 days except by special authorization.

A physician should not prescribe on "Form 1403" except for the relief of some ailment from which the patient is known by the physician to be suffering. A physician shall not prescribe for any person within a period of ten days more than one pint of potable distilled spirits; one quart of wine; or any spirituous or vinous liquor containing more than one-half pint of alcohol. All prescriptions for liquor must be written on "Form 1403", except that in certain cases where a "*grave emergency*" exists, a duplicate prescription may be written on the ordinary prescription blank, when the requirements of the Regulations have been complied with.

Every physician who prescribes liquor is required to keep a record of such prescriptions in book "Form 1402".

The Federal Food and Drugs Act as it Relates to Drug Products[1]

The Act, as provided for therein, applies to all drugs which enter interstate or foreign commerce, or are made, sold, or offered for sale in any Territory of the United States (including the insular possessions), or the District of Columbia.

It should be understood that the term "drug" includes all medicines and preparations recognized in the United States Pharmacopœia or National Formulary for internal or external use, and any substance or mixture of substances intended to be used for the cure, mitigation, or prevention of disease of either man or other animals.

The law provides in effect that a drug is adulterated if, when sold under a name recognized in the United States Pharmacopœia or National Formulary,

[1] The Food and Drugs Act is enforced by the Bureau of Chemistry of the Department of Agriculture of the Federal Government.

it differs from the standard laid down in these authorities, or if its strength or purity falls below the professed standard under which sold; and misbranded, if the labeling bears any false or misleading representation regarding the product or its ingredients, or any false and fraudulent statement, design or device regarding its curative or therapeutic effect.

The term "label" as used in the Act is held to include any printed matter that accompanies the package, such as box, carton, or bottle label, wrapper, booklet, circular, etc. And any literature, though it may not accompany the package, should not exceed in the impressions produced, what may properly appear in the labeling. The law does not require that a formula or list of ingredients be stated on the label of drug products, but it does provide for a declaration thereon of certain specified substances. The intent of the Act is that the purchaser be not misled in any particular. It is, therefore, essential that the impressions conveyed to the public by the terms of the labeling, in whatever manner they may be expressed, should be fully justified by the ingredients of the product. As Justice McReynolds, of the U. S. Supreme Court, recently stated in a decision "The statute enjoins truth".

In considering the label of a medicinal preparation the Bureau of Chemistry is accustomed to take for its guide the consensus of modern medical opinion; and in its interpretation of the label it is accustomed to place itself in the position of the average purchaser, who cannot be expected to make finely drawn distinctions. The Bureau does not consider as adequate authorities for therapeutic claims, statements based on personal belief, or testimonials in general, excerpts from dispensatories, medical works, or obsolete medical practices. It is the duty of the manufacturer to carefully consider whether the representations he makes are strictly in accord with the facts.

The printing of names of diseases or disorders on the labeling of a medicine for public sale conveys to the purchaser the impression that the product in itself is a competent treatment for the diseases mentioned. The names of diseases on a label, therefore, should be limited to those for which the article, in view of the recognized medicinal action of its ingredients, considered singly or in combination, is a treatment. Names of organs or portions of the body should not appear upon a label unless the product can properly be considered a treatment for any and all disorders to which such organs or parts may be subject. Representations of curative or beneficial effect conveyed by testimonials are subject to the same requirements as other therapeutic claims. A manufacturer must assume responsibility for all therapeutic claims made in this manner to the same extent that he does for promises of benefit made in his own words.

The wording of collateral advertising in newspapers and elsewhere should in no instance exceed, in the impressions produced, the terms of the labeling. This is also true of claims made by agents or otherwise. The Act does not authorize the Department to approve or suggest labels, formulas, trade names, or advertising literature, and any printed matter upon the label implying that such approval has been granted will be without warrant. Also, it is no longer permissible to use either the serial number or guaranty legend on the label or package of products that come within the jurisdiction of the Act.

Frequent inquiry is made regarding toilet preparations, and in this connection it may be stated that unless a toilet preparation is intended or represented, directly or indirectly, to be useful for the cure, mitigation, or prevention of disease it is not subject to the law, as will be evident from the definition of "drug" previously given. It is expected, however, that the manufacturer will exercise due care that such preparations do not contain any

ingredient that might be injurious to health. It should further be noted that the issuance of a trademark, copyright, or patent for a preparation does not exempt it from the provisions of the Act. In conclusion, attention is invited to the following important quotation from an opinion of the U. S. Supreme Court on the Act:

"The Statute is plain and direct. Its comprehensive terms condemn every statement, design, and device which may mislead or deceive. Deception may result from the use of statements not technically false or which may be literally true. The aim of the statute is to prevent that resulting from indirection and ambiguity, as well as from statements which are false. It is not difficult to choose statements, designs and devices which will not deceive. Those which are ambiguous and liable to mislead should be read favorably to the accomplishment of the purpose of the Act."

Therefore, in order to avoid possible conflict with the law, manufacturers should clearly understand that it is in their interest to see to it that only well warranted therapeutic or other statements appear upon labels of drug products. It is suggested as advisable that consideration be given to what should be eliminated from the label to bring about conformity with the law, rather than to use phraseology which might incur criticism.

Patent and Proprietary Medicines

Patents—A patent is a license issued by the United States Government, giving to the holder thereof the exclusive right to make, use, and sell the thing or process patented for a period of seventeen years. This license is issued by the Patent Office in Washington. In order to secure it, an applicant must file with the office an affidavit, with appropriate charts, drawings, models, etc., showing the exact composition of the thing or process which he has invented or discovered. "Letters patent" should issue only when the Patent Office is of the opinion that the invention or discovery is both novel and useful.

The right conferred by the letters patent is an exclusive right, and all others besides the patentee and his assignees are prohibited from infringing on that right during the life of the patent. At the expiration of the seventeen year period, the right passes to the public generally. Thereafter any person is at liberty to make, use, and deal with the thing or process patented, without any restraint whatever imposed by the patentee.

Proprietary Medicines—The manufacturer of a proprietary medicine takes the risk of its being made and sold by anyone who can copy it. Unless he is protected by a patent he cannot prevent anyone from dealing at will with the article.

Trademarks—The protection given to the owner of a trademark exists by virtue of common law, *i.e.*, irrespective of any right conferred by statute. If the maker of any article chooses to mark it with a distinctive device or brand, to designate the source or origin of the article, such device is a trademark, and it cannot be copied or used by anyone else without permission of the owner. The right to the exclusive use of the trademark, however, lasts only so long as the owner or his assignees actually make general use of it in trade. As soon as such use is discontinued, anyone may step in and use the trademark and the first one to establish his right to use it, would in turn be protected from subsequent infringement of the trademark by others.

For convenience in establishing one's right to the use of the trademark, a registration office is located at Washington. There, anyone who desires to employ any distinctive and original device in marking the goods put out by

him, may register such device, and the fact of such registration will be of assistance in showing that he is actually using such mark or device at that particular time. The fact, however, that such device is registered, gives no greater rights to the one using the same than he has by common law. He has the exclusive right to employ it only so long as he actually makes use of it in the general trade.

Trade Names—"Undoubtedly words or devices may be adopted as trademarks which are not original inventions of him who adopts them, and courts of equity will protect him against any fraudulent appropriation or imitation of them by others. Property in a trademark, or rather in the use of a trademark or name, has very little analogy to that which exists in copyrights, or in patents for inventions. Words in common use, with some exceptions, may be adopted, if, at the time of their adoption, they were not employed to designate the same, or like articles of production. The office of a trademark is to point out distinctively the *origin, or ownership of the article to which it is affixed;* or, in other words, to give notice who was the producer. This may, in many cases, be done by a name, a mark, or a device well known, but not previously applied to the same article.

"But though it is not necessary that the word adopted as a trade name should be a new creation, never before known or used, there are some limits to the right of selection. This will be manifest when it is considered that in all cases where rights to the exclusive use of a trademark are invaded, it is invariably held that the essence of the wrong consists in the sale of the goods of one manufacturer or vendor as those of another; and that it is only when this false representation is directly or indirectly made that the party who appeals to a court of equity can have relief. This is the doctrine of all the authorities."

Per Mr. Justice Strong, U. S. Supreme Court, in *Canal Company v. Clark*, 13 Wall. 311.

PART VIII

THE BUSINESS REQUIREMENTS OF PHARMACY

CHAPTER LXXX

BUSINESS ADMINISTRATION

THE Profession and the Business—Every profession has a business aspect. The clergyman, the physician, the artist—all must be compensated for their services. A part of this compensation lies in the satisfaction which the individual derives from the performance of the service and in the recognition accorded him by his fellowmen for his professional achievements, but there must also be remuneration in money if the professional man is to live and take care of his dependents. Giving professional service, therefore, of necessity involves an exchange of that service for profit which is just as much a "sale" as is the exchange of a commodity for profit in a mercantile establishment. There is a commonly recognized distinction between a professional man and a tradesman, as far as selling is concerned, namely that the professional man shall think of the service to be rendered first, and the profit, incidentally, whereas the objective of the tradesman is primarily profit.

The pharmacist serves in a dual capacity. He is both a professional man and a tradesman. In giving his professional services he should not forget profit but it must not be the primary consideration. On the other hand, in his merchandising, he is justified in placing profit first, for without it, he is unable to finance the service features of his profession and business.

It is therefore apparent that a pharmacist must know something about business as well as pharmacy and apply equal skill to both sides of his calling if he is to fill the niche which modern standards of living have created for him in this country.

Business itself is now classed as a profession because it no longer depends on guess-work or "rule-of-thumb" procedures. Many universities and colleges give special courses in business administration. Business scientists in these colleges and elsewhere have evolved the fundamental laws underlying commercial transactions and are continually engaged in researches designed to bring out more essential facts, determine causes, and study effects, to the end that those engaged in various divisions of business may increase their chances of success. It is recognized that business researches are just as important to the welfare of mankind as researches in chemistry and the medical arts. Both classes of research lead to greater knowledge, simplified procedures, and a higher type of civilization.

If business is looked upon as a profession also, the pharmacist may be considered as the practitioner of two professions—pharmacy and business, and it stands to reason that he should be well trained in both.

One important fact in connection with the business of pharmacy must never be lost sight of and that is the desirable prestige which professional pharmacy gives to the pharmacist. No matter how commercial a retail pharmacy may be, it always stands far above the most dignified mercantile establishments in the eyes of the public, because it is quite generally recog-

nized that the pharmacist is, by training and legal preferment, much more than an ordinary merchant. It is unfortunately true that some pharmacists do not conduct their businesses in a manner calculated to enhance this inherent prestige, and this adversely affects public opinion of pharmacists as a class. There are enough pharmacists, however, who realize the importance of the professional stamp upon their stores, even from a commercial viewpoint, to emphasize that feature whenever possible.

It is evident that the average merchant recognizes the value of the association of "drug" or "pharmacy" with "store", for all sorts of attempts have been made in recent years on the part of such merchants to take advantage of the public confidence in drug stores by giving their establishments a pharmaceutical aspect. Such terms as "drugless drug store", "medicine store", etc. have been used as signs over establishments of the general store type which sell package medicines and toilet articles, together with the usual non-pharmaceutical side lines and sundries that make up a large part of the stock of a modern legitimate pharmacy. This has gone so far that in the interest of the public health as well as in their own interest, pharmacists in several states have petitioned their legislatures to pass laws prohibiting the use of the words "drug", "drugless", "medicine", and similar words or phrases in connection with names of establishments that are not pharmacies in the legal sense of the word. A number of laws of this character have been passed.

Pharmacists who go into business should at all times emphasize the professional side of their calling even if it represents only 10 per cent of their total volume of business. It is their greatest asset, commercially as well as professionally, and should be protected and preserved for business reasons, if for no other.

The most successful pharmacists are those who have learned how to coördinate the professional and the business activities of their calling and have never given the general public an opportunity to question their status as pharmacists first and merchants only secondarily. The slogan now so frequently used: "Your druggist is more than a merchant" must be lived up to if it is to create any lasting impression upon the public.

The Need for Business Training—By far the larger portion of this book is devoted to the technical training required in the professional side of pharmacy but, for reasons already set forth, it has been considered necessary to introduce a section dealing with the problems of business as they apply to pharmacy.

Twenty-five years ago it would have required much argument to prove the necessity for training pharmacists in the science of business. It was only after a struggle that Joseph P. Remington, in 1900, established the first compulsory business course in a college of pharmacy. Today, however, the importance of such training is universally recognized and it is made a requirement in the model courses outlined in the Pharmaceutical Syllabus. It is but natural that the subject matter of the chapters on business in this book is particular rather than general. It deals with various phases of the science of business as applied to the conduct of a retail pharmacy. For a broad consideration of the fundamentals of business science, such as is given in the courses of graduate schools of business administration, the student is referred to other sources.

The ability to maintain efficient and progressive professional service in any pharmacy requires that it be conducted on a profitable basis. Profit will result only if the business is carried on with a due regard for economic and professional principles. This involves a knowledge of and continued search for facts. Knowing how to buy intelligently, display attractively, sell rapidly and abund-

antly, at prices that are fair to the consumer and profitable to the seller, may be considered as the chief ingredients of the *success formula* in merchandising.

The fact has been emphasized that profit is essential and the student of pharmacy will soon realize that while there is ample opportunity throughout the activities of every business day for the pharmacist with professional ideals to serve mankind, and also for those who enjoy business as a game to have their fill, yet all opportunity and satisfaction vanish when there is no financial profit.

The Necessity for Knowing the Facts about a Business—Coördination of the factors entering into what has been called the "*success formula*" is a prime essential. The *stock* of a store and the *buying policy* for example, should bear a reasonable relation to *sales*; the total *expense* must be known and compared systematically with sales figures.

If buying is in excess of sales, there is need for better buying judgment or for more capital; if expenses are mounting, a sharp reduction in some items of expense may be necessary, or perhaps a stimulation of sales is the proper antidote. Increased expenses or lowered sales volume will proportionally reduce and often wipe out profits.

The beginner in business who has received no special training, usually fails to recognize the importance of these basic principles. He does not realize the need of having the facts systematically assembled for study. Frequently, there is no definite plan and each problem is handled as it arises without relation to the last or to the next that is to follow. If, under such circumstances, there is ultimate success, it comes only at the expense of many embarrassing and often costly mistakes and, only too frequently, ventures which might have enjoyed extraordinary success, yield only a mediocre return and often end in financial failure.

Planning and Organization are Necessary—Business training as now recognized and taught in leading colleges and universities takes cognizance of the fact that guess work must give way to intelligent planning if the number of failures is to be lessened. An effort will be made in these chapters to point out and briefly discuss the essential planning required in the conduct of a retail drug business. It may help the student to carry in mind a picture of the factors entering into a successful scheme of organization, by recalling the form of organization of the U. S. Army in the late war.

In the stress of those momentous days when the finest brain and brawn of our country were being molded into an effective fighting force, Colonel Samuel P. Wetherill, Jr., worked out a plan of organization which was approved by General Pershing and his staff and put into effect throughout the entire American Expeditionary Force.

The plan was vividly pictured to every man in the army through a graphic chart, consisting of a soldier whose right hand typified the *division of command.* By means of the right hand an order is written or directions are given. The left hand typified the *intelligence department.* The left hand holds the map or notebook from which information is obtained on which to base the next move. The right foot typified the *attacking force* including infantry, cavalry, tanks, artillery, etc., for it is with the right foot that the soldier always takes the first step in an advance. The left foot represented the *supporting divisions,* the commissary, hospital and ammunition trains, etc., and it of necessity rests on solid ground. All of these elements were coördinated by the *head* thus completing the "man chart" of A.E.F. fame.

The same form of organization may be applied with equal effectiveness to a retail business. The head of the business, whether it be a corporation, a partnership, or a one-man store must coördinate the various factors to produce

a smoothly running machine. In order to accomplish this he must oversee the various tasks that make the machine run smoothly. In other words he *commands* his staff or himself, formulating policies and giving directions for the carrying out of these policies.

His *intelligence department* furnishes him with buying and selling information, knowledge of finances, general business conditions, and information about the goods he has for sale. The sources of such information may be salesmen, journals, newspapers, financial agencies and his own education.

The *supporting division* may be visualized as the store itself with its stock and all that pertains to it and the *attacking division* consists of the methods of exchanging commodities and service for profit, with proper aggressiveness and a due regard for the professional background of the retail drug business.

Summarized, the factors entering into the administration of a retail pharmaceutical business are:

1. Administrative organization as considered in this Chapter
2. The store or place of business.
3. The service and commodities offered for sale.
4. The methods of exchanging service and commodities for profit.

Administrative Organization

Under this heading will be considered the necessary qualifications of the owners or managers of a retail drug business. What must be their knowledge of business in general and how can they organize to the best advantage for financial success?

If the owner of a pharmacy is a trained pharmacist he will, of course, be prepared to carry on the technical portion of his calling. If he is not a pharmacist he must engage someone with the proper technical qualifications to act as the head of the business. The same is true of a corporation. In the case of a partnership, where one of the partners is not a pharmacist, the partner with pharmaceutical training must assume the responsibility of management in order to satisfy the legal requirements.

There is still a lack of uniformity in the pharmacy laws of the various States but all of them require that a pharmacy shall be in charge of a registered pharmacist at all times. Provision is made in some cases for temporary absence and in several States, notably New York and Illinois, it is now a legal requirement that the owner of a pharmacy must be a registered pharmacist. This law rules out corporation stores and non-pharmaceutical partnerships which were not already established when the law became operative. In all cases the technical training of those in charge of retail pharmacies is fixed by law, but the head of a business must be informed on all branches of that business if he is to retain the respect of his employees and the confidence of the public. Both pharmacy and business are constantly developing and this development brings changes in the knowledge required and the methods involved in business.

Practices which are modern today may be entirely out of date a few years hence. How often it is said of unsuccessful men: "He did not keep abreast of the times", or "He persisted in the old fashioned methods of doing business and the younger generation simply does not take to them". Continual study, both of the technical and business phases of pharmacy, is the price of success in this field just as it is in any other. The well-informed physician or chemist of ten years ago is technically ignorant today unless he has by hard study kept up with the rapid strides made in these professions in recent years. The same is true of the department store manager or the hardware storekeeper. Therefore

the head of every business and especially the manager of a pharmacy should make an earnest effort to keep informed on all developments in his field. To this end pharmaceutical and other related journals as well as an up-to-date library of books on the professional and the business side are indispensable. (see page 1625).

Division of Labor Essential—The proprietor or head of a business must learn very early in his career that time is valuable and must not be squandered on non-essential tasks. As soon as it is possible an organization should be built up which will relieve the proprietor of the details of conducting the store, that he may become, in every sense, a manager or directing head. The more time the proprietor spends in taking care of petty details the less time will be available for the proper planning and development of the business as a whole.

The management of a modern retail drug store, when analyzed, naturally divides into the following subdivisions: Buying, selling, stock-keeping, delivery, manufacturing, dispensing, bookkeeping, and supervision of departments such as soda fountain, cigars, sundries, confectionery, etc. In a very large store it may be possible to have heads for all of these subdivisions, or two or more divisions may be placed under a single head.

In smaller stores the proprietor may be required to assume all or most of the many duties theoretically assignable to various administrative heads but the sooner this situation is remedied the more certain will be the growth of the business. No one person can hope to function efficiently in all of these fields and in attempting such an impossible task a definite limit is immediately established for the business.

Occasionally some one takes pride in the seeming ability to handle all of the innumerable details involved in conducting these various departments but the result will be a failure to grow properly. A "one-man organization" is always dangerous, and if the one man should break down or leave, the entire machine would be disorganized, at least temporarily.

Even in the smallest business, the proprietor should begin to divide the duties by developing reliable helpers. The multiplication of personal ideas and capacity is unlimited if one will pay the price of *careful selection, systematic training, and adequate reward* for associates.

Perhaps the first step in seeking assistance beyond the usual help of a boy to run errands, is to get help in the accounting or bookkeeping requirements of the store. This is readily available for any store, by giving some trained bookkeeper in the neighborhood an extra job or by engaging a young woman assistant who will also be able to relieve the proprietor of other minor duties. Correct and understandable facts about finances are the very foundation of growth and prosperity. (See page 1269, also pages from 1391 to 1426.)

If there is a soda fountain in the store the proprietor should seek relief from its problems by placing the right man or girl in charge there, holding them strictly responsible for carrying out the proprietor's ideals of service and also for profitable management.

Gradually, as the business grows, each department may be organized with someone at its head who is immediately responsible to the proprietor or manager. In every case the department manager or managers should be encouraged to confer frequently with the proprietor or general manager on the various problems of the business, discussing with him personally the individual difficulties of the department and receiving from him encouragement and advice regarding new plans and methods for increasing the business.

Every subordinate, no matter how low in the scale he may be, should be impressed with the important relation of his task to the business as a whole.

After all, each employee is the representative of the head of the business in the particular task assigned to him and if this fact is properly emphasized he will not only be apt to perform his own duties better but his estimate of the job assigned to him will also be greater and he will take more interest in it.

Capital—In order to begin business one must have some capital, that is, sufficient money available for the initial investment in fixtures, stock, working capital, etc. Naturally, the first question asked is "How much will be required?"

The character of the store will in part determine this, since a small neighborhood store would of course necessitate a much smaller investment than a large, down-town business. However, the amount of capital may be determined in part by the estimated business. There must be a certain amount in fixtures and equipment, also in the initial stock and adequate working capital must not be forgotten or the business will be handicapped from the start.

The amount needed for fixtures is variable and depends upon the quality and also the size of the store, but the cost of stock usually bears a definite relationship to the sales and the efficiency of management.

An illustration of the figures of a modern business are given below as the basis for discussion.

Business Factors in Percentage

If an average sale per day is anticipated, amounting to	$100.00
The sales of a month would be, approximately	$3,000.00
Then with 100 per cent representing the sales	$3,000.00
And 66 2/3 per cent the "first cost" of goods	2,000.00
There would remain 33 1/3 per cent as "gross profit or margin."	$1,000.00

Out of this margin must come the "*overhead expense*" and "*net profit*".

The "overheads" are frequently classified theoretically as a basis for study as follows:

7 per cent—rent, heat, light	$210.00
12 per cent—Salaries (including that of the proprietor)	360.00
1 per cent—Advertising	30.00
5 per cent—All other expenses, (insurance, hauling, watchman, taxes, telephones, etc.)	150.00
Thus the 25 per cent expenses, or "overheads" equal	$750.00
This leaves 33 1/3–25 or 8 1/3 per cent as "net profit" or	250.00
The "overheads" and "net profit" together equal the "gross profit"	$1,000.00
Now if the "sales" per month were	$3,000.00
In twelve months they would be	36,000.00
The average "cost of goods" (at 66 2/3 per cent of sales) would be	$24,000.00

With this graphic picture of a business as an illustration, the amount of stock required for the assumed sales volume, would be dependent entirely upon the number of "turnovers" or "stock-turns". If the merchandise has been resold (or turned over) four times within the year, the capital would be one-fourth of the yearly cost of goods or $6000. If it is possible to increase the number of turnovers, the capital can be reduced proportionally.

A fair estimate of the capital required for an average business can be made on the following basis:

Stock (based upon 4 turnovers)	$6,000.00
Fixtures (including soda fountain)	5,000.00
Working capital	3,000.00
Total capital needed	$14,000.00

The reader should not infer, however, from these figures that at least $14,000.00 in cash capital is necessary to start a business of $100.00 a day. In actual practice, this might work out more like the following actual figures taken from a store that is operating successfully and that does an annual business of $42,000.00. The exact statement of this druggist is as follows:

Assets	
Cash	500.00
Inventories	8,000.00
Fixtures, fountain, cash register	5,500.00
Goodwill (actual cost)	4,000.00
	18,000.00
Liabilities	
Accounts payable (one month's purchases)	2,175.00
Notes payable (fountain fixtures and cash register)	4,150.00
Notes payable (goodwill)	3,000.00
Capital stock issued	6,000.00
Surplus	2,675.00
	18,000.00

The fixtures, fountain and cash register may be bought on terms that permit the capital to be increased as profits are earned. The goodwill of the business often may be purchased on the same basis. Occasionally a stock of merchandise is obtained on term payments.

The purchasing of merchandise on term payments, however, is apt to be very unprofitable for the retailer, because it ties him to one or two sources of supply and puts him at a great disadvantage in getting the best price and in earning cash discounts.

There is very little lost, however, by purchasing equipment on the term basis for the simple reason that it is only purchased once and the 5 per cent cash discount that is lost by purchasing standard unit fixtures for example, on a two year term basis, is more than offset by the 2 per cent monthly discounts on merchandise purchases that in twelve months would be 24 per cent and in twenty-four months would be 48 per cent. The fact that even the Pennsylvania Railroad and some of the great countries of the world buy railroad equipment and labor saving devices on a partial payment plan is assurance that the policy is sound, provided the equipment will perform a service commensurate with the investment.

It is apparent from the above example that this store was purchased and successfully operated on a cash capital of about $7500.00. As a matter of fact, $5000.00 of that $7500.00 was borrowed on long term notes financed by the family of the young druggist.

Many times drug businesses have been financed with as little as $2000.00 or $3000.00 cash, but this is an added risk and unless such a druggist possesses unusual ability and is fortunate in his location, he will be very apt to lose his investment.

An old store may exist on its reputation and goodwill but a new store is judged very quickly by appearances; unless it makes itself presentable from the start, it has little chance of competing successfully.

If an established store is purchased there will no doubt be a charge for "goodwill". By studying these figures a fair value for a store offered for sale may be estimated.

How to Procure Capital—*Individual ownership*—In some instances the prospective purchaser is already in possession of the necessary capital or may be able to procure it through his family. If the would-be proprietor has been

able to save a reasonable amount either through a saving fund, building and loan association, or a life insurance policy, it is usually considered an evidence of character and ability, and is of material assistance in securing further credit.

If capital is turned over to a young man by his father or by relatives without other obligation, it very often is received without appreciation and, only too frequently, proves to be a weakness in the foundations for success. When capital is supplied by the family or close friends, it should be accepted as a serious obligation, notes being signed, and interest paid, and these notes should be met with the same sense of honor and exactness which would be accorded any other business agreement.

A Partnership—A second method by which capital is sometimes procured is through a partnership agreement. Frequently someone with money to invest, is willing to place it in the business on a partnership basis, balancing it in part against the professional experience and training of the pharmacist. On the other hand, the partnership may be one in which every member of the firm equally contributes the capital and shares in the professional responsibility. The obligations of partners has been discussed under "Common Law", see page 1247, and should be thoroughly understood, and the agreement should be in writing, drawn up by a competent lawyer, before any business relations are assumed. This should hold true whether the partners are total strangers or the closest friends. One never knows what differences may arise in the conduct of a business and if there is a disagreement it is best for all concerned to have a proper legal status upon which to base a dissolution. A most important success factor in a partnership is an exact understanding of the duties and responsibilities of each partner. This should also be in writing.

Financing by Wholesale Firm—A third method for obtaining capital is to secure the financial assistance of a wholesale drug house. This was at one time a more common method of getting into business than it is today. The advantage to the wholesale house is that it obtains another outlet for merchandise, but the National Wholesale Druggists' Association in recent years has cautioned its members against multiplying store owners promiscuously, in this fashion. There are some disadvantages to both retailer and wholesaler in this plan. When a wholesale house or manufacturer supplies stocks on credit, to be paid through a series of notes, it practically amounts to a temporary partnership. Rather than lose his first investment with a retail druggist who does not make an immediate success of his business, the wholesaler may be tempted to extend further credit and he may be "throwing good money after bad". On the other hand, the retailer is in honor bound to practically limit his purchases to the wholesale house, which has extended credit, and this is not always desirable.

Corporation—A fourth method is to organize a company, incorporating and selling stock, or floating bonds in order to obtain the required funds. Large business ventures frequently raise the necessary capital by this means. The affairs of such an organization should be managed through a board of directors.

When this method is resorted to it is important for the pharmacist to arrange for a controlling interest in the concern so that he may be able to dictate its policy and insure his own future as a member of the firm.

Aid from Banks—Occasionally a well-known individual may be able to obtain some capital from banks on the strength of his personal reputation for business ability, honesty, and local popularity, but in such cases a close watch will be kept by the bankers on the progress of the business.

Capital is money which remains constantly employed in the business. Bank loans should be sought only for temporary or unusual needs, in which the

money may be returned to the bank after the circumstances demanding it have passed.

The retail druggist may reasonably expect two types of credit accommodation from his bank. The following example illustrates the first type. For his Christmas trade a druggist may want to buy in October an unusual quantity of imported novelties and paying cash for them at that time whereby he may obtain an unusual price concession. Past experience gives him every reason to believe that he can sell his purchase profitably during the holiday season. If he does not have the money to pay cash, he may go to the bank and ask them to advance it to him. Suppose the amount of his proposed order is $500 on on which he can obtain a 5 per cent discount by paying cash in October. He gives the banker a note for $500, due three months later, say January 15 (when the merchandise will have been sold). The banker gives him $492.50; the $7.50 deduction is 6 per cent interest for the three-month term of the note. By paying $7.50 interest for this loan, the druggist is able to save the $25 cash discount. The profit is apparent.

The other type of credit accommodation which the druggist may obtain from his bank is known as the improvement mortgage. For instance, a druggist may feel that by modernizing his building and equipment he can enhance greatly the value of his property and also increase his business. If his proposition looks practical, the bank may agree to finance for him a part of the cost of making the improvements. Suppose the cost of the improvements is estimated to be $3000. The bank may agree to advance $2000 of this. The first week that alterations are under way $300 worth of work may have been done. After this work has been inspected and approved by an officer of the bank, a payment is advanced by the bank to the extent of two-thirds of the cost of the work actually completed. Additional funds are advanced by the bank in like proportion as other parts of the work are completed. The amount advanced by a bank on an improvement mortgage is usually limited to 50 to 75 per cent of the cost of the improvements. Funds for the rest of the cost must be obtained from other sources. Sometimes the druggist uses his own money or the contractor may give him credit in exchange for a junior mortgage. Payment upon improvement mortgages is often made serially or the bank's mortgage may be funded later into a long term mortgage.

It is, of course, not the business of banks to lend capital. As a matter of fact, a bank is supposed to be able to recover on its assets within four months and if money were loaned for capital, it would not ordinarily be available for years. Many retailers seem to take offense because their banker has refused them a loan for working capital, but as a matter of fact the banker has no other choice. It might be mentioned that a banker is seldom interested in the physical appearance of the store, nor is he interested in the great stock of merchandise, nor in the prospects of the store. If a store is in a position to borrow money for seasonal business fluctuations, then all the banker is interested in seeing are the figures, for if based upon accurate records they are representative of the condition of the business.

Personal Credit—The pharmacist who goes into business faces, early in his career, the problems which relate to credit in one form or another. He soon finds it to be a fact that the underlying foundation of business is *confidence,* which is only another word for *credit.* For himself he must build up a credit which is based, first upon the actual property in his possession, either in the form of real estate or other marketable collateral; and secondly, upon his reputation for integrity and reliability. No business man is able to avoid a consideration of the relation of these factors to his business.

Commerical Agencies—Almost immediately after opening, the new pharmacist will be visited by a representative of one of the *commercial agencies*, such as Dun or Bradstreet, and will be asked to supply the necessary information concerning his financial standing so that a "rating" can be given him in order that merchants, with whom he attempts to do business, may be able to learn, through mercantile agencies, his worthiness of credit. It is desirable, therefore, that if an agent of one of these rating houses presents himself, the pharmacist should give without restraint all of the desired information, and above all make no false statements. The facts given are always verified as far as possible, and any deliberate attempt to falsify would seriously prejudice the securing of future credit. Willingness to give information of the type desired by credit agencies is interpreted as honest and straightforward dealing on the part of the business man. Hesitancy and foolish arrogance on the part of the retailer will do absolutely no good and may do a great deal of harm to his credit rating. These agencies have methods of securing the information desired anyway so it is the part of wisdom to let them get it directly and correctly in the first place.

It is desirable throughout all business relations to maintain the strictest guard over all matters which affect one's reputation concerning financial obligations. All money agreements should be promptly met, either by payment or by some satisfactory settlement.

Commercial Agency Form—A form indicating the type of information required by credit agencies is given below.

THE ———————— COMPANY

————————,..... 19

M.....

.....

We respectfully request that you furnish us a statement of your financial condition, on the within form, in such detail as you may elect, with a view to insure the correctness of our report. By so doing the chances of error will be lessened and confidence inspired in the minds of grantors of credit.

Those of whom you buy must get information regarding your responsibility, and employ The ———— Company to make the necessary investigation. That we may be better enabled to serve them and yourself is the sole object in making this request.

We ask such attention as the subject deserves.

THE ———————— COMPANY

Date.....19...

Statement made by.....
Corporate Style.....
Business.....

Where located—
NAME OF CITY OR VILLAGE.....
COUNTY.....
STREET AND NUMBER.....STATE.....

Date of Charter.....
Incorporated in what State.....
Commenced when.....
Succeeding whom.....
.....

OFFICERS

	Full Given and Surnames	*Residence*
President		
Vice-President		
Secretary		
Treasurer		
Manager		

DIRECTORS

Full Given and Surnames	*Residence*

CAPITAL

	Authorized	*Subscribed*	*Paid in*
Common Stock	$	$	$
Preferred Stock	$	$	$

How Paid in:

In cash	$
Patents, trademarks, patterns, etc.	$
In other property	$

Give particulars and the value of each kind of property

ASSETS 19

Cash in bank	$
Cash on hand	
Notes receivable, actual value	
Accounts receivable, actual value	
Merchandise (finished and unfinished)	
Raw Material	
Machinery and fixtures	
Real Estate	
Other investments (specify)	
Total Assets	$

How much, if any, of above Accounts Receivable have been assigned or pledged for loans $

LIABILITIES 19

Capital stock paid in	$
Surplus and undivided profits	
Bills payable	
Accounts payable	
Bonded debt	
Mortgage on real estate (not included as Bonded debt)	
Chattel mortgage on all kinds of property	
Borrowed money from banks (not included above)	
" " " individuals (not included above)	
All other liabilities	
Total Liabilities	$
How much, if any, of the above indebtedness is past due	$

Amount of annual business..... $.....
Amount of annual expenses..... $.....
Annual dividend..... $.....
Surplus (not including undivided profits)..... $.....
Indebtedness of company to stockholders included in liabilities... $.....
Amount of insurance on merchandise..... $.....
Amount of insurance on buildings and plant..... $.....
Ever had a fire; if so, give particulars.....
.....
.....
Is plant protected by automatic sprinklers.....
Other interests of *principal* directors.....
.....
.....
Bank with.....

TRADE REFERENCES FROM WHOM PRINCIPAL PURCHASES ARE MADE

Give Address of Each	*Amount Owing*
Name.....	$.....
Address.....	
Name.....	$.....
Address.....	
Name.....	$.....
Address.....	
Name.....	$.....
Address.....	
Name.....	$.....
Address.....	
Name.....	$.....
Address.....	

REMARKS

.....
.....
.....
.....
.....

Sign here .....
Official Signature

Banking

It is difficult, one is almost tempted to say impossible, to conduct a business of even comparatively small proportions without the facilities of a bank. Therefore the pharmacist who goes into business should immediately establish proper banking relations. To many people a bank is merely a place for the safe keeping of money, and other valuables, but this is only one of its many functions. The payment of accounts by check, through a bank, simplifies and makes safe the handling of money and insures a receipt for the amount paid. Banks also offer other services to the business man, such as assisting him in establishing credit, loaning money to him in emergencies on proper security, providing a safe place for the storing of valuable papers, such as inventories, legal documents, etc., and performing other important functions.

Whether the institution with which the pharmacist affiliates is to be a national, state, or private bank, a trust company, or other form of banking house, will depend greatly upon the opportunities, convenience, and needs.

Opening a Bank Account—It must be recognized at once, that for satisfactory relations, confidence must exist between both banker and depositor.

It is presumed that before opening an account the business man has assured himself that the institution is sound and properly managed. This establishes confidence on the part of the depositor.

Before permitting the opening of an account the bank requires that the individual or corporation officers be introduced or that they in some way establish their identity. Then in an interview, usually with the cashier, the prospective depositor is invited to state the nature of the service desired from the bank and information is given regarding the regulations established by the bank, with reference to balance required, interest rate, etc.

To be frank and absolutely truthful is the only policy to be followed in making these arrangements. It is folly for a business man to hide his financial condition from a banking institution from which he expects service. Plans, prospects, and financial conditions should be frankly explained and an endeavor made to inspire confidence in one's integrity and ability. Any deception is certain to be discovered, and credit will suffer, probably irreparably. Of course it should be understood that a bank is just as much a business institution as a retail store and the banker does not confer a special favor by accepting an account; that is the business of the bank. However, banks are usually so well regulated both by law and good management that it is common to consider the risk in the business relation between a bank and a business as being greater on the part of the bank. That naturally places the bank in a position of advantage when banker and business man get together. When a business has developed beyond a certain point it frequently happens that banks are desirous of obtaining its account and make special efforts to do so.

Signature—When the bank is satisfied that it is dealing with someone of good standing, and mutually agreeable arrangements have been made, the depositor is asked to enter his name in the form thereafter to be used on checks and other formal documents. This is done for mutual protection, since the only evidence which the bank will have that a check is genuine, when called upon to pay it, will be the similarity of the signature on the check with the one on record at the bank.

Making Deposits—The depositor is given a *bank book* sometimes called a *pass book*, in which the "receiving teller" at the bank will record the deposits that are entered to the credit of the account.

In making out deposit slips classify the deposit as indicated on the blank, entering all checks singly and indicating the name of the bank upon which the check is drawn or writing in the number assigned to the bank, which will be found printed on checks. This slip, with the properly endorsed checks and any cash to be deposited, are presented with the bank book at the receiving teller's window.

The bank book is retained by the depositor and is only returned to the bank at intervals for balancing; *i. e.*, the entering of the total drawn out and a statement of the balance remaining to his credit. Many banks today issue to their customers a monthly statement giving a complete list of deposits, checks drawn, and the bank balance. This is of great help to the customer and should be requested.

The Check Book—Banks provide check books for their customers and when the account is a large one, specially bound books are provided with checks arranged for convenience of signature, etc. The name of the individual or firm running the account may also be printed on the check. When an order is drawn on a bank to pay a stated sum of money to a third party (called drawing a check) there should always be a record on the permanent stub, of the essential facts regarding the check. This will include a duplicate

number, the date, the name of the party in whose favor the check was drawn, the amount to be paid, and any additional explanation of the purpose or reason for payment. Brief but full notes of explanation on the stub will prove of great value in keeping accurate accounts.

In drawing the checks one should see that they are numbered consecutively in order to facilitate reference to the notes on the stub, and for verifying the records when the checks are returned by the bank after payment. Arrangements can be made to have numbers printed in series on the checks.

The date should be the current one unless that be a holiday or a Sunday. To date checks ahead, called *post dating*, is objected to by the banks, and unless there is a very good reason it should be avoided.

The name of the party for whom the check is drawn should be clearly written, and all blank space left should be filled in by a line. Usually the check is printed with the words *or order* following the name, to permit the receiver of the check to order its payment to another party, if desired.

The amount of money for which the check is drawn is indicated by numerals, and also written out, and, should there be any discrepancy between the two amounts the written figures are usually accepted.

Here again any space left is filled in by a line where the amount is written, and the numerals should be placed close to the dollar sign ($), to prevent *raising*, or the increasing of the amount, by adding to the figure originally written. Many expedients have been offered to prevent the "raising" of checks. Some of these protective measures consist in the use of paper which will be changed in color if chemicals are applied to alter the figures. Others use paper covered with fine lines, which would be destroyed if scratched. Most commonly the area where the numerals are written is afterwards finely perforated and inked in such a way that tampering with a check would easily be detected, while others cut out the amount from the paper with a special machine or else stamp the sum across the check with a machine which cuts the surface of the letters and introduces indelible ink at the same time. Writing the amount in "India" ink is another safeguard sometimes practiced.

The signature should be that adopted and registered at the bank and should be consistently uniform and legible.

Endorsement—When a check is drawn to the order of an individual or firm, it must be endorsed before it will be accepted on deposit or cashed. Endorsement consists in writing the name on the back of the check exactly as it is written on the face of the check. The endorsement should be written on the end which corresponds to the left hand side when reading the check.

When the name has been wrongly written or misspelled on the face of the check, it should be endorsed similarly, but followed with the correct signature.

When it is desirable to limit the use of a check, when endorsed, the signature should be preceded by the words, "Pay to the order of————". If for deposit, write "For deposit" and then endorse.

If the payee only signs as endorser, without any restriction as to payment it is called "signing in blank" and should the check fall into the hands of a third party for whom it was not intended it is negotiable and can be cashed. It is always best to use the "restricted endorsement" introducing the words "Pay to the order of———".

Voucher Checks—A check when returned through the bank, is one of the best forms of receipt, as it requires the signature of the party in whose name it was drawn, and this is evidence that the money was received.

It is often difficult, however, to prove that the money was in payment

of a specific indebtedness, and to obviate this the "voucher check" has been introduced.

This form specifically states that the check is drawn in payment of a certain debt, which is mentioned, and that endorsement will be an evidence that the obligation is fully satisfied and no further receipt is needed.

The voucher check is frequently a special printed form and sometimes the bank will supply these without additional cost but, if this is not practicable, the ordinary check may serve the purpose of a voucher check, if a rubber stamp is provided and used on the back, immediately above the place for endorsement. This stamp should read as follows: "Endorsement of this check is evidence of full payment of the following": Below the stamp can be entered the dates of invoices or a brief description of the obligation which is being paid.

Other Types of Financial Paper—In the chapters devoted to Commercial Law (see pages 1245 to 1249), there is a discussion of financial paper from a legal standpoint, but in connection with banking it is well to call attention here to a few of the more important papers which are commonly associated with business enterprises.

Promissory Notes are frequently given in settlement for goods purchased with the object of securing prompt payment at a specified time. There is a definite legal form for such notes, which may be given as security for money borrowed or in settlement of an account to fix the amount of the balance agreed upon and a time for paying it.

Drafts are sometimes employed as means of collecting debts. A draft consists of an order drawn by the creditor on the debtor directing the debtor to pay a certain sum of money to a third party. While similar to checks in some respects the form and wording of drafts differ from those of checks and whereas a bank is bound to pay a check when properly drawn and presented, if the funds are on deposit, it is not compulsory for the merchant to honor a draft if he does not choose to do so. Of course, failing to honor a draft may influence credit adversely.

Trade acceptances and *bank acceptances* are being used extensively in paying accounts spread over a period of several months in which either a bank or a business organization are the endorsers. By means of acceptances it is possible for a business man to purchase quantities of merchandise on a time basis making regular payments at intervals through acceptances, previously filed with the bank or creditor, until the bill for the goods has been met.

The Bank—Safety is the prime requirement which everyone expects of a bank and this should be insisted upon before selecting a depository. Fortunately in the United States, a banking system has been developed through the aid of the National Government, which insures a maximum of safety and service and, with the more recent development including the Federal Reserve banks as a part of the system, elasticity has been given to the currency and many new functions have been provided, while previous defects have been eliminated.

National Banks—The first type of bank, therefore, to be considered is the *national bank*. This is established through a written application to the Comptroller of the Currency in which is stated the desired title, the location, the amount of capital to be provided and the names of at least five persons who propose to become stockholders.

At least 50 per cent of the capital must have been paid in before the organization is perfected and the balance must be paid in monthly installments of 10 per cent each, dating from the opening of the bank. In other words, there must be an approved location, where there is a real necessity for a bank,

and the capital must be all paid in within a stated period. The amount of capital is definitely fixed by the Banking Act—$25,000 is the minimum in towns not exceeding 3000 people,—$50,000 in places not in excess of 6000 people—$100,000 where the population does not exceed 50,000, and $200,000 in cities of over 50,000. The directors of the bank must own at least ten shares of the stock, which must remain free from any obligation, such as use for collateral. The director must also be a citizen of the United States.

A national bank may own its own building but that must be used exclusively for banking purposes. The bank is not permitted, however, to hold other real estate, excepting temporarily when taken over as security for an obligation to the bank. A national bank may perform the following banking functions:

(1) Discount promissory notes, (2) receive deposits, (3) buy and sell exchanges, coin, and bullion, (4) loan money on personal security or other satisfactory collateral, (5) loan on the security of farm land and on improved or unimproved real estate, (6) issue circulated bank notes, (7) act as trustee, executor, administrator, receiver, registrar of stocks and bonds, or may perform any of the routine banking functions permitted state banks and trust companies, (8) a national bank may act as agent for insurance companies or as the broker in negotiating loans on real estate but this last function may be performed only in towns of less than 5000 people, (9) they may accept drafts or bills of exchange, and (10) may establish branches, either in this country or abroad.

Loans may not be made to any individual or group of individuals for more than ten per cent of the capital and surplus of the bank. There are other restrictions on loans, such as that they must be for a comparatively short time, not more than three or four months. A national bank may not overcertify checks.

National banks are permitted to issue bank notes but these must be secured by a deposit of United States Government Bonds which are held in the United States Treasury. These bank notes circulate as currency throughout the country. This privilege is not granted to any bank other than the Federal Reserve Banks.

A national bank may not make contributions toward a political campaign. It may not loan trust funds to directors. There are also other minor restrictions which tend toward increasing safety. One reason why a national bank is considered especially trustworthy is the responsibility assumed by the shareholders. In case of insolvency, not only will a shareholder lose the value of the stock owned, but will be also responsible personally, if called upon, for an amount equal to the par value of his stock.

A regular and important feature of the National Banking System is an examination by representatives of the Comptroller of Currency. These examiners must visit the bank, inspect all books of accounts, securities, and assets, as well as liabilities, and may demand information from any officer concerning the condition of the bank. The examinations may be as frequent as is thought necessary and are without notice. All expenses, however, must be paid by the bank.

The establishment of the Federal Reserve System in 1913 greatly enlarged the functions and influence of the National Banking System. Every national bank was required to subscribe to the Federal Bank stock an amount equal to 6 per cent of its paid-up capital and surplus. In other words, the Federal Reserve Banks serve in the same relation to member banks as the individual national bank serves its depositors and stockholders.

When a National Bank is in need of further currency to loan to customers, a Federal Reserve Bank will discount the collateral already held by the National Bank, thus providing it with additional currency for re-loaning. A Federal Reserve Bank also establishes the rate of discount, preventing excessive charges which in times of money stringency had always been one of the serious defects of the old system.

The Federal Reserve Banks also issue bank notes, a privilege originally granted only to the National Banks.

The functions of the Federal Bank are as follows: (1) To discount the endorsed paper of member banks, maturing within ninety days if the proceeds are to be used for commercial purposes. If the proceeds are to be used for agriculture or livestock, it may be nine-month paper. (2) To discount acceptances upon imported or exported goods if they carry shipping documents or warehouse receipts, such paper to be endorsed by a member bank, and to be due within six months. (3) To deal in cable transfers, banker's acceptances, and bills of exchange. (4) To deal in coin or bullion. (5) To establish rates of discount, and (6) to make advances to member banks on their notes, when secured by approved collateral. The entire Federal Banking System is under the management of the Federal Reserve Board of eight members, who are the Secretary of the Treasury, the Comptroller of the Currency, and six others appointed by the President of the United States. Federal Reserve Banks have been established in some of the larger cities throughout the country and are geographically distributed so that all parts of the country may be adequately served.

The Clearing House—An important part of the National Banking System is the clearing house. This is an association of national banks and such other banking institutions as subscribe to the regulations. The clearing house is for the purpose of exchanging drafts and checks and settling the balances between the member banks. It furthermore serves to promote the general welfare of all of the banks in the organization.

A clearing house is established in every banking center and, on every business day, representatives of each bank present themselves at a stated hour, usually ten o'clock, a desk being provided for each. A clerk of each bank remains at the desk to which the bank has been assigned, and the second clerk moves from desk to desk with the packages of paid checks, made up for each member bank. The envelope of checks carries a statement of the amount involved and a receipt is given upon delivery at each desk. When every clerk has systematically presented the package of checks to all banks involved, the totals are quickly made up and a check drawn for the difference by either the bank representative, if there is a debit, or by the clearing house clerk if there is a credit. In this way the accounts of every bank with every other bank are quickly balanced and settled every day. Smaller banks in outlying districts, which cannot send personal representatives, arrange for one of the city banks to "clear" their checks.

The benefits of the clearing house are evident. The expense of collecting on checks is greatly reduced. The use of actual money in settling between banks is not required. Should a member bank meet with temporary misfortune, though fundamentally sound, the other member banks will come to its assistance.

In time of panic, the clearing house also provides opportunity for united action, even to the extent of issuing clearing house certificates in lieu of cash, should that become necessary. The clearing house also keeps all banks up to a high degree of efficiency.

Other Banking Institutions—A number of other financial institutions have been organized under State laws, and are well established in many places. The most important among these are the so-called *trust companies*. They originally possessed some advantages over National Banks, being permitted to act as trustee, administrator, etc., of stock, but the Federal Reserve Act has broadened the functions and privileges of the National Bank so that it may now perform many of the same services.

Trust Companies—A trust company receives its name from the service which it renders corporations through acting as the trustee of the collateral upon which bond issues were secured, and guaranteeing to the purchaser of bonds a proper record upon the books of the company. The trust companies also very largely assume the obligation of trusteeship or executorship for estates, especially in taking charge of affairs of minors.

Another function of trust companies in many localities is that of guaranteeing the title of property. This is referred to on page 1288. Trust companies usually pay a small rate of interest even upon deposits subject to check. As a rule, this is not more than 2 per cent.

State Banks—Another form of bank is the State Bank, organized under the laws of the State in which it is located. It is subject to supervision by the State banking department only. The general business conducted is similar to that already described, excepting that the banks are not permitted to issue notes. This function, prior to the establishment of the National Banks, was a common custom for State Banks; but in 1863, when the National Banks were established, a 10 per cent tax was placed upon circulating notes of State Banks and this is prohibitive.

The importance of this is readily understood, since the issuance of notes must of necessity carry confidence and reliability and the old bank notes were frequently found to be valueless.

Savings Banks—These banks occupy another field among financial institutions. Small amounts are accepted for deposit and the depositor cannot withdraw money by check but must give two weeks notice. Savings banks are mutual, that is, profits are shared by the depositors since the assets are entirely their property, there being no stockholders. Because of their character, the State banking laws rigidly control the kind of investments permitted. Safety rather than large return is the primary consideration. As a rule, the only types of investment permitted are loans on approved collateral, investment in government, state, or municipal bonds, and loans on approved first mortgages.

The object of savings banks is to cultivate thrift and provide safety and interest for the small as well as the larger depositors. As a rule, a saving fund does not pay more than 3.65 per cent interest.

Private Banks—This is still another form of bank which is an important factor in financial circles. Such an institution is dependent only upon the financial standing and credit of the owners. Such banks have at times performed very important services, especially in international affairs, as they are free to give help which may involve large risks but which may be of very great merit. Private banks also frequently serve an important function in stock market transactions through over-certifying for those in whom they have confidence. Such houses as Drexel and Company, Philadelphia, J. P. Morgan and Company, of New York, and the Rothschilds, of Europe, are illustrative of firms of this character which have become internationally known.

Postal Saving Banks—The small private banks in the foreign sections of large American cities, are usually conducted by one or a group of the foreigners

themselves. They do not, as a rule, offer very satisfactory security. Largely for this class of citizens, the Government has established a postal saving system which permits the individual to deposit any amount, from 10 cents up, at any post office. As evidence of the deposit, stamps are issued for amounts less than $1.00, and postal saving certificates for $1.00 or more. Two per cent interest is allowed if the money remains on deposit for a full year.

The depositor may withdraw his money at any time by presenting his stamps or certificates to the proper officer at the post office or payment may be made by mail upon request. In this way, safety and confidence are provided for those who may not be in a position to open an account in a regular bank.

Building and Loan Association—A consideration of financial institutions would not be complete without briefly discussing building and loan associations. These organizations are always established for local benefits and were started in Philadelphia in 1831. The primary object is to enable the members to become owners of their own homes. They also serve to stimulate saving. The association issues shares, usually of $200.00 each, the members paying monthly installments at the rate of $1.00 for each share, until the accumulation of dues and the interest on investment has created a value of $200.00 for each share when the amount is paid over to the shareholder. Frequently the building and loan association will advance money, on first mortgage, to the shareholder who then pays the monthly dues and also six per cent interest on the loan, in monthly installments and, usually, in addition, a small premium. In this way, month by month, an amount is paid which is generally less than would have to be paid for rent, but which within from eleven to twelve years builds up a surplus which insures the ownership of the property.

Building and loan associations are subject to very exacting state regulation and inspection, and, with a few exceptions, have been of great benefit to the shareholders, providing perhaps the largest return on investment available to the average individual.

Insurance

The head of a business, being responsible for its welfare, seeks to protect it against all possible losses such as those from fire, accidents, death, or illness of important officers, errors, or other unavoidable factors. To guard against such financial losses he may take advantage of the various types of insurance now available.

Insurance in its various places has been one of the developments of modern business. It involves the principle of a number of individuals uniting to share a possible loss, each paying a small percentage but receiving the protection agreed upon in a written document known as the "policy". This document should be carefully drawn and should enumerate all of the conditions and agreements.

Insurance companies may be stock companies in which the profits are divided among a limited number who hold stock, or the company may be "mutual", in which case all policyholders share in the profits, through a reduction in rates or the distribution of a "surplus".

Insurance companies are controlled in their business methods and in the character of their risks by state or federal laws and are subject to regular governmental inspection.

The rate to be charged, known as the "premium", is determined through years of experience and varies according to the conditions. When the risk increases, due to a greater fire hazard in case of fire insurance, or when an

individual is no longer young and the expectancy of life is less, as in the case of life insurance, then the premium is larger.

The first essential in considering insurance is the selection of a reliable company. In taking out insurance, it is usually preferable to insure through a local agent. This has the advantage of securing personal interest in the protection purchased, through the desire of the agent to give service and acquire a good reputation and more business, and also in case of loss it will be a matter of personal pride with the agent and good business for him to make satisfactory and prompt adjustments.

The principle of insurance is today applied to any condition which may involve a risk. There are insurance companies which will insure any individual against any loss which might occur. The most important applications of insurance are protection against loss by fire, against marine disaster, against accident, injury, or sickness, or it may be liability insurance, which covers responsibility for injury to someone else, or perhaps life insurance, or burglary or plate glass insurance, or title insurance for property, or any other of lesser importance, such as tornado, steam boiler, property damage, parcel post, weather, etc., etc.

Considering the more important of these individually, fire insurance probably should come first.

Fire Insurance—The first consideration is the amount for which to insure. Naturally the policy should not be taken out for more than the property is worth. In case of fire, strict inventorying of all losses and the proof of the loss will have to be provided before the amount of the policy is paid. Fundamental honesty is a basic requirement. It is always wise to keep a copy of a recent inventory of the store in a safe deposit box outside of the place of business.

Re-insurance—Re-insurance is a practice common among insurance companies whereby they share risks in any one locality. Should one insurance company write a large fire insurance policy for an industrial plant or many individual fire insurance policies in one community, rather than risk the possibility of a large loss in case of fire, the company will re-insure these risks in a number of other companies. This is also true of marine insurance, one company writing the policy for a ship and then dividing it among many other companies.

The Eighty per cent Clause—Having determined the value of the property to be protected, the policy should then be drawn for at least 80 per cent of the value. What is known as an 80 per cent clause, is a feature of practically every fire insurance policy. This means that unless the owner is insured up to within 80 per cent of the possible loss, he becomes a *co-insurer* and shares in the loss. The equity in this is evident, since it might otherwise be possible for a $100,000 plant to be protected by a $10,000 policy on the assumption that there was not likely to be more than a $10,000 loss at any one time.

If this were done, however, with the 80 per cent clause in operation and a fire occurred, the owner of the property would receive only one-tenth of the loss, it being recognized that he had assumed nine-tenths of the risk.

The Rider—An insurance policy always carries a rider which is a typewritten form attached to the standard policy, setting forth the specific conditions applying to the property insured. There should be permission to make repairs, to close the store or property for a limited time, that is, months or weeks during the year, to use electric lights or other form of lights, if necessary. It should also carry the standard clause, protecting the property against fire by lightning, and should permit the use of gasoline or oil stoves, if this is necessary, or any other special privilege desired. (See page 1397 for a typical policy.)

Assignment of Insurance—If the property is mortgaged, the insurance policy is assigned to the owner of the mortgage through a special form.

In Case of Fire—In case of fire, all reasonable means must be taken to prevent further loss, such as might occur through theft or breakage. Notice should be given immediately to the insurance company, setting forth all of the facts. Usually the company retains the privilege of re-building if it desires to do so, and most insurance policies include the right to pay the loss within six months, but, as a matter of fact, good companies make every effort to pay promptly as it places them in good repute and stimulates more business.

An inventory of fixtures and stock will be discussed elsewhere, but its importance in the adjustment of a fire claim cannot be overestimated, since an evidence of loss must be produced for the settlement of a claim. If a recent inventory is available, the adjustment is simple and if the inventory is arranged according to sections of the store a claim can be readily substantiated, even should only a partial loss occur.

Life Insurance—If an individual has assumed grave responsibilities, either for entrance into business or involving the duties toward a family, and if there is not ample reserve capital available, the taking out of life insurance becomes an imperative duty. Fundamentally, life insurance is only for the use of beneficiaries, although policies are being written today which provide protective features for the person insured, such as income for life in case the insured is incapacitated by accident or sickness, or when the policy becomes "paid up" and is then operative at a certain age. If the individual has no large obligation and no one who is dependent upon his support, then life insurance is not considered so desirable a form of investment, as larger returns can be secured from many other safe investments.

Forms of Policies—Policies are written in many forms. The *ordinary life policy* requires a relatively low premium, since it pays only for the estimated cost of carrying a policy. A *limited payment life* policy is one in which the premiums are paid for a fixed number of years when the policy becomes "paid up". This form of policy is only paid to the beneficiaries after death.

Another form of life insurance, commonly written, is known as an *endowment policy*. The premium in this case is larger, since the policy guarantees the return of a fixed amount to the insured at the termination of an agreed period, usually ten or twenty years. The cost of the policy must cover the risk, plus the principal, which accumulates. A *joint life policy* is one which insures two or more lives, the amount to be paid to the survivor or survivors. It is especially applicable to partnerships and is intended to cover the loss of capital or service incurred in case of death.

A limited term policy is one in which the amount of premium is fixed for definite periods, say five or ten years and is the cheapest form of life insurance. Should the period terminate and the insurance be renewed, it must be at a higher rate, based upon the age and conditions. This policy may usually be converted at any time into other forms.

An annuity policy is one which insures the payment of fixed sums of money after a stated period of years, or at death. This policy is of particular value in the protection of a family, for it guarantees definite income for a number of years, without the probability of loss. Frequently insurance policies are paid to the beneficiaries who invest the money thus acquired unwisely and the policy thus fails to perform the purpose for which it was intended. Annuity policies avoid such a contingency.

All life insurance rates are determined through what are known as *mortality records*, assembled over many years, from all civilized countries. This has

established an average *expectancy of life* and all life insurance companies use this as a basis for their rates.

Insurance policies which involve the endowment or annuity features possess a cash value which may be obtained at any time should the insurance policy be canceled, or which may be used as collateral for the securing of a loan. The person taking out insurance may direct the payment of the benefits accruing from the policy to any individual named. This person is termed the *beneficiary*. This, of course, is usually a near relative or some individual or interest to be benefited.

There is no limit to the amount of insurance that may be placed on the life of an individual, except the passing of the physical tests and the possession of the ability to pay the premiums on the policy.

Accident and Health Insurance—This form of insurance is being extensively carried by those who are dependent upon an income from their service. It usually covers a weekly allowance in case of illness, and frequently includes the cost of hospital and operative charges in case these should be required. The policy establishes a fixed amount for the loss of an eye, an arm, etc., or in case of death by accident. A policy of this character should be very carefully scrutinized to be certain that it does not include special clauses, which may render it of no value when most needed, for instance, illness from tuberculosis may exclude the policy holder from the benefits.

Burglary or Theft Insurance—This form of insurance gives a double protection. Not only is there remuneration in case of theft, but the company always provides a plate to be attached to the property, in a prominent place, and the robber knows that when property is so protected there will be special efforts made to apprehend the thief, through the employment of skilled detectives. There is usually some hesitation therefore to burglarize the property.

Plate Glass Insurance—The retail drug store is particularly in need of plate glass insurance. This may be written to cover the plate glass windows, also the glass-shelving, case-tops, etc. The windows are particularly prone to meet with accident from the outside.

Title Insurance—In many states the guaranteeing of the title of property by a special company which writes title insurance, is a requirement in case of mortgage. In fact, anyone buying property should make it an "iron-clad rule" to insist upon receiving, with the bill of sale, a guarantee of the title. This necessitates the company making a "search" of the property, and unless this is done there is always danger of some other obligation, such as back taxes, or mortgage, or lien, becoming a prior claim, thus rendering the sale and title of no value.

Liability Insurance—This form of insurance, as it applies to the retail drug store or other professional service, is of special importance. Accidents may occur in any drug store or professional service may be the subject of blackmail. Liability insurance provides competent defense in the form of skilled lawyers. It covers the consequence of prescription errors, mistakes in delivery, and poison accidents. It does not, however, lessen the necessity for the utmost care on the part of the insured. It gives no permission to be careless for the ultimate defense must depend upon there being no *contributory negligence*. This means that the person insured must comply with every regulation of the law in the conduct of his business. The proprietor of the store and the individual clerks must be separately named in the policy. Liability insurance is also carried or should be carried by every person who drives an automobile. Accidents are frequently unavoidable and the driver may be held liable for large damages.

Workmen's Compensation Insurance—This insurance is a requirement of the law of many states. It guarantees the employee, in case of accidents, certain specified payments in lieu of wages. The amount is determined by the amount of wage earned. The minimum premium in Pennsylvania for this compensation insurance is 19 cents per $100.00, thus a $19.00 annual premium would cover an annual payroll of $10,000.

Fidelity Insurance—Many firms, especially corporations, require that all employees be bonded. This means that the employee must provide necessary information concerning his character and financial standing. Individuals named as references are asked to express their personal judgment concerning the character and worthiness of the insured. This form of policy has the advantage of protecting the firm or corporation against loss through theft or embezzlement, but its most potent force is in its influence upon the individual who knows that in case of misdemeanor he would be compelled to face a cold-blooded tribunal that would give no consideration to any personal friendship.

All of the foregoing types of insurance apply to the drug business, or the executives of a business. Most of them also apply to other types of retail business. Insurance should be looked upon as protective and wherever there are risks the management of a business should study the possibilities of covering them adequately. Many a reputable pharmacist has been the victim of blackmail in the matter of alleged errors in prescriptions, and has had to pay tribute to protect his good name and avoid harmful publicity, when a small sum, paid annually, would have afforded him protection through an insurance company ready to take his case to court and frustrate the scheming blackmailer.

Income Tax

The owner or managing director of a business is now responsible to the United States Government for an annual statement of receipts and expenditures in the form of an income tax statement.

The establishment of an income tax by the United States Government, while looked upon with disfavor by many, has been one of the potential influences for success in American business through its development of correct accounting methods. It has oftentimes made it possible for a concern to discover serious losses and greatly increase its efficiency of organization and management.

An income tax report is required by the United States Government from those individuals or firms receiving annually the amount of income specified in the Act which is in force at the time of making the report. The minimum amount has been so frequently altered by acts of Congress that this detail should be procured through the local collector of Internal Revenue. Exemptions are provided which become greater if the individual is married and if there are children. When the income exceeds a specified amount, the rate of tax increases.

The first essential in the making up of an income tax report, which is required every year, is that there be proper financial record of all transactions. If this is available, there is little difficulty in making up the report. Almost every bank offers expert advice to its customers in the preparation of these reports and the Collector of Internal Revenue in each district is also prepared to give information. In making up an income tax report, care should be taken to include among the deductions, all expense connected with professional service. For instance, a physician may deduct the cost of upkeep for the automobile used in visiting patients. If this automobile is also used for pleasure, an adjustment must be made.

Another important deduction frequently ignored in making up an income tax report, is that of deterioration on property and fixtures. In the case of fixtures, this is usually one-tenth of their replaceable cost on the assumption that new fixtures will be required within ten years. Income tax blanks may be procured from the local Collector of Internal Revenue.

It is just as important not to include the items that are unnecessary in the report as it is to include those which are required. The Government demands correct returns.

In the Chapter on Accounting, page 1391, there will be found a system of keeping business records which will show the exact financial status of the retailer from week to week, from month to month, or from year to year. These records will provide the facts needed for making out the income tax record required by the Government.

In general, the data which a small business man needs to have at hand for calculating his income tax are gross sales, purchases of the year, inventories at the beginning and end of the year, and the selling expense. The following information issued by the Internal Revenue Bureau is of value in this connection:

"The gross sales over the counter are known to every progressive store or shopkeeper. In many cases he has his cash register memoranda. Even if he has no register, he usually has some other records of his intake.

"Aside from cash sales, most small stores have running accounts with customers. In the case of a new business, it is important that accounts receivable for goods or services furnished during the taxable year are added to the cash receipts, the result to be taken as the gross sales of the year.

"In the case of a long established business in which the balances due from customers will average about the same amount each year, the storekeeper has the privilege of figuring his net income on a 'cash basis'. That is, by ignoring the balances due him from customers and including in his cash receipts the total of intake, regardless of when his goods were sold, he will arrive at an acceptable computation of the net result of the year's transactions.

"In any case where both the cash intake and the accounts receivable created during the year are taken into consideration as the gross sales, the storekeeper should guard against duplication of the same income by omitting the payments received on back accounts that were taken up in prior years as accrued income.

"There are, therefore, two methods of arriving at gross sales for the year. On the one hand is the 'cash basis', which is more practical for a long established store, and on the other hand is the 'accrual basis', which is more accurate from an accounting standpoint as showing the correct earnings of the store during the year.

"The purchases of goods and supplies during the year are obtainable from the inward invoices, which most shopkeepers retain for their own use in fixing retail prices. Invoices of goods not received at the end of the year should be included, and in these cases such goods must be included in the inventory for the end of the year; for, although in transit, the title to the goods has passed to the shopkeeper and they are considered as on hand. Goods or local products received in exchange for other goods should not be included; neither should cash purchases be considered if the intake for the year is figured on the basis of the daily gain shown in the cash drawer.

"The construction of inventories of goods on hand unsold at the beginning and at the end of the year is not a difficult matter in small merchandising. The stock on hand is generally well known to the owner, who, if he is wide

awake, keeps an eagle eye on his shelves and storehouse. The pricing of this stock is the thing that he must be most careful about, particularly in these years of fluctuating costs. The pricing should be by one of two methods: (1) Cost of each item or, (2) cost or market whichever is lower on each item. In either case he cannot value the stock at any price higher than cost, and by the second method the shopkeeper may use market price if it is lower than his actual purchase price, on any or all items.

"In pricing inventories there is another important rule of the Government to be observed; that is where goods are so intermingled that they cannot be identified with specific invoices they are deemed to be the most recently purchased, and the latest invoice prices on those particular items should be used.

"As to selling expenses, these are easily figured, for a shopkeeper keeps a close watch on his till and knows what it has cost to pay his help, to light and heat his store, to pay his rent, and to maintain his delivery service. Then there is the telephone, telegraph, postage, expressage, freight and repairs. He is also allowed to include *interest paid on borrowed money*, taxes on his business property, and a reasonable allowance for wear and tear on his fixtures, wagons, horses, delivery auto, or any machinery or other equipment which he owns and uses in the business.

"With the above data at hand, any small dealer may make the same computation as his big-town fellow merchant to figure the net income of the business. The procedure is as follows:

"Add the inventory for the beginning of the year to the purchases for the year; from this sum subtract the inventory for the end of the year, and the balance is the cost of goods sold. Taking this cost from the gross sales for the year he reaches a figure which is his gross operating profit for the year. From this gross profit he is allowed to deduct his selling expenses. The result is *net profit*, to which he should add any interest or other business income not included in his gross sales, and the result will be the amount which he will consider as his business net income.

"By pursuing the above method the shopkeeper eliminates consideration of his own salary or withdrawals from the business. If he made withdrawals from the business, whether daily, weekly, monthly, annually, or irregularly, in the form of cash or in goods for his home consumption, this amount must either be added back into the net income as computed by the method explained above or he should consider it as a salary withdrawn, and therefore taxable income. The point to be borne in mind is that Mr. Storekeeper is taxable on his entire net income, whether withdrawn or not.

"A merchant may have withdrawn a considerable amount of money from his business and yet have actually suffered a net loss in his year's transactions, his shelves having been depleted of their stocks. On the other hand, a million merchants are building up and extending their business, withdrawing only enough for living expenses. Their goods for sale, piled up at high purchase prices, may contain a goodly income earned during the year in the business done over the counter. Whether the earnings are put back into goods or are placed in the bank, or whether they are used to maintain the shopkeeper and his family or withdrawn by him for other purposes, the net result of the year's business must be identified and considered in its entirety when the income tax season arrives.

"It is also pointed out by the Internal Revenue Bureau that if the shop or store is operated by a partnership a return must be made on Form 1065, regardless of the amount of its net income. A partner must consider as

income his share of the net profits, whether distributed to him or not, together with his other taxable income.

"If the store is incorporated a return must be made annually on Form 1120, regardless of the amount of its net income.

"If operated by one proprietor he must consider the net income of the store, together with all of his taxable income from other sources, in determining whether a return is required. And, if he must file a return, Form 1040 or 1040-A should be prepared with due care and accuracy and filed on or before March 15th.

"In addition to the above returns there is another return required if any employee, landlord, mortgagee, or other person, or any fiduciary or partnership was paid in wages, salary, commission, bonus, rent, interest, or other determinable income, a total amount of $1500 or over during the year. Forms 1099 and 1096 are furnished for this purpose."

Legal Responsibility

In another chapter of this volume (see Part VII) will be found a discussion of the laws governing the practice of pharmacy. From a business standpoint it behooves the store owner or manager to keep in constant touch with the development in the laws and regulations governing the conduct of the drug business, for it is an axiom that ignorance of the law excuses no man if he becomes a violator. Federal, state, county and municipal laws, ordinances, rules, and regulations with respect to property, responsibility and restrictions must be lived up to and the head of a business should see to it that his employees are familiar with the legal limitations of their rights and privileges and their legal responsibilities to the business and to the public. The proprietor is in most instances legally responsible for the acts of his employees performed in the discharge of their regular duties, so it is a case of self-preservation to instruct employees in the laws governing their acts.

Briefly, the laws which affect the practice of pharmacy are as follows:

Federal Laws	State and Local Laws
Food and Drugs Act	Food and Drugs Act
Narcotic (Harrison) Act	Pharmacy Act
Prohibition (Volstead) Act	Narcotic Act
Patent and Trademark Laws	Prohibition Act
Insecticide Act	Trademark Laws
Anti-trust (Sherman) and other acts governing conduct of business enterprises	Insecticide and Fungicide Laws
Tax Laws (including income and revenue measures)	Advertising Laws
	Sanitation Laws
	Employees Liability Acts
	Miscellaneous Laws and Ordinances covering business transactions

The best method of keeping posted on the legal restrictions surrounding the drug business is to become a member of national, state, and local pharmaceutical associations which keep the members informed of proposed legislation as well as that which is enacted. In these days of great multiplicity of bills presented to state legislatures for enactment, it is very important for pharmacists to enter their protest against proposed legislation which would work a hardship on the public as well as the pharmacist. Many well-meaning legislators and professional reformers introduce, or have introduced for them, measures that on the surface seem harmless to any particular group and beneficent in their general intent, whereas close analysis will often show that if enacted into law such measures may not only seriously interfere with estab-

lished customs and business methods, but may even go as far as to have an effect directly opposite to that which is desired. "Eternal vigilance" must therefore be observed by the officers and legislative committees of pharmaceutical associations during legislative sessions and their activities can only be successful when they are backed by the moral and material support of the members of the profession, both individually and collectively.

An important factor that should never be lost sight of by pharmacists in discussing legislation affecting their calling or in requesting the enactment or the suppression of a proposed legislative measure, is the duty of the legislature toward the public which they represent. Laws are not intended to confer privileges upon a class. They are intended to protect the life, health, property, and liberty of the people. If in protecting the public health, a pharmacy law confers certain privileges upon the pharmacist, that is merely incidental and a correlative of the original intent of the law which is to protect the public against the dispensing of medicines by incompetents. A legislature would have no more right to pass a law limiting the ownership of a pharmacy or the dispensing of a prescription or sale of poisons to pharmacists than to pass a law limiting the selling of radio outfits to electrical engineers, were it not for the fact that pharmacy ownership, dispensing of prescriptions and sale of poisons are matters concerning the very life and health of every man, woman and child in the State.

The pharmacist will therefore do well to remember that pharmacy laws are not enacted to conserve his rights, but rather to protect the public against incompetents by limiting the practice of pharmacy to those having proper qualifications.

With the many "side lines" that are creeping into the merchandising end of pharmacy it is also advisable to keep in touch with the legal requirements governing the sale of such items. This can be done through membership in chambers of commerce and other organizations of business men.

Executive Functions

It has been said that every institution is the lengthened shadow of some individual. This is particularly true of a retail business. The proprietor's policy is reflected throughout the entire establishment. If his clerks are pleasant, reliable, and give good service, he is credited by the public with maintaining a progressive shop. If they are grouchy, careless, and indifferent to customers, the proprietor is condemned for their acts. Employing the right kind of help from the registered pharmacist down to the errand boy and porter is therefore a very important function of the head of a business organization.

Selection of Help—It is well to obtain all possible information bearing on the character, habits, and abilities of the prospective employee. Large firms use a form of questionnaire or application blank on which to record the information desired and it is highly advisable for even a small business to follow this procedure. One is very apt to forget to ask some questions of the applicant which are essential unless a note has been made of them before the interview. It is not neccessary to have a printed blank, but the necessary questions to which answers are required should be set down and either verbal replies should be obtained and recorded or the applicant should be asked to write out his answers. References ought to be looked up carefully since the information obtainable from previous employers may decide the question as to whether one or another applicant with similar qualifications is the better suited for the position in question, always making due allowance for the possible prejudices of a former employer.

The following form of application is used by R. S. Sherwin, manager of Petty's Pharmacy, a large retail firm located in Newark, N. J.

APPLICATION FOR EMPLOYMENT

Department.....
Name..... Salary.....
Address.....
Age.....Married or Single.....Experience.....
Registered Pharmacist.....College Graduate.....Nationality.....
Father's (or mother's) name.....
Address.....
Last place of employment.....
How long there.....
Employed in what departments and how long in each.....
Left or discharged.....
Reason for leaving.....
All other places of employment in the last five years.....

Do you use tobacco?.....Cigarettes?.....Beer?.....Liquors?.....
I have read the above and all answers are truthful
Date..... Signed.....
.....

These blanks furnish complete information of a routine nature which is helpful in making a decision but it is most unwise to engage anyone without a personal interview. Much that cannot and will not be said on an application blank or in a written communication comes to the surface in an interview guided by intelligent questioning. The human factor is the greatest of all in the employing and handling of help. "Failures" working for an average employer often become outstanding "successes" under employers who know human nature and who can bring the best out of an individual by sympathetic and judicious handling. The following comments by E. H. Cone of the E. H. Cone Inc. Drug Stores of Atlanta, Ga., on the employment of help, are pertinent and indicate the broad view which employers in this generation are taking of the help question:

The following form is used by E. H. Cone Inc. for applicants to the various departments of their stores in Atlanta, Ga.:

APPLICATION FORM

Fill out in your own handwriting and return in person or mail to above address

Date.....192.....
1–A Name.....
1–B Address.....
Street and Number City State Phone
2–A Name of person with whom you reside?.....B–What relation?.....
3 Born at.....B–Age.....
4 In what places have you lived?.....
5 Married or single?.....6–Religious affiliation?.....
7 Who is dependent upon you for support?.....
8 Give father's name.....B–His occupation.....
9 What position do you now hold?.....
B Name of company or employer?.....
C How long so engaged?.....D–Salary.....
10 Why do you wish to change?.....
11 What is it your ambition to be?.....
12 What are you doing in self-development to reach that aim?.....

APPLICATION FORM—*Continued*

13 Give record of previous employment—fill in accurately:
Company or employer: Address: Time (dates) of service Salary rec'd Reason for leaving:.....
.....
.....
.....
.....
14 Name schools or colleges you have attended?.....
.....
B What grade or class did you finish?.....
C Do you operate a typewriter?.....
D Are you registered?.....Date.....State.....
15 Name some of the books you have read in past six months?.....
.....
B What magazines do you read regularly?.....
16 To what social, athletic, religious or military organizations do you belong?.....
17 Have you a hobby?.....B–If so, what?.....
18 What exercises, recreation or amusements do you have?.....
.....
19 Are you:
Careful?.....Patient?.....Thoughtful?.....Nervous?.....
Optimistic?.....Orderly?.....Active?.....Calm?.....
20 What illness have you had in past three years?.....
B Is your eyesight or hearing defective?.....
21 What is your height?.....Weight?.....
22 How many cigars do you smoke daily?.....How many cigarettes?.....
23 Have you any income other than your salary?.....
24 What is the approximate amount of obligations you now owe?.....
25 Give name and address of 3 references not related to you and by whom you have not been employed:.....
.....
.....
26 Tell in a general way what plans you have for the future and why you think you are adapted to our line of work?
.....
.....
.....
.....
.....
.....

"Can he smile? Smile naturally because he feels that way, I mean. That is one of the first things we want to know. To be a good salesman a man—or a woman—must be happy, friendly with the other people in the store, good humored. He must not be harassed by debts. He must be well. That is the type we try to engage.

"There are certain physical, visible qualities we prefer in engaging a clerk. For instance, he must not be above the medium height or weight. Why? Because this type is light upon his feet; he does not tire so easily from standing. And he moves about more freely in the restricted spaces behind the counter and between the cases. He does not have to squeeze past customers in the aisles.

"'Qualifications for Employment with E. H. Cone, Inc.', is a printed sheet containing twenty-six questions and blanks for the answers. After the name, address, and age, is the question 'With whom do you reside?'.

"We prefer clerks who live with their families; especially in the case of girls. They are better cared for, happier. We ask also whether anyone is

dependent upon them, for we want to know whether the salary will meet the demands upon it.

"We ask what position the applicant now holds, how long he has been there, what salary he earns. We want to know why he desires to change. If it is for some trivial reason, some disagreement, we advise him to go back, forget his troubles and stick. If he is willing to come to us for the same salary, we want to know what is the matter at the old place. If he wants a very material increase, we want to know why he thinks he can earn so much and why he did not have the chance with his present employer.

"We inquire whether he has any income other than his salary and the approximate amount of his obligations. A clerk burdened by debts, in the hands of loan sharks, harassed by demands his salary cannot meet, cannot do justice to himself or his employer. We have helped promising men out of such troubles, arranging for a gradual repayment and putting them on their feet. It made new men of them.

"We ask first of all about an applicant's health, whether he has been ill in the last three years and whether there is likelihood of its recurring. The health of a clerk is vital. If he is run-down, below normal, he cannot do his best work. We have had men who appeared to be slipping backward and we took them to a physician for examination. A bit of advice as to diet, a recommendation to take exercise at the Y. M. C. A., did wonders. We are glad to see that they have the opportunity to improve their health.

"A man's sight and hearing are important. If his hearing is defective he cannot answer the telephone properly and he is likely to annoy customers by failing to understand. If he does not see well, he is handicapped also.

"We ask how many cigars he smokes daily, or how many cigarettes. Smoking does not bar a man from our employment, but we like to know if there's an excess. We prefer a cigar-smoker to a cigarette-smoker. The latter is tempted to slip out frequently for a puff or two, and if he smokes too much his fingers are stained.

"We prefer married men because they take their work more seriously. We do not like employees who have made many changes, for they are not likely to stick. It is poor economy to keep hiring new men and we do not desire to engage men who wish a mere temporary place.

"Many of these matters are those in which employers would interest themselves, though perhaps not too systematically, but the Cone application blank goes further. Here are some of the questions that may be considered as odd:

"'What is it your ambition to be?'

"'What are you doing in self-development to reach that aim?'

"'Name schools or colleges you have attended.'

"'Do you operate a typewriter?'

"'Name some of the books you have read in the last six months?'

"'What magazines do you read regularly?'

"'To what social, athletic, religious, or military organizations do you belong?'

"'What exercises, recreations, amusements do you have? Are you careful? Patient? Thoughtful? Nervous? Calm? Optimistic? Orderly? Active?'

"'Tell in a general way what plans you have for the future, and why you think you are adapted for our line of business?'

"It is not merely the answers to these questions that count, but the way they are answered. We can get quite a good line on an applicant's character from the way he fills out that blank.

"Having graduated from a college is not a requisite. A clerk need not be a

typewriter operator, although it is convenient in prescription work. We would not bar a member of the militia. On the contrary we would be glad to have him, and would see that he could go to the encampment.

"But we do like to have a fairly intimate knowledge of the individual side of our people, their human characteristics. We like to know what they are interested in, what the natural turn of their minds may be, their temperaments. It will help us to place them in just the work they are most adapted to.

"And of course the interview with the applicant tells us a great deal more than he puts in words. If he is resourceful in applying for a place he will be resourceful in waiting on a customer. If he is slow in understanding; hesitant; if he does not look you in the eye, if he is not at ease, these are all points against him.

"The goal all modern employers are striving for is 100-point men in moral character, health, previous training, appearance; men above the normal. We may never reach that goal, but the nearer, the better."

Supplying References—References should be cheerfully given regarding former employees when asked for by prospective employers and the information sent should be fair, impartial, and straightforward. This is a business courtesy that is valuable to both the employer and employee and should be placed by employers on a basis of mutual helpfulness. Courtesy also demands that unsuccessful applicants who may have spent much time and effort in making application, be notified that the position has been filled.

It is well to establish a salary schedule that is graded on the basis of time of service and efficiency. If a profit-sharing scheme can be worked out, this will be found most satisfactory because it keeps up the interest of the employee. Many clerks who know they have reached the maximum salary which the store can afford to pay are apt to lose interest in their own productiveness and simply do the day's work without special effort to improve their value to the business.

Sometimes a druggist is influenced by the apparent economy of low wages. A registered man being paid $65 a week may very well be worth three times as much as the one who will work for $35 a week. Fair and even liberal wages tend to bring a reward out of proportion to their extra cost. In addition to an increased interest in the welfare of the store, the feeling of goodwill engendered has proved over and over again a strong deterrent to petty thievery of merchandise and cash.

If the proprietor pays living wages he can conscientiously insist upon the utmost care in the handling of his merchandise and cash. The LaWall Business Record System (described on pages 1202 to 1421) provides without extra work an excellent means of checking stock and cash leakages. Suppose the expenses and profit have been found to average 35 per cent of sales. On the 20th of each month, note the total sales for the month up to that time. Compare this total with the corresponding figure for purchases. If purchases exceed 65 per cent of sales, obviously something is wrong. The intelligent proprietor can learn very readily the cause once he knows there is a cause for investigation. The trouble may be overbuying, a falling off in sales, with no corresponding decrease in expenses, too low selling prices, or thievery by customers and employees.

It is unfortunate that dishonesty is not an uncommon trait among employees. For the protection of the business, as well as the clerks who are honest it is important to keep a close check on inventories and sales in the various departments so that leaks may be detected immediately and proper steps taken to eliminate dishonest employees. Profit-sharing schemes, bonuses, and

other methods of compensating clerks for resultful efforts may help to keep them out of temptation to take what does not belong to them.

Happily the long hours of service required in former days of both proprietor and clerks are giving way to a more rational adjustment. Whenever possible the help should be worked in shifts which will reduce the labor of any individual to a number of hours per day comparable with those of other business organizations. Drug store employees are entitled to their periods of recreation and will give a better account of themselves during business hours if they are given sufficient time for rest and relaxation.

Relation to Other Business Men in the Community

It is expected that a pharmacist will govern his relations with other members of his profession according to the Code of Ethics adopted by the American Pharmaceutical Association and most state and local pharmaceutical organizations (see page 9). The basis of this Code of Ethics is the "golden rule" and it can very readily be extended to include the relations of the pharmacist as a business man with other business men in his community.

The pharmacist may learn a great deal from other merchants and contact with them through personal association or through the medium of civic clubs, chambers of commerce, etc., will often prove decidedly beneficial. Every merchant owes a certain responsibility to the community upon which he draws for his business success. The pharmacist is considered more than a merchant so that he should stand out among his fellow business men as a personification of all that is good in their methods of doing business plus the unselfish service which he is supposed to give as a professional man.

In his relations with other business men, the pharmacist should be very tactful. He is often open to criticism because he handles many articles of merchandise which other stores consider their legitimate field. He should not be too critical of his fellow merchants and if there are occasions when the grocery man or hardware man attempts to sell drug products or poisons which are regulated by the pharmacy laws and which he therefore has no right to sell, it is better to instruct the other merchant in the legal phases of the matter and endeavor to dissuade him from breaking the law than to incur his enmity by reporting him at once to the authorities. It is plain, of course, that it is the pharmacist's duty to help enforce the law and if the general merchant does not yield to common sense entreaties, there is nothing left but to resort to legal measures.

The pharmacist should join other merchants in all endeavors to uplift the community in which they are doing business. Movements to keep business in the community, to carry on civic enterprises on a high plane, to educate the public to the use of better goods, thereby effecting certain economies, are all worthy objects and should be entered into whole-heartedly.

Relation to the Public

As the head of a business organization which combines professional service and merchandising, the pharmacist has a twofold relation to the public. As the professional man he is their counsellor in times of ill health and other misfortunes. It is common for people in the neighborhood to turn to him first for advice of all kinds because they expect him to be a man of better education and greater general knowledge than any other business man in the community. In order that he may live up to the qualifications which the average person expects of him, he must maintain a certain poise and

dignity which are essential qualities in the professional personality. It is important that he should have good health. So much depends on the head of a business that he owes it to himself, to his family, and to the community which he serves, to maintain himself in the highest state of efficiency at all times in so far as this is humanly possible. The confining atmosphere of a pharmacy is not conducive to good health and the proprietor should therefore make it a point to get out into the open at regular intervals, to seek change and recreation from time to time, so as to maintain his good nature and general efficiency.

In order to live up to the public conception of the head of a business organization, the pharmacist should be fairly prosperous. It is not necessary to possess or acquire great wealth but more than the ordinary income is required to take part in the various community enterprises to the same extent as the average successful business man. To this end, money should not be squandered on questionable stock promotion schemes and other get-rich-quick propositions. A reserve for expansion of the business and to provide the wherewithal to live up to his station in the community should be acquired as early as possible.

Most persons are apt to think a great deal more of the man who is honored by his own craft and who achieves distinction in his own line of work than of the individual who is never heard of or written about in contacts with his professional brethren. When the pharmacist is active in the work of his local, state, or national association, it is the part of good business to let the local paper print news items regarding his activities. Such information appearing in the papers enhances his prestige in the eyes of customers. It should be remembered, however, that in order to achieve distinction in any profession or business it is necessary for the individual to put far more of himself into that profession or business than he can ever hope to get out of it. If association work is undertaken merely for the popularity and distinction that may come to the individual, it will be unsatisfactory both to the association and to him. His sole idea in entering such work should be to give service to his craft. The rewards are incidental and the publicity feature is cited in these pages chiefly because so many pharmacists in the past have rendered service deserving of recognition and have never permitted the fact to become known, while others who have done much less have been heralded as public benefactors simply because they had a little chat with a newspaper reporter or editor now and then.

The great advantage enjoyed by the independent storekeeper over his chain store neighbor is that people like to deal with individuals rather than with corporations. The individual storekeeper should take full advantage of this situation by cultivating acquaintance with his customers, learning their peculiarities and endeavoring to take a personal interest in them. There is a double advantage in this, for not only does the customer have increasing confidence in the proprietor or clerk with whom he stands on a friendly footing, but it gives the storekeeper a clearer insight into the manner of people who make up his trade. The local merchant is really a buyer for his community. He represents them in the larger markets. To do this intelligently he must know the limitations of the community in which he does business but his endeavor should be at all times to improve those limitations. If he builds upon his experience wisely, he can decide very quickly whether a proposed new product will "take" or whether it will fall by the wayside. Large manufacturers lament the fact that they cannot get information regarding distribution of their products through retail storekeepers. Very often it becomes

necessary for them to send representatives into retail stores to get the viewpoint of the consumer. A wide-awake retailer should be able to give this information quite accurately, for no one has a better opportunity than he to observe the wants and desires of his community.

It is wise to establish a definite policy for a retail store which is elastic enough to provide for the constant changes that are taking place in our community life, especially as that relates to the pharmacy. The establishment of a policy involves a decision as to the kind of goods to handle. In some cases it is necessary to handle cheap, medium priced, and high priced articles because there are three distinct groups of customers. In other communities only the very cheapest kind of merchandise will have any sale and in still others nothing but the highest quality products can be sold. Investigation before entering upon the business will reveal the proper adjustment of the policy in this respect to some extent but only actual experience can verify it.

Whether to do a cash or credit business is another feature of the store policy which must be decided. In most cases a cash business is preferred but there are communities where it is impossible to do business excepting upon a credit basis. It would be suicidal for a pharmacist to attempt a cash business in such a location. A credit business naturally involves additional expense and prices will have to be adjusted to take care of this.

How far to go in the merchandising of non-pharmaceutical products is becoming a more difficult thing to decide each year. People think of the drug store as a service station and largely because of the fact that it is open during hours when other retail establishments are closed, it is expected that the drug store shall have on hand many articles of merchandise ordinarily entirely foreign to drug store commodities. The temptation to yield to the demand for constant increases in the side lines handled is very great and it becomes more difficult all the time to decide where to draw the line. It is plain that the line must be drawn somewhere unless the drug store is to become a department store entirely, with only a small drug and prescription department.

A safe rule to follow in the average neighborhood drug store is to remember that the pharmacy enjoys its reputation and popularity largely because of its professional aspect. If this is subordinated entirely and the pharmacist goes into active competition with practically every merchant in his community, he will soon find a combination of those merchants arrayed against him and he will not only lose much of his merchandising business but also his professional prestige. The "live and let live" principle should prevail.

Relation to Physicians

The Code of Ethics of the American Pharmaceutical Association is very explicit in its rules governing the conduct of the pharmacist with physicians. Tact is the great requirement here. The pharmacist stands between the physician and the public and in this position he may be subject to abuse from both but he can cultivate the friendship of both to a degree which will help him over many awkward situations.

If it should happen that a physician carelessly writes for an overdose of a potent remedy and the pharmacist detects the error, the incident should end with the detection and correction of the error. Under no circumstances should the pharmacist use the incident either to injure the physician or to exact tribute from him in one form or another. The pharmacist never knows

when he or someone in his employ may make an error in compounding and when he will want the help of the physician in correcting such an error with the least possible harm to his reputation. There should be no secret arrangement between the physician and pharmacist as to formulas for prescriptions, or rebates, or commissions to the physician. Such arrangements always lead to misunderstandings and suspicion and serve no good purpose in the end. The pharmacist should be rewarded for his professional work and the physician who writes a prescription is not conferring any favor upon the pharmacist. He is simply doing his duty by the patient and depends on the pharmacist to give the necessary compounding and dispensing service.

It is not the pharmacist's province to diagnose disease. He is not trained along this line and should never attempt to take the life of a patient into his hands by prescribing over the counter for what may seem to be a minor ailment. Many an unfortunate victim has been lulled into a false sense of security by following unskilled advice on what to take for a certain pain.

In the matter of giving medical advice and administering first aid, the pharmacist is called upon again and again to use the greatest tact. Ignorant people cannot understand why a pharmacist with all the medicine that is around him cannot mix up some sort of a concoction which will restore them to health and they frequently attribute the pharmacist's advice to see a doctor to commercial motives. Even at the risk of such suspicions the pharmacist should always maintain this ethical position. If he is asked to sell a certain product he may do so, but recommending a product for a given set of symptoms is wrong and should not be tolerated in a high class pharmacy.

When there is an injury to someone from an accident nearby, it is natural to run to the pharmacist for first aid. Here again, it is important for the pharmacist to know his limitations. He should immediately send for an ambulance or for a physician and only employ such emergency measures as are plainly indicated as necessary by the conditions.

CHAPTER LXXXI

THE STORE OR PLACE OF BUSINESS

To DEVELOP a professional or commercial retail drug business there must be an opportunity for service; that is, there must be a public demand for it. The *location* of a store therefore becomes a vital factor. There must be prospective customers somewhere within a reasonable distance, and real professional service is only possible when physicians and dentists are also nearby. Most of the purely professional pharmacies in the United States are located in or near "medical buildings" or in a medical center. In an outlying, thinly populated territory, where but one physician is found on a twenty mile drive, but little prescription filling or clinical analysis could be expected. Here, however, there might be very important professional opportunities for the pharmacist in helping to maintain community sanitation and health.

The distance customers must travel to reach the store has a number of important effects upon the character of the store's business. If people must come ten to twenty miles, their visits will not be as frequent but their purchases on any one visit will be larger. (Incidentally, the extent and condition of roads and other transportation facilities has a determining effect upon the extent of the territory from which the store can draw.) Such a store has the possibility of developing a mail order business. It may also find an automobile delivery profitable.

In stores where automobile delivering is required, it should be watched very closely, as the cost of light truck maintenance and operation is often much more than the sales justify and the service is not always appreciated at its full value by the customer.

These services naturally add to the cost of doing business; an attempt to do a cut-rate business under such conditions would be suicidal. In the thinly settled sections of a city, where many customers must come several blocks to reach the store, the proprietor may expect to do a large telephone and delivery business. The opening of charge accounts may also become necessary (see page 1391). In such a store, window and store displays do not have the drawing power that they have in a transient location and the proprietor therefore must resort to circular letters, handbills, billboards, and perhaps advertising in the street cars to attract trade.

The selection of a location therefore calls for a careful consideration of the conditions.

In selecting the place of business, it is well to bear in mind that the 22,000,000 automobiles in this country provide gasoline transit for practically every family. With the rapid increase in good roads, a decided change has been made in the entire structure of retail business. People will travel from eighteen to twenty miles to a shopping center, or, in other words, will give an hour of their time to reach a city or town that is an accepted shopping center. Progressive towns with active retail associations, bright show windows and good theaters are growing rapidly in their volume of retail business.

In selecting a location, therefore, the druggist should pay more attention to the activities of the neighboring stores rather than for the actual population of the town. In some sections, such as in West Virginia, a town of 500 often has a drawing power of 5000 to 10,000 people and a town of 5000 will often

support six or seven prosperous drug stores. In short, the business man should look behind the superficial figures and analyze the real facts.

When our communities were small and the pharmacist's business was largely in drugs and medicines, the location of his store was not a great problem. He usually fitted up his laboratory and storeroom near the business center of the community and whether it was on a corner or in the middle of a block was of little consequence because the people had to come to him for their medical supplies. Things are vastly different now. The matter of location of a store has a tremendous influence on its possibilities of success. This is true because the rapid development of our cities and the multiplication of our activities as a people require conservation of time and effort. It is therefore only natural for people to go to the most accessible establishments for their supplies of all kinds, other things being equal.

The druggist need not feel, however, that limitations upon his natural trading area forever circumscribe his activities. Anyone familiar with drug stores knows that some druggists attract trade from wide areas in spite of natural limitations. There are drug stores in American cities which fill prescriptions and sell other merchandise to persons all over the world. In general, there are three influences which help to extend a store's normal trading area. They are:

1. Character of the service rendered.
2. Extent of the stock carried.
3. Prices.

Location of the Store—It is impossible to lay down definite rules for the location of a pharmacy which will cover all cases. The so-called transient store must be situated where it will attract the greatest number of people in a given time. The neighborhood store, while commonly located at a corner, has often been successful even though it was located in the middle of a block. In smaller towns and rural communities it is customary for the pharmacy to be located in what is known as the business center or main street. Very often three or four stores are found within one block of each other in such towns, each one serving its own clientele and having established its trade among the farmers and others who come to town to do their shopping at stated intervals.

Transient Location—Transient customers are not such a factor as they were once thought to be. Chain stores have almost discarded the idea that their customers are transient even in the busiest sections of the city and are endeavoring more than ever to build permanent customers. For instance, in one busy chain store on Fifth Avenue near 42nd street, New York, the manager says that less than 10 per cent of his volume is from transient customers. To prove this he points out that at the soda fountain the same faces can be seen there at the same hour every day. The transient customer is not, as a rule, a profitable customer but the fact must not be lost sight of that nearly every transient customer is a potential permanent customer and he should be treated with the end in view of making him a regular supporter of the store.

In opening a store for transient business, which will naturally depend for its trade on the people that pass, it is important to be able to decide which of several locations may be best. Given any four corners in a large city there will always be an advantage at one intersection over another. This advantage may be brought about by the fact that street cars or buses may stop at one corner and not at the other or there may be a large office building, theater, auditorium or department store closer to one location than to another, and this of course means that a larger number of people will pass one particular point in twenty-four hours. There is only one way to decide intelligently

on the advantages of a location of this kind and that is on the basis of facts. An investigation of the immediate neighborhood of the location is necessary.

Consideration should be given to the character of the surroundings of the proposed store. Women form the largest proportion of the patronage of a pharmacy. Surroundings which are distasteful to them should be avoided. For instance, billiard rooms, garages, and saloons are poor neighbors for a pharmacy. The physical appearance of the store itself also affects its value. Good window display space can be used effectively to increase sales and consequently enhances the value of the property. An awkward entrance and interior arrangement decreases the value of a location. Large chain stores organizations desiring to determine the advantage of one location over another will frequently station observers at various points and will actually count the number of passersby during certain hours of the day so as to determine where the most people pass. They will further analyze the situation from the standpoint of whether these people are on their way to and from business or whether they are more or less of a leisure group with time to glance at window displays and with sufficient interest to step into a store and buy. It may easily happen that more people go by one location than another but that the percentage of possible buyers in the location where fewer people pass will be greater than where the larger number pass. As a general rule, however, it can be demonstrated from actual observation that the gross sales of a transient store will be greatest where most people travel because ways and means are devised to interest a certain percentage of those who pass, in the merchandise for sale.

The question of rent naturally enters into these calculations. It may be found more economical to take a corner where there are fewer passersby, at a reasonable rent, than to occupy another corner where more people will pass but where the rent is exorbitant or the lease unsatisfactory. Transient stores like any other type can attract people by their advertising, their service, and their merchandise values, but in this highly competitive commercial era these factors are apt to be well taken care of by all store owners and it must be borne in mind that people will not cross a street, especially in a busy section, in order to trade with a certain merchant if they can get what they want under equally satisfactory conditions on the side of the street on which they happen to be. If one contemplates the opening of a transient store in a city or town not well known to the prospective owner, it is advisable to consult reliable real estate dealers, officers of the local chamber of commerce and merchants in other lines, for the purpose of gaining as much information as possible about the present and future development of the business section of the town. Very often the business districts of the city have developed in an entirely different direction from that planned by the founders. In the older cities the trend of business is well established, but in growing towns it is sometimes difficult to determine the direction of future growth if there are possibilities in more than one direction. The newcomer should not depend entirely on his own judgment or that of friends. It serves his interests best to obtain information from as wide a group of people as possible before coming to a definite decision.

It is important to study beforehand not only the characteristics of the location itself, but also those of the area from which the store expects to draw its trade. If the store is located in a city or neighborhood which is growing and which has every indication of continuing to grow, the proprietor may expect a normal increase in his business, solely as a result of this growth. On the other hand, if the population of the community is stationary or declining, constant

and increasing efforts will be necessary merely to maintain the volume of business that he has.

As a further consideration, any changing tendencies in the population should be noted. A fine residential section may be rapidly becoming a center for rooming houses. Native American workingmen may be in the process of being succeeded by recent immigrants. These changes do not mean necessarily a loss of business but they do mean a change in the character of the business. The proprietor should consider himself in relation to these changes. A pharmacist may be very successful in serving a high class residential clientele, but a flat failure in dealing with recent immigrants. Likewise stock which would be salable in a high class residential section would be entirely unsuited to the demands of foreigners, not yet accustomed to American habits of life.

Buying a Transient Store—When it comes to buying a transient store which is already established it is important to get all of the facts about the business of that store not only for the past year but for the past ten years, if possible. Such information will immediately show whether or not there has been a steady decline or a healthy increase commensurate with the general growth of the section, and it may also reveal the real reason for the owner's desire to sell. If a transient store has for any reason acquired a bad reputation, it should be remembered that a considerable expenditure will be involved in correcting that reputation. If at all possible, the building should be purchased with the store. If this is not possible, the lease should be very carefully investigated. If it has only a year or two to run, there is great danger that when the lease expires the rent will be greatly increased, perhaps beyond the amount justified by the business that may be done at that location. It is not uncommon in the present day of growing real estate values, when old leases expire for rents to multiply fivefold and more, for desirable locations. In this matter, as in any other involving legal phases, it is most advisable to consult a competent attorney and to have the benefit of the advice of a reliable real estate man.

Neighborhood Location—The selection of a location for a pharmacy in a neighborhood section presents problems of a slightly different type than those mentioned in connection with the transient store, although most of the factors applicable to the transient store apply with more or less force to the neighborhood store. Assuming that a new store is to be opened, it is important to inquire into the character of the neighborhood, the possible number of people that might reasonably be expected to trade at the store, taking into consideration the proximity of other pharmacies and the tendency of the people to buy in the down town sections. In addition to studying the potential buying power of the people, it is also advisable to consider what percentage leave for summer or winter homes during a part of the year, whether or not they depend for their income upon one industry which may be subject to shutdowns or strikes and any other local factors that may influence business. The greatest mistake that the prospective owner can make is to go into the proposition blindly. The facts are obtainable and should be sought.

Builders who are developing new sections of our cities usually make preparations for the location of stores of various kinds. If one contemplates the opening of a pharmacy in a new section and storeroom is provided, it is well to consult with the builder and give him some idea of the peculiar requirements of a pharmacy in the way of space and layout.

The question of ownership and the possibility of obtaining a satisfactory lease holds good in this case just as in the case of the transient store. When an established business is to be purchased, it is well to ascertain the following facts: The total annual volume of business, with information as to its increase or

decrease in the past five years or more; the character of the business done in the store, that is, whether it is largely in package medicines, in side lines, in prescriptions, in loose drugs and products of the pharmacist's own manufacture, or in soda and confectionery; the character of the community, whether it is rich or poor and whether it is possible to educate the neighborhood to purchase its pharmaceutical needs near home rather than in the transient districts where the people work or shop; the reputation of the present owner in the neighborhood, in other words, the value of his goodwill; the reason for selling the store; a careful investigation of the prices at which goods are sold to determine whether or not a reasonable profit is possible. All of this information coupled with a careful inventory and satisfactory arrangements regarding lease or purchase of the building should be at hand before a decision is made to buy.

It is also wise in all cases to obtain an option to buy the building, as a part of the lease, so as to avoid the possibility of having the building purchased over one's head by a competitor.

The location of a new store or the purchase of an established store in a small town requires consideration of all of the factors, in a greater or lesser degree, which have been outlined under the transient and the neighborhood stores.

Of course, no location can be considered perfect and it is important for the pharmacist to know both the advantages and the limitations of the particular site selected. Knowing this, the policy of the store and its management can be so adjusted as to overcome disadvantages of the neighborhood and to profit fully by its advantages.

Location is of course important but it is not always the greatest factor in the success of a store. Some druggists are unsuccessful in merchandising even in the best locations, whereas others will be successful in localities which ordinarily are considered extremely poor.

Name of the Store—The name of a store in a transient location is a very important asset. If the business has been conducted by a reputable individual whose name is attached to it and has become fixed in the minds of the people of the community, it would be folly to change that name, although it is entirely proper to advertise the name of the new owner in connection with it. If on the other hand, the former owner has not enjoyed the confidence of the public, it would be equally unwise to continue the establishment under his name. It is difficult for the public to disassociate names and personalities. The thought of the former owner and his lack of service or other faults will come up in spite of the knowledge that a new man is in charge, if the former owner's name is continued.

Very often a substantial sum is paid as part of the goodwill that goes with the sale of a store for the name under which the establishment is known. It is to the interest of the new owner or the prospective buyer to establish by inquiry and observation the value of the name to the store. The name of the individual associated with a store lends a personal touch and is to be preferred whenever possible even in a transient section. General designations, such as "Red Cross Pharmacy", "Purity Pharmacy", "Service Pharmacy", etc., are usually employed when the store is owned by a group, or when the proprietor has some reason for not wishing to use his own name. In such cases, it is difficult for the public to recognize the real owner and the store is apt to lose the personal touch which is so advantageous to any retail business.

It is true that some store owners today are thinking only of the establishment of a paying business, for the purpose of re-sale. In that case, impersonal names such as "Palace Pharmacy", "College Pharmacy", etc., seem to be

preferable, as they can be retained by the new proprietors without letting the public know there has been a change in ownership.

One of the chief assets of a neighborhood store is the fact that it is possible for the owner to cultivate acquaintance and friendship with his customers. It follows that the owner's name on the store window or over the door will carry more confidence and commercial value than an impersonal designation. In general, it would seem to be the part of business wisdom for every pharmacist who is in business to make his name the name of the business establishment.

One danger of handing down the name of an established pharmacy is the possibility that its reputation may not be sustained. This depends, however, very largely upon the manner in which the organization is continued. Many firms of established reputation have existed years after the founder had sold out and died and the original policies and reputation have been fully sustained. This is largely a matter of control.

What Should be Paid for an Established Store—Many elements enter into the final answer to the question "What should be paid for a store"? First, the location; second, the actual physical value of the fixtures and stock; third, the business being done and the net profit earned. Location and goodwill have already been discussed. Whatever is paid for goodwill should be charged off to a large extent within the first year, for after a short time the continuance of the patronage of the community will depend on the personality of the new owner or manager. A strategic location has a value which must be paid for and which can always be redeemed. The value of the physical equipment will depend upon age and adaptability to the present demands of the community. Today, many consider ten years as the life of fixtures and soda fountain and consequently write off ten per cent depreciation each year. If the store will have to be refurnished to bring it up to date, the old fixtures are worth nothing to the new owner. He probably would not be able to give them away if he wanted to dispose of them. It is a wise plan to ask the judgment of a good store fixture man before agreeing upon the value of the fixtures in an established store.

The value of the stock should be determined on the basis of a recent inventory. It is folly to buy on the prejudiced guess of the one who would sell. A real inventory by a disinterested and qualified third party should be insisted upon even if made at the buyer's expense. There are always men in wholesale drug houses trained to do this and it will give a real basis for value in discussing the sale price, and if the sale is consummated, it gives the new proprietor correct figures for starting his accounts. An inventory has other values but these will be discussed later (see page 1417).

The value of stock in the store should be determined not alone by its inventory. Stock which is salable in one store may be useless to another. For instance, a store removed from the central section of a city and serving a workingmen's neighborhood can sell many novelties which could not be handled by another store whose customers are wealthier and accustomed to shopping downtown. The inventory should be studied to determine the quantity of unsuitable or slow-selling items and allowance made for them in determining the value of the stock to the prospective purchaser.

Store Arrangement—The change in the nature of the drug business, which has added considerable merchandising to the original function of the pharmacy, has brought with it necessary variations in the planning and arrangement of modern drug stores. When the pharmacy was almost exclusively a place where medicines were compounded and sold, it was only necessary to provide enough

room and proper facilities for the storage of the various drugs and preparations, a comfortable place for patrons to wait for their prescriptions, and perhaps a counter or two with an occasional display case. As the various side lines were added, it became necessary not only to provide storage space but also space for display. "Goods well displayed are half sold" is a phrase that is commonly used today and there is no question about the fact that much merchandise is sold because it is attractively displayed and can be seen and handled by the prospective purchaser. One of the great problems in organizing a new store is to know how to plan for adequate display for the various items that constitute the stock of the modern retail pharmacy. The matter of quick service is also of importance, and a store, particularly one of the type that is handled largely by one man, must be so arranged as to have things convenient for quick service. It is now customary to relegate the old time show bottles to the back room and to use all shelf and counter space for the display of attractive packages. Of course, the requirements of the one-man store are different from the larger stores where numerous clerks are employed and where these clerks frequently remain in one department and do not sell goods in other departments. There should be ample aisle room between wall and floor cases. Twenty-four inches of space is advisable and it is not safe to allow less than 20 inches in any case. Space at the front of the store is generally considered more valuable than space at the rear so that it is customary to lay out a store with the departments that yield a rapid turnover and good profit in the portions most accessible to the public. Very often the layout is so planned as to require customers to pass counters or cases where special merchandise is on display in order to reach the place where items frequently called for may be obtained (see also page 1310).

The fundamental principle involved in a store layout is that departments and goods be so grouped that maximum sales and profits result. This means that full advantage must be taken of every available space in the store which can be used to promote sales. Non-productive departments should be located elsewhere. Departments should be grouped, as far as possible, to distribute customers through the store.

On this and following pages are shown typical layouts for stores of varying dimensions. The dimensions of the store and its location will greatly influence the planning. It will be seen from some of the illustrations that it is possible to economize considerably on space if necessary and to secure a great deal of shelf space, counter space and places for keeping necessary things, such as wrapping paper, string, the cash register, etc., if proper plans are made. Very often only a limited space is available in a high priced locality and it becomes the problem of the druggist to get as much stock and the necessary things to work with into that space, as would ordinarily occupy twice the room in a more commodious store.

In planning the store it is wise to get the advice of experts. The designers and manufacturers of drug store fixtures have naturally had a great deal of experience along this line and this experience is available to the retailer for the asking. It is possible to obtain fixtures at various prices, depending upon the quality of the material, the workmanship, and the reputation of the manufacturer.

Creating Store Atmosphere—Every store reflects a certain atmosphere which becomes characteristic and is associated with it in the minds of customers. It goes without saying that the conditions should be pleasing. To make them so requires careful planning. What may be a proper atmosphere for a confectionery store, a stationery store, or a grocery store, would not do for a high class

pharmacy. Among the features which distinguish the pharmacy from the average retail store are the prescription and drug department which should be so located and so outfitted as to quietly dominate the store. In other words, there should be something which will immediately indicate to the customer that he is in a pharmacy and not in an ordinary merchandising establishment. There is, on the one hand the constant demand for making the store a greater asset in the merchandising field and on the other the necessity for maintaining a professional background. Some of the illustrations in these pages indicate how this atmosphere has been provided and maintained.

For those who are interested in conducting strictly professional pharmacies with a minimum of merchandising the illustration of the front of the store of Hynson, Westcott and Dunning, in Baltimore, will be of great value. It has been suggested that the decorative scheme of the store interior might follow along the line of some medicinal plant design (see J. A. Ph. A., 1917, p. 376). The old show globes which were characteristic of the apothecary's windows many years ago have their modern counterpart in some of our pharmacies, and, with their colored liquids sparkling in the ray of an electric light, they have the same attraction and create much of the atmosphere of the "show bottles" of old.

The entrance to the store should be inviting. Considerable time and effort has been spent by manufacturers of fixtures and other equipment in designing store fronts that are both attractive and efficient. One should aim to make the store easy of entrance. For this reason complicated doors and narrow entrance are to be avoided. There should be a pleasing display at the entrance if possible, so as to attract attention and hold the interest of the person about to enter.

Too much ornamentation should be avoided. The plain, rich looking type of fixture is more attractive to most people than much fancy work.

Store Fronts—In general, store entrances may be divided into two kinds. The ordinary straight store front with the window parallel to and in line with the edge of the sidewalk, and with windows running back on converging lines to the door.

Arcade store fronts have become very popular in recent years. They have one or more show cases located in the vestibule or store entrance, with passageways on the side, and at the rear of the show case. The arcade type of store front is generally impracticable for stores with a span of less than thirty feet. Such fronts should not be less than 10 feet in depth. Arcade fronts increase show window display space. They give shoppers an opportunity to examine displays without being jostled by the crowds on a busy street. They give a store a very attractive appearance from the street. In stores facing the south and west, arcade fronts are of value because they give less exposure to direct sunlight than the shallow straight type of store front. There is therefore little danger of fading in the displays. They are desirable for shelter in bad weather thus affording the passerby an opportunity of studying wares in a comfortable frame of mind conducive to sales. They permit of unit displays. On narrow frontages they permit maximum show window footage.

On the other hand, arcade windows are expensive. They hide the doorway and congest the store entrance. They take space from the actual selling space in the store. They darken the store to some extent. They require a larger amount of samples for display, increasing the possibility of losses from light, dirt, and handling. They are more difficult to keep clean and will require more of the window dresser's time.

Windows in the store should be shallow, about two or three feet deep from the street. Aisles in arcade store fronts should not be less than 5 feet wide.

Bulkheads should be about 18 inches high. The plates of glass in the front should generally be 7 feet 6 inches in height. Prismatic glass should be used for transoms in all cases where the maximum of daylight inside the store is desired. All angles should be made 90 degrees to eliminate reflections in the windows if this is possible.

The light sources in the vestibule ceiling should be few in number so as not to detract from the show windows. One good light is sufficient.

The General Layout—In the planning of a retail drug store, when newly established or if being refurnished, various objectives should be kept in mind. One objective is the stimulation of sales. Another is to arrange things so as to enable the minimum number of sales people to handle the business with

FIG. 440

Professional pharmacy of Hynson, Westcott and Dunning

the least fatigue. Mechanical efficiency is of great importance. By carefully studying mechanical efficiency in its relation to the human element, the cost of help has been materially reduced in the last ten years in one of the largest pharmaceutical organizations in the country. Figs. 442 to 444 illustrate the layout of drug stores as planned by organizations having large experience. It will be noticed that there are three primary divisions, and this is common to most retail drug stores. It should be understood at the outset that the character of the business planned will largely determine both the number of departments to be established and also the space allotted to each. If the pharmacy is to be strictly professional, then the number and the character of the departments will be materially altered. In other words where the entire store is devoted to the handling of drugs, prescriptions, sick-room requisites, and hospital and surgical supplies, a particular layout would be planned. An excellent illustration is seen in Fig. 440, representing one of the largest profes-

sional drug stores in the United States, namely, that of Hynson, Westcott and Dunning, of Baltimore.

While all large centers are now developing strictly professional pharmacies, their number is limited and, therefore, greater consideration will be given to the type of drug store so largely established at the present time in the United States. In these stores there seems to be a generally accepted classification into at least seven departments as follows:

(1) *Drug and Prescription Department*—This section includes in addition to prescriptions and poisons, household remedies, or other medicines which are not classified as package goods, and which must be sold through the intelligent control of a registered pharmacist.

(2) *Package Medicines*—In this department are included medicines of a proprietary character, also insecticides and veterinary remedies.

(3) *Hospital Supplies*—The items in this department consist of hot-water bottles, syringes, surgical dressings, bedpans, etc.

(4) *Fancy Goods*—This department primarily carries the perfumes, soaps, chamois, and brush goods of the old-time drug store, but today there may be added innumerable fancy novelties and other merchandise. Its scope seems to be almost unlimited in modern stores.

(5) *Candies*—The candy department may offer both bulk and package candies.

(6) *Cigars*—Proper handling of cigars, cigarettes, and tobacco, either loose or in boxes, involves facilities for their storage, under proper conditions of humidity.

(7) *Soda Fountain*—The scope of this department is a matter of personal opinion and opportunity.

In stores in transient locations the soda fountain frequently has become one of the most important departments in the store. A cash business and quick turnover make the department especially profitable. In addition, it acts as a magnet to attract people to the store, resulting in their making purchases in other departments. The emphasis given to the soda fountain in some stores has been frequently criticised. Objections are made to the sale of sandwiches and the performance of other restaurant services. These are undesirable, however, only if, as a result, the store tends to lose its distinctive character as a pharmacy.

As an illustration of efficiency in planning, the general organization of a Liggett store (see Fig. 479) may be studied with profit. It will be found that as the store is entered the soda fountain occupies one side near the front. On the opposite side is placed the cigar case with such other merchandise as men may want. Next to the cigar case is the candy department. These two departments being side by side, may be served by either one or two clerks. If two are provided, they may relieve each other during the meal hours. Next to these departments will be found, on one side, the hospital supplies and package medicines. Here again, if two clerks are provided, one may relieve the other during meal time.

Opposite these counters are the sundries, one or more clerks taking care of the sales.

The drug and prescription department is located in the rear of the store and is in charge of registered pharmacists.

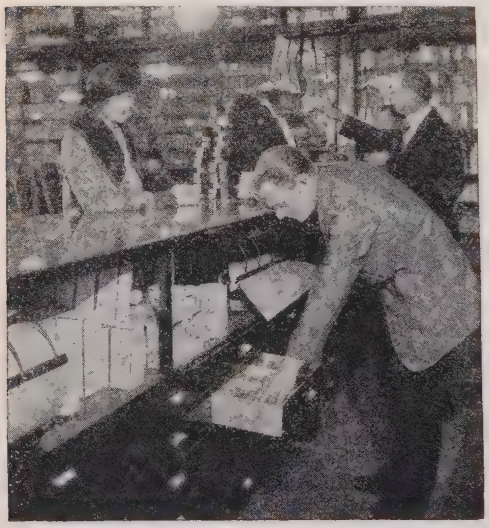
In such a layout the clerks remain within a small area and thus conserve both energy and time. It also provides a maximum of coöperative service.

The so-called one-man store can be arranged somewhat along the same lines but everything must be compact, the space available must be utilized to the

utmost and, above all, things should be so arranged as to save useless steps and thus conserve the energy of the one in charge.

The fixtures in all stores should be so constructed that they give the maximum of display, since this is an important factor in sales. The cases should also be accessible to the clerks. Several more or less standard plans are in vogue. In one arrangement the counters are placed in front of the wall cases and this is approved by many who have carefully studied various layouts. Other experts advise the use wherever possible, of wall cases only, so constructed that the bases and tops offer a large display area. It is argued that this type permits the clerks to stand in front of the case and readily reach the specific item in which the customer is interested, there being more or less difficulty when the clerk stands behind the counter and tries to find an item in the case which has been pointed out by the customer.

FIG. 441



An efficient sales and wrapping counter

The general *drug sales and wrapping counter*, illustrated in Fig. 441, shows a careful study of the principles of efficiency. The rolls of wrapping paper are accessible immediately below the counter but do not occupy valuable display space. The entire back of the case is arranged with drawers, suitably partitioned, and in which may be placed many of the small items that are frequently called for. The object again is to give quick service, save the clerks' time, and reduce the amount of physical labor required. The front of this case carries an appropriate display, special bins being provided for sponges or similar merchandise. This counter is made by the Wm. B. McLean Manufacturing Company.

The type of show case used will depend somewhat on the other fixtures. If the room is narrow, wall display cases will probably be more efficient than display cases in the center of the room or counter display cases. An effort should be made to avoid the appearance of crowding even though it is necessary to use every inch of space. It is now possible to obtain units which will give satisfactory display and at the same time avoid the appearance of crowding. Enough has been said on this subject to indicate that the planning of a layout for a store and the decision of the kind of fixtures to use require the most careful study and that proper layouts and fixtures will contribute very largely to the financial success of a business.

Display Fixtures—The furniture in a store, including wall and counter cases, stock shelves, prescription and laboratory equipment, etc., is generally referred to as fixtures. We distinguish, in this discussion, between permanent fixtures, such as wall and counter cases and movable fixtures, such as special types of show cases, tables, soda fountain, etc.

In selecting the style and quality of furniture for a store, attention should be given to the natural light, location and size of the shop. A dark location

may be brightened by the selection of light fixtures and a very bright store may be toned down by the selection of dark fixtures. Beech, birch, elm, gum, mahogany, oak, Circassian walnut, and willow are the woods generally used, with oak and mahogany finish predominating.

The lightness or darkness of the room is not however the vital factor. First, because the natural light that flows into the room is often a disadvantage rather than an advantage since it casts a shadow on the front of the goods. Light bills are the cheapest advertising the store has and the vital factor after all is to set the merchandise off to advantage. Great retailers like Wanamaker, Liggett, and Marshall Field, have studied this. There is no color that sets off the items of display better than rich tone mahogany.

The druggist is interested in selling, and therefore in showing his merchandise. His fixtures are simply a necessary piece of machinery, but in providing conveniences, the fixtures should not conflict or compete in any way with the display. The fixtures should merely be a frame that sets off or accentuates the merchandise. As a matter of fact, the actual amount of square feet area of fixtures showing, should be so small that they could not detract either from the display or from the lighting. Inasmuch as most drug store merchandise is light, the equipment to show contrast or accentuate display should be dark.

Fixtures vary in price according to the quality of material and workmanship. It pays to buy something that will last and will not lose its attractiveness. First cost is not always the main consideration. Something substantial and conservative is to be preferred to gaudy furniture that covers up poor quality of material and workmanship.

The manufacturers of fixtures will gladly submit sketches of furniture with the general layout so that the buyer may visualize just what he is purchasing. Furthermore he may incorporate some ideas of his own into the plans submitted. The experience of experts in this line is worth a great deal because they know the advantages and disadvantages of various plans and types of fixtures now in use.

Special kinds of cases and display units are required for the different lines of merchandise handled. Long experience in the manufacture of drug store fixtures leads to special knowledge along this line so it is advisable to buy fixtures from concerns that specialize in the drug store fixture business.

Individual department furniture and supplies, as cigar cases, soda fountains, candy cases, etc., will be discussed in connection with the organization and selling methods in these departments.

Lighting Facilities—The problem of lighting show windows and the store itself, with artificial light, is not a simple one if pleasing effects are desired.

A good show window and a fine display, well arranged, can be greatly lessened in value by lack of attention to proper illumination. Furthermore, glaring light from badly placed fixtures inside the store is not conducive to the comfort of a customer and will not tend to prolong his inspection or conversation regarding merchandise.

Engineers from the larger electric lamp manufacturing companies will gladly furnish lay-outs for the proper lighting of the storeroom and windows. These engineers will make such layouts without charge, and if the pharmacist will listen to their helpful suggestions, he will obtain much valuable information.

In the selection of lighting fixtures and the placing of sources of light one must remember that these should be entirely subordinated to the goods to be shown and sold. This is also true of other store fixtures. It is of no value to the pharmacist to have the greatest impression made upon the customer by the

intense illumination in his store or the beauty and elaborateness of his fixtures. The object of a lighting system should be to illuminate the store and merchandise adequately so that favorable impressions of these rather than of the fixtures, shall remain with the customer.

After nightfall, if the store is illuminated with diffused light, and all sources of light are out of the range of vision, the effect will be most pleasing and the whole interior can be taken in at a glance. The ceiling will have a "raised" appearance. Signs, price cards and departments will be readily distinguished and whatever artistic lines the general layout may possess will be accentuated.

Direct lights or bright bowls produce exactly opposite effects. The attention of the customer will be concentrated on the fixtures and as these are not for sale, in most instances, there is just that much loss of interest in the things which really are for sale.

It is much easier to plan the lighting system with the store than to make it an after-thought.

A properly planned lighting system should accomplish the following results:

1. Create favorable publicity through its pleasing impression on the customer, without making him realize that the lighting is the cause of the good impression.
2. Eliminate sharp, annoying, disagreeable shadows without destroying the necessary shaded areas which are required for proper contrasts.
3. Eliminate excessive cost of wiring and current.
4. Cut depreciation to the minimum. When the right kind of fixtures are selected, practically the only actual depreciation occurs in the lamps used.

The consensus of opinion among lighting experts seems to be in favor of indirect or concealed lights. The 200 watt color lamps or 300 watt "daylight lamps"—a light which resembles natural daylight in color quality—are suggested for good effects.

The space between the lighting units should not greatly exceed ten feet. The lamps should be properly shaded and both shades and reflectors should be of dense white glass rather than of colored or frosted glass. Shades should surround or enclose the lamps. Shades and lamps should be cleaned frequently. For uniform illumination in stores over 16 feet wide, it is well to have two rows of lights. In stores with 12 to 14 foot ceilings, lights should be mounted not less than 10 feet from the floor. Walls and ceilings should be painted a light color and have a mat finish so as to prevent reflections. The effectiveness of a lighting system is, of course, greatly influenced by the amount of light reflected from walls and ceilings.

Various devices can be purchased for securing extraordinary lighting effects in display windows. The window may be considered as a miniature stage with the passersby as the audience. Whatever lighting effects are pleasing on the stage will probably be relatively so in a show window.

In stores, catering to transient trade, where the windows are of prime importance, the window dressers often produce beautiful effects by adapting certain stage devices in their schemes of illumination. In the smaller stores this can be done in a limited way and creates much favorable comment.

Both in window and in show case lighting it is always advisable to have the source of light in front of the goods displayed. This avoids undesirable shadows. Lighting units should be placed in the upper front part of windows. Small lamps are preferable to one large unit here in order to have greater diffusion. By varying the intensity of light at either end of the window, different effects may be obtained. Footlighting is used in show windows to some extent but is

not satisfactory in all cases and always requires some overhead light to cut shadows. Except under special conditions lamps should not be placed in the middle of the show window ceiling, as this causes the front of the goods displayed in the foreground to be in shadow. Lamps so placed cannot be concealed effectively. This is another disadvantage.

It is not wise to place a lamp directly outside of the window. The glare is very bad and while it illuminates the sidewalk, the window will fail to "stand out" and the goods in the window will not be lighted effectively. Such a light may attract attention but, on the whole, the impression of the window will be unfavorable. Colored lighting effects do not work out successfully on dark backgrounds.

Lights and reflectors at the top and front of show windows are now most often concealed either by painted signs or by short curtains known as valances.

Good valances are very ornamental and lend to the store an artistic appearance which cannot be supplied in any other way. The initials or trademark or full name of the proprietor are frequently worked into window draperies giving an air of exclusiveness and individuality to the store front. It is customary to allow 2¼ to 2½ inches for every foot of window height, measuring from sidewalk to transom bar or point at which valance will hang. Thus a window measuring 10 feet high from sidewalk to transom bar will require a valance finished to a depth of 22 to 25 inches overall.

Every storekeeper has experienced difficulty from reflections in the plate glass of his window. These may be of the sky, opposite buildings or passing objects. Under certain conditions they are so severe as to prevent the merchandise being visible. There has been no entirely satisfactory method developed as yet to overcome these reflections. Provision of suitable awnings for some situations partially solves the matter. A patented design of curved plate glass will entirely eliminate the trouble; however, this is quite costly, detracts from the general appearance of the window, particularly at night, and uses valuable space. Artificial illumination of the show window during the daytime is often attempted as a solution. Its effectiveness depends on local conditions and it has serious limitations, chief among which is the expense of the great amount of electric current used.

In show case lighting it is advisable to avoid, as far as possible, casting reflections of the tops of glass show cases. This cannot be avoided entirely but, by careful planning, can be kept to a minimum. In the cases themselves the lights should be concealed in the corners and the light thrown directly on the product, away from the eyes of the prospective purchaser so that the lights will not drive the eyes away from the case, but will lead the vision easily into it, and allow it to rest with comfort upon the product. By careful observance of these principles, by keeping the lights in the cases scrupulously clean, and replacing the units which have burned out, a store may add materially to its public appeal.

Floors and Floor Coverings—The floors in old stores are not infrequently unsightly. When new fixtures are installed the contrast makes them appear even more so. The ordinary method of repairing a floor in an old building is to lay a new hardwood maple floor of good kiln dried stock, so that it will not open up in cracks. In new buildings the floors are generally of good quality and need no special attention.

Various methods and preparations for preserving wood floors are in use. The preservative preparations, applied to the floors are usually liquids which fill the pores, cement the wood fibers and make it impervious to water, thus

preventing decay and splintering. Such treatment of wood floors also makes them more sanitary.

Various plastic coverings for wood floors are on the market. Most of these are comparatively new and it is wise to inspect a store where the covering has been in use for some time to note the effect and also inquire as to the satisfaction given, before deciding on any special one.

Linoleum and similar compositions of various qualities and kinds have long been used as floor coverings and have given general satisfaction. The use of carpets and rugs is now rare. Mosaic tile and stone floors are in use to some extent with corrugated rubber or carpet runners to relieve the extreme hardness and cold appearance.

Show Cases—The first show cases that had any extended use were small counter display cases a few inches high and frequently built with German silver corner moldings. These were placed on top of wooden counters or cast iron legs in the old-fashioned stores. One still finds occasional small cases of this type for the display of odd articles but more modern types are now in general use.

For display purposes, plate glass is far superior to other forms of glass. It should not be confused with window glass, a much less expensive product.

The difference between the two materials is clearly set out by the Bureau of Standards in the United States Government Master Specifications for Flat Glass for Glazing Purposes:

"*Plate Glass*—Transparent, flat, relatively thin glass having plane polished surfaces and showing no distortion of vision when viewing objects through it at any angle. Plate glass is made at present by rolling large sheets periodically or by rolling a continuous sheet. The sheets are then ground and polished.

"*Clear Window Glass*—Transparent, relatively thin, flat glass, having glossy, fire finished, apparently plane and smooth surfaces, but having a characteristic waviness of surface which is visible when viewed at an acute angle or by reflected light. Clear window glass is made at present by hand blowing, or by machine blowing and drawing into cylinders and flattening or by drawing directly into a sheet, the surface finish being that obtained during the drawing process."

An additional element of importance in getting the specified material, beside the difference in price of market value, is the fact that at least some of the companies who insure plate glass store fronts have declined to issue policies covering windows glazed with other materials than genuine plate glass.

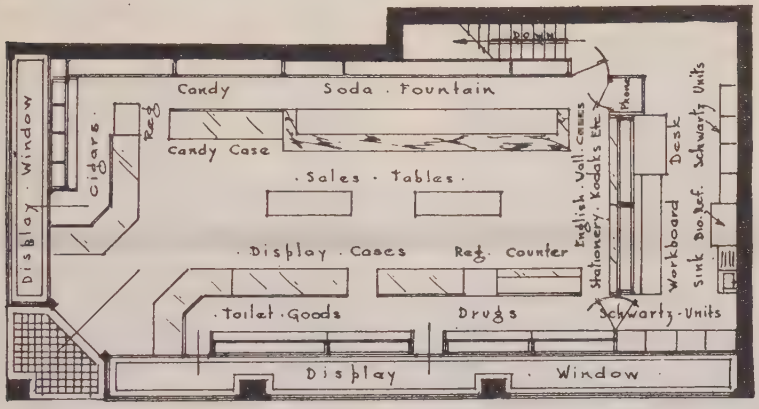
Full height cases made entirely of plate glass and bolted or cemented together with bases of wood or marble are the prevailing style at present. A point to keep in mind, however, is that the insurance companies in insuring the all plate glass type of show case—that is the type of case in which the plate glass corners are bolted or cemented together—base their insurance on the fact that 90 out of 100 such show cases have a breakage of some sort on it within a year.

Some manufacturers do not make the all plate glass type of case for that very reason, but make a type of case that appears to be all plate glass from the front but has enough of a wood frame end so that breakage has been reduced to a minimum. Furthermore, there is no display lost by having this light wood frame, as it merely provides a division between displays that accentuate the display. And again, in a line of show cases, the ends can be butted together tightly, thus making a more orderly, a more sanitary arrangement than the all plate type of case, where there is a space of 1½ to 2 inches between the actual glass ends of the case. An improvement on the wood or marble base, which

allows no foot room for customers standing close to the case, is the receding type of base and the leg base. The latter is the most sanitary as it permits sweeping and cleaning the floor under the case. Lighting of show cases has been dicussed in a previous section.

Various movable display units are now available, both of wood and metal

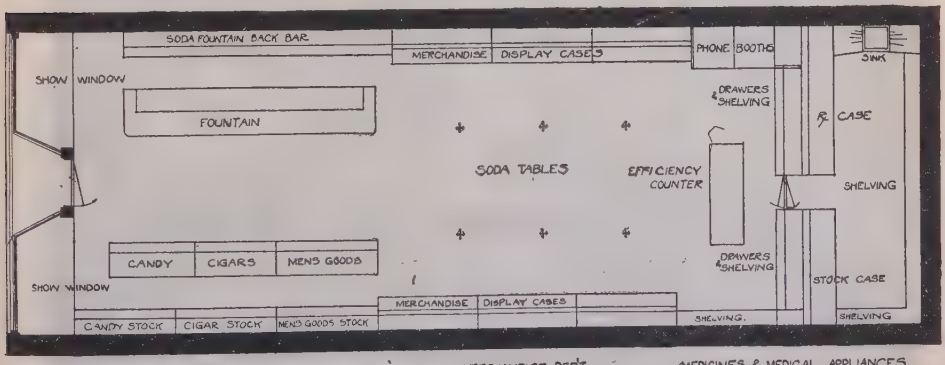
FIG. 442



A drug store layout by the Wilmarth Showcase Company

construction. These have an advantage in that they may be placed wherever there is room, either to supplement the display of a particular department or for making available something special or new. The disadvantage is that they are

FIG. 443



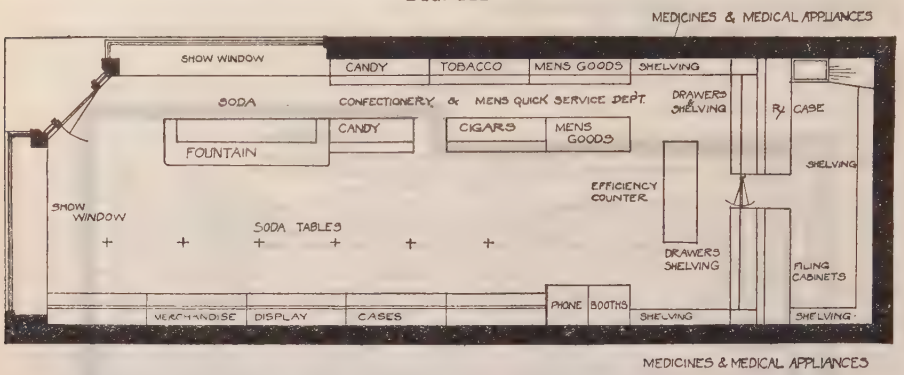
A center door layout by the W. B. McLean Manufacturing Company

not covered and merchandise may become dusty and shopworn or may be stolen readily.

Fig. 442 represents a store layout as planned by the Wilmarth Showcase Company, Grand Rapids, Mich. Note the space for display windows at the front and along one entire side of the store. Cigar and candy departments are close together and the soda fountain immediately adjoins the candy department, differing from the usual layout which places the soda fountain close to the entrance of the store. In this plan the toilet goods department shares

with the cigar counter, the advantage of attracting first attention upon entering the store. Other features follow more or less conventional lines.

FIG. 444



A corner door layout by the W. B. McLean Manufacturing Company

Fig. 443—A layout supplied by W. B. McLean Manufacturing Company, Pittsburgh, Pa., pictures a store with a center door and window display space on either side. Here the fountain occupies one side of the entrance while candy,

FIG. 445

A typical Liggett drug store

cigars and commodities for men, in the order named, are opposite the fountain. Merchandise display cases occupy both sides of the store in the central portion and the drug department is in the rear.

Fig. 444—Another layout supplied by the Wm. B. McLean Manufacturing

Company which represents a corner entrance with show windows at the front and part of the way on one side. There are no counters along one side at all,

Fig. 446

The front of the Hynson, Wescott and Dunning Pharmacy

display cases taking their place and making room for soda tables in the center. The opposite side provides for installation of the soda fountain, cases for candy, cigars, and merchandise for men, in the order named, with drugs at the rear.

Fig. 445—A typical store of the Liggett chain. Note the soda fountain arranged partly with seats and partly for standing room along a greater part of one side of the store, while on the opposite side, cigars, candy and toilet articles, are arranged in the order named, and the drug department is in the rear. In the center, are special display cases and tables providing striking dis-

Fig. 447

The Powers and Reynolds Pharmacy

plays, some of which must be passed no matter what department of the store a customer is patronizing.

Figs. 440 and 446 show the front of the pharmacy of Hynson, Wescott and Dunning, Baltimore, Md. Note the professional atmosphere and the dignified displays of pharmaceutical and toilet supplies. The absence of ordinary merchandising displays with the comfortable chairs and the writing table carry one back to the period when pharmacies were places where people came to have prescriptions compounded very much as they visited the physician for the diagnosis of their ills.

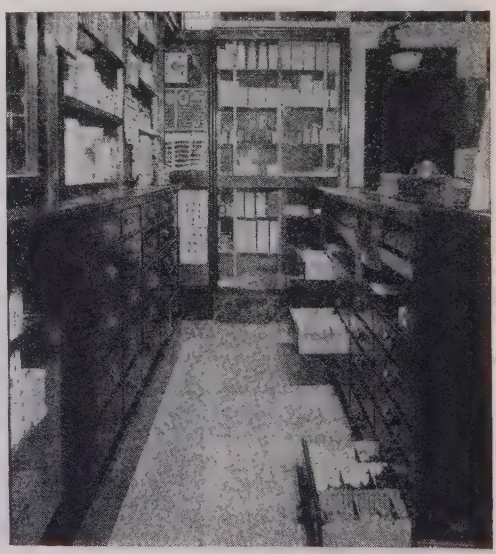
Fig. 448

The pharmacy of Rees C. Roberts

Fig. 447 illustrates a well arranged store. Note that soda fountain customers are within sight of practically all departments. The display wall cases near the tables doubtless act as salesmen very often. This is the Powers and Reynolds store of Philadelphia and was fitted by the Wm. B. McLean Manufacturing Company.

Figs. 448 to 452 illustrate the store of Rees C. Roberts in the Chalfonte Hotel Building, Atlantic City, N. J. Fig. 449 shows a very efficient arrangement behind the counter which enables the clerk to work rapidly and without much lost motion. Note the compact wrapping counter in which space immediately under the top is used for storing rolls of wrapping paper and the string at the end of the counter. Drawers with their various compartments containing merchandise in frequent demand, help the general efficiency plan.

Fig. 449



Combination of drug and wrapping counter

Fig. 450 is an illustration of how the proximity of one department to another frequently adds to the day's receipts. The cigar customer is here shown in the act of becoming a candy customer as well. Incidentally, the display case is one of the newer type, making merchandise visible at one glance.

FIG. 450

Combined cigar and candy departments in the pharmacy of Rees C. Roberts

FIG. 451

Sundries and fancy goods in the pharmacy of Rees C. Roberts.

FIG. 452

Soda booths and drug department in the pharmacy of Rees C. Roberts

FIG. 453

The pharmacy of the Adamson Drug Company

FIG. 454

The prescription department of Hynson, Westcott and Dunning Pharmacy

FIG. 455

The use of the Schwartz Sectional System in the prescription department of Fred Howard

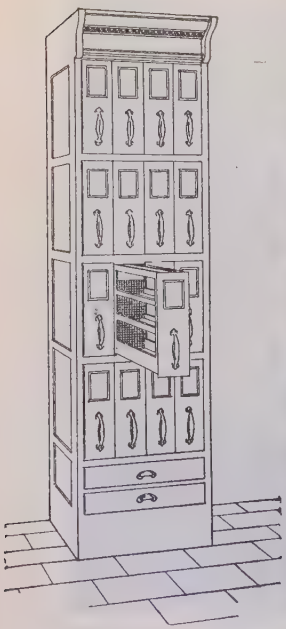
Fig. 451 shows a corner of the merchandising department in which the wall case and display case are combined for very efficient and effective service.

Fig. 456

The Schwartz System in the prescription department

Fig. 452 presents a view of soda booths and tables so arranged as to keep various items of merchandise continuously before those who are sitting at the tables. Note the styles of tables and chairs along the sides and the booth arrangement in the center. This store was planned and furnished by the Wm. B. McLean Manufacturing Company.

Fig. 457



Sectional case for small packages

Fig. 458

Typical prescription case

Fig. 453 represents part of the Adamson Drug Company's Pharmacy in Los Angeles, California, and indicates another combination of wall and show case which is very effective in a large store. This store was planned and furnished by the Wilmarth Fixture Company.

Fig. 454 is a view of the prescription department in the Hynson, Wescott and Dunning Pharmacy, Baltimore, Md.

A good method of conserving space in the prescription room is illustrated by the pharmacy of Fred Howard, Lowell, Mass., which is shown in Fig. 455. All containers are under cover in the Schwartz sectional cases. This makes for orderliness and cleanliness. Fig. 456 illustrates a similar arrangement. A similar type of case is illustrated in Fig. 457.

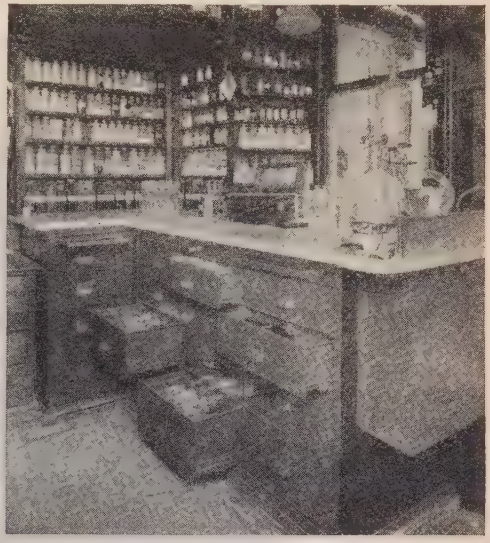
A typical prescription case and work counter for a store of moderate size is shown in Fig. 458.

Figs. 459, 460, and 461 are from the prescription department of the pharmacy of Frank E. Morgan and Sons, in Philadelphia. They show the application of steel furniture in prescription departments. The available space has been very ingeniously used through careful planning. The layout was planned by the Wilkinson Equipment Company of Philadelphia, and the fixtures were manufactured by the Watson Steel Furniture Company, Jamestown, N. Y.

Fig. 459 shows the sliding shelves equipped with plate glass tops which are used for mixing ointments and similiar operations, and the bottle drawers which are all equipped with roller bearing suspensions and subdivided with adjustable partitions for different size bottles.

Fig. 460 shows the method of storing prescription books. The shelves here are equipped with rollers and are adjustable for any size of book. This particular piece of equipment solves the problem of handling prescriptions in book form satisfactorily.

Fig. 459



Steel furniture in the prescription department of Frank E. Morgan and Sons

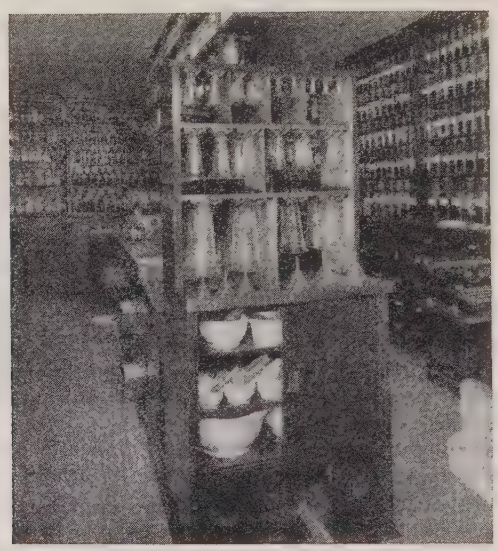
Fig. 460

Prescription book case and steel furniture used by Frank E. Morgan and Sons

Fig. 461 shows a graduate rack which is constructed of bronze. The graduates are held in position in such form that they may drain and the shelves are sloped to permit the water to run off into the sink. Throughout this construction the steel is finished in baked enamel while the tops of cases are of marble.

Every prescription department should give careful consideration to the facilities for cleaning apparatus since this often reflects the true ideals of the

FIG. 461



Bronze graduate rack, mortar closet and sink in the pharmacy of Frank E. Morgan and Sons

store. A well-arranged sink and drain board, with modern sanitary plumbing, and an adequate stock of these elementary but essential parts of the equipment, namely, the graduates and mortars, will do much to impress the visiting physician with the standards of the prescription department.

A draining rack over the sink, made by fastening round wooden sticks at an angle, in regular rows in a board against the wall, is very convenient for drying graduates, bottles, flasks, test tubes, etc. Such an equipment is inexpensive and generally satisfactory.

CHAPTER LXXXII

THE SERVICE AND COMMODITIES OFFERED FOR SALE

EVERY pharmacy has two things to offer the public. (a) Professional service, and (b) commodities. The variety of the offerings under each of these classifications are greater in pharmacy than in any other business or profession. Under the heading of professional service may be classified such individual items as prescription filling, the giving of information covering a wide field but specializing on health matters, emergency service such as every pharmacy is called upon to supply more or less frequently, and special service which takes the form of personal courtesies, such as supplying postage stamps, extending credit for goods purchased, and similar matters.

The supplying of pharmaceutical commodities, which originally centered around drugs and toilet preparations, has in recent years expanded to include many items that have not even a remote connection with pharmacy in the professional sense of that term. These commodities include, in addition to simple drugs and chemicals, various proprietary products, hospital supplies, candy, stationery, cigars and tobacco, rubber goods, bristle goods, toilet articles and perfumes, soda and allied items branching out in some cases into articles of food customarily obtained only in restaurants or food stores. More recently there has been added to the list a variety of novelty goods varying in their character according to the location of the establishment and the needs and desires of the immediate neighborhood.

As has been repeatedly brought out in these pages, ultimate success is greatest in those pharmacies which do not entirely submerge their professional background. As long as prescription and health service are continued as the main factors and the public is made to feel that these are of primary consideration, there is justification for holding out the pharmacy as a superior retail establishment even for certain kinds of general merchandise. Once this professional background is entirely removed or so subordinated as to be unrecognizable there is nothing about the store which makes it superior to the ordinary merchandising emporium. There is no particular objection in the more commercialized type of drug store, to the placing of the drug and prescription departments to the rear, provided these are arranged as a separate section and are always in charge of competent people. To maintain this atmosphere there, however, must always be that impression made upon the public that the main service of the store is the proper compounding of prescriptions and the insuring of an adequate supply of pharmaceutical products of high standard and reliability. When the public sense this professional atmosphere in a pharmacy they will automatically have a feeling of confidence in the conduct of other parts of the store. It cannot be expected, however, that this peculiar confidence will exist where there is a complete submersion of the pharmaceutical department, even though all other departments are run with the highest efficiency.

What Constitutes a Retail Drug Business?—Analysis of the sales of many hundreds of drug stores the country over, by competent observers, has established approximate percentage figures to indicate the make-up of the average retail drug business of today. These percentage figures are as follows:

Prescriptions, about 10 per cent
Proprietary medicines, about 22 per cent
Toilet Articles, about 10 per cent
Rubber goods, about 3 per cent
Confectionery, about 5 per cent
Cigars and tobacco, about 8 per cent
Soda, about 14 per cent
Miscellaneous items, including sundries and unspecified merchandise, about 28 per cent

These figures will probably not fit any single store and there are many cases where the prescription business constitutes more than 10 per cent of the total. However, these figures are based on the facts as gathered from a variety of stores.

It would be impossible to give detailed information on the many items that make up the stock of any modern individual pharmacy, so they will be considered in the main groups tabulated above and their subdivisions. The principles of buying, storing, pricing, and handling the stock of a pharmacy are, in the main, identical for all groups but where there are special considerations these will be brought out under the individual groupings.

Buying Merchandise

The Buyer—Successful merchandising depends to a very large extent on judicious buying. No matter how well the sales work is organized, profits are not what they should be unless goods are bought at the right price. Experience is a great asset in this phase of business as in all others. There are always some individuals who have a natural bent for making shrewd deals and the knack of taking advantage of opportunities. A study of market conditions and a knowledge of past performances in the various markets, with an application of the law of averages, must be a part of the mental process of a successful buyer. In large establishments the buyer is usually spoken of as the "purchasing agent" and he maintains a department, with assistants, whose business it is to follow the markets and to tabulate information as to requirements and sources of supply, so that every advantage as to price, quality, and delivery may be assured the purchaser.

In a retail pharmacy the buyer is usually the proprietor or manager although the purchasing of stock may be delegated to a subordinate who has shown particular ability along that line. One advantage in making an assistant the buyer is that the time of the proprietor or manager is conserved and if there are special deals, subject to high pressure salesmanship, and involving more or less risk, the buyer can obtain all of the information and then submit it to the head of the organization for a final decision. Whoever is charged with the duty of purchasing supplies should, of course, maintain constant contact with the various departments for which supplies are bought, as the people who do the selling know what is in demand and are likely to be in a position to give good judgment on the possibilities of selling something new or have the information concerning the quantities of standard merchandise required within a given time.

A knowledge of the buying capacity and of the demands of the community are essential to intelligent buying. Often the most expensive grades of merchandise may not be salable or the reverse may be true. The more all around information the buyer possesses the more intelligent will be his decisions as to what is and what is not a good purchase. It is not well for the buyer to attempt to carry in his mind all the information on which he depends for his judgment. With more than 3000 items to consider this is practically impossible. Records of purchases, with quantity and price, should be kept even in the smallest stores. A simple method is to keep an alphabetical card index of every commodity bought. If the card is made out at the time the goods are bought it does not involve much trouble. The information to be recorded consists of the name of the item, the date of purchase, the quantity bought, the price, and the source. A specimen card is printed herewith (see Fig. 462). The first entry indicates that 25 pounds of citric acid were purchased at 60 cents per pound

from R. W. P. Company on February 25, 1925, and so on down the line. Let us assume, for sake of example, that a chemical salesman came to this buyer with a special price on citric acid in 50 pound lots about the end of June, 1926. Naturally he would be forced to decide whether it would pay to tie up the money required for this purchase. Without a record of previous purchases he would depend almost entirely upon a guess, but with a record such as the above his decision can be based on facts and will therefore be less apt to result in an ultimate loss rather than a profit, if the deal is entered into. The card record shows that the first 25 pounds of citric acid lasted about three months. The next 25 pounds lasted about two months. Then 50 pounds were bought and that lasted five months. The next 25 pounds lasted a little more than two months. This indicates a total consumption of 150 pounds in about thirteen months or about 12 pounds per month. Fifty pounds should therefore last about four months. But it should also be noticed that more was sold in June and July than

FIG. 462

CITRIC ACID

Date	Amount	Price	Source
2–25–25	25 lb.	60¢ per lb.	R. W. P. Co.
6–2–25	25 lb.	65¢ per lb.	R. W. P. Co.
8–2–25	50 lb.	55¢ per lb.	R. W. P. Co.
1–5–26	25 lb.	60¢ per lb.	R. W. P. Co.
3–12–26	25 lb.	62¢ per lb.	R. W. P. Co.
6–30–26	50 lb.	52¢ per lb.	R. W. P. Co.

Record of purchases

in the fall and winter months. Therefore a special price on 50 pounds in June would be a more attractive proposition in this store than at another season, yet it is a question whether it would be wise to tie up the capital necessary to buy that quantity. The saving over the regular price will determine this. Having the purchasing record on hand when the salesman calls enables the buyer to decide intelligently whether the deal would be to his best interests and will prevent him from becoming merely the victim of a good sales talk. Such a card index takes up little room and becomes increasingly valuable as a buying guide. It also supplies information to those who do the buying in the absence of the regular buyers. The buyer should have access to recent price lists and to publications giving market prices and changes in these prices periodically. A monthly list is not of great value for articles that are subject to much fluctuation. Weekly trade journals and daily publications such as the *Journal of Commerce* and the *New York Commercial* should be subscribed to in order to keep an accurate watch on the trend of the market.

Methods of Buying—In the larger centers where there are wholesale houses it is now customary for such concerns to telephone periodically to their customers for orders. In the cities, daily calls are made. In outlying territories,

the calls may only come two or three times a week. These telephone calls are intended to take care of the routine orders. Special deals and orders that require conferences with sales representatives are taken care of by the traveling salesmen of wholesale houses. In many cases orders are mailed to the wholesale house at regular periods, so calculated, as to make sure of the receipt of the goods at a given time.

It is a sign of inefficiency for the pharmacist to be out of any item that is regularly called for in the average drug store and it is one of the most difficult problems of store management to prevent this happening. It is an established rule in most stores that when any clerk observes the stock of an item he is selling to be low that he shall immediately write the name of this item in the "want book". Very often the "want book" is in the rear of the store and the clerk has several customers to serve so he postpones writing the item into the "want book" and later forgets it entirely. The best method of overcoming this is to have several "want books" at convenient places and insist that the item be entered at the time the sale is made no matter how busy the clerk may be. It may happen that the same item will be entered in two or three "want books", if there are that many about the store, but it is much better for the buyer to assemble the books and check up duplications than to be out of stock when an item is called for. "Want books" are supplied by various wholesalers and manufacturers or a standard form of book may be devised for the individual store. An ordinary blank book will answer the purpose.

If it is customary to give orders over the telephone, the buyer should have his order ready at the time the telephone call is usually made and not have to depend on snap judgment when the call comes. It is important that the ordering shall be done by one person and that items ordered be checked by a distinguishing mark in the "want book", to avoid duplicating orders.

While it represents some extra work, the only satisfactory method of keeping track of goods ordered is to make out the order in duplicate on a regular form provided for that purpose. Various wholesale houses and manufacturing concerns furnish order books with carbon paper so that the druggist can retain a copy of the order sent in. However, it pays to have order forms printed for the store to suit the methods of the management. A carbon copy duplicate of all orders should be retained in the file of the store so that when goods are received there is something at hand against which the invoice may be checked. It is unsatisfactory to depend on the "want book" for this purpose although some pharmacists simply write the quantity ordered opposite the name of the item in the "want book" and cross it off when it is received. This makes it difficult to read the item in case it is necessary to check it back at a later date. For all around satisfaction in ordering merchandise there is nothing better than the individual order form made out in duplicate. The original is sent to the wholesale or manufacturing house, the duplicate is retained. If at any time it is desirable to determine whether or not certain goods were ordered, reference to the duplicate order will give the information. When the goods are received the invoice may be checked against the original order and all shorts are immediately revealed. When the bill for the goods comes in this can also be checked against the original order for quantities and for "shorts". In other words, instead of depending upon memory or the unsatisfactory record sometimes made in the "want book," but more often omitted, the buyer always has on hand a definite source of information upon which he can depend. It frequently happens that a wholesale house sends more or less of an item than has been ordered. This, of course, is revealed in the checking and should be immediately reported, unless the wholesaler's invoice indicates on their part a

knowledge of the change. It is of importance to report "overs" as well as "shorts", should these occur. In larger establishments, there are, of course, order departments and receiving departments, but in the ordinary store, this is taken care of by the regular force and does not take a great deal of time. It is also well, even in a small store, to have some single individual responsible for the checking of goods received, to approve all bills, and to order all items needed.

Whenever it is possible the buyer should take advantage of the opportunity to purchase materials directly from displayed stocks. This applies particularly to the buying of merchandise other than standard pharmaceuticals and chemicals. Regular visits to the centers of supply, whether made in the same city or in neighboring communities, are very helpful. They not only give the buyer an opportunity to see what is new but supply contacts with manufacturing and wholesale concerns which result in a fresh viewpoint, greater information about various items, and all the advantages that accrue from personal contact with individuals in the concerns doing business with the retailer. The cost of occasional trips to the buying centers is amply repaid by the advantages just referred to.

It is a good plan when making out orders to prepare a third carbon copy of the items ordered but to omit the quantities and then insist that the person unpacking the goods insert the quantity received. This list is then compared with the copy of the original order and shortages or over-shipments are noticed immediately. It will also cause greater care in the checking of the goods by the receiver.

When goods have been bought and received, a careful checking of the bills is necessary and each item should be priced in accordance with the cost and prevailing selling prices. It is routine practice in many organizations to have a receiving room of suitable size with a table upon which everything is placed as it is unpacked and upon which the articles are left until checked off and priced. The goods should then be stored properly. For this purpose there is usually provided a place where the excess stock may be carried, only a few packages being placed on sale. A feature of the Liggett store organization is the arrangement of the stock room into departments corresponding to the departments in the front of the store. The goods for each department are kept on shelves behind a locked door, the sections being divided off by heavy, rat-proof, wire screen, nailed on a frame. The stock is arranged on the shelf in the storeroom in the same order as in the store, so that it can be found readily.

An idea proposed and used by the late H. P. Hynson, in his stockroom was the utilization of wooden boxes of uniform length and depth, 5 feet by 3 feet, but of different widths. These boxes were laid upon their side to form a stack. If a low shelf was needed the narrow box was used. If the items required more height, a wider box was put in place. In this way an adjustable set of shelves was provided and also shelves which could be readily moved or rearranged. It is very convenient to have, posted on the outside, a list of the items contained in each bin or section, and an alphabetical list with a mark opposite each item to show just where it may be found on the stock shelves.

It is of prime importance that the stockroom should be dry, rat-proof, of average warmth, and well lighted, and it should also be kept free from dust; otherwise serious losses will occur through deterioration.

In some modern drug stores, the stockroom is eliminated entirely. As soon as merchandise has been checked it is placed in the store. This method has several important advantages. The fact that all the stock is in full view of the customers impresses them with the extent and variety of merchandise carried

by the store. It creates confidence and promotes "shopping". The store is less apt to be out of wanted items. Salespeople know they cannot depend upon a reserve supply in the basement, which may or may not be there. Time of customers and salespeople is saved because no time is lost looking for reserve stock.

Stock in the basement is also subject to serious losses through theft. The ashman, drayman, and many other strangers have ready access to stock there.

In marking goods, both the selling price and the cost should appear. The latter figure is written in code and is very convenient in taking inventory or referring to the cost in case of special allowances. Usually a word of ten letters or two words totalling ten letters are used to represent the figures from 0 to 9 as

1 2 3 4 5 6 7 8 9 0

PHARMOCIST and combinations of these letters are then employed to designate various cost figures. PT would represent 10; MT = 50; HM = 25 and so on. Crossed lines are also used to work out codes. By arranging 4 lines as in

FIG. 463

1	2	3
4	5	6
7	8	9

Pricing code

Fig. 463, and numbering as indicated, a code can be worked out using the diagrams made by the intersections to represent the figures 1 to 9 and 0 for zero. Thus ⌊ ⌋ would be 25; ⌊ ⌜ = 19; ⌜ ⌝ = 80; ⌊ ⌞ = 43. By starting the numbering in different corners or at other points various changes in the same code may be produced, as indicated in Fig. 464 below:

FIG. 464

3	2	1
6	5	4
9	8	7

1	4	7
2	5	8
3	6	9

6	1	7
5	2	8
4	3	9

Pricing codes

Pricing

One of the most important considerations in connection with successful merchandising of either service or commodities is the establishment of prices, reasonable enough to meet competition, but which will at the same time furnish an adequate profit. Nothing is more fallacious than the idea that everything charged above the cost of an item is profit. It is *gross margin* to be sure, but it is very far from being *net profit*. Inability to establish the cost of conducting a business, or its "overhead" accurately, and failure to include this figure in the "mark-up", has been the ruination of many a promising business.

The most recent figures on retail drug store operations and profits indicate that a common margin of gross profit is close to 34 per cent. This means that out of every dollar taken in over the counter 66 cents represents actual cost of the goods sold. The 34 cents left must pay for labor, rent, heat, light, and other expenses. In a well conducted business approximately 11 cents

of the 34 would go for clerk hire; 5 cents for rent and from 6 to 9 cents for light, heat, advertising, insurance, taxes, telephone and the many other incidental expenses that come up. This leaves from 9 to 12 cents actual profit which is spoken of as "net profit". Thus it can readily be seen that if the price on a $1.00 article is cut from 9 to 12 cents there is no net profit and if it is cut more than 12 cents there is an actual loss which must be made up in some other way if this actual loss is to be avoided. Of course it is true that there are some departments of the business which may yield a greater gross margin than 34 per cent but as conditions become more competitive these higher margins are gradually reduced and cannot always be depended upon to make good the losses elsewhere. Furthermore there are departments where the normal margin is far below 34 per cent. The point to be stressed at this juncture is that pricing of goods must be on the basis of their actual cost, plus the cost of doing business. Methods of arriving at the latter figure for any particular store will be found in the chapter on accounting but some of the factors involved will be discussed here.

It costs money to carry slow-moving merchandise in stock as can be demonstrated by checking up the profits on rapidly-moving items, comparing them with those on slow sellers. The "carrying charges" on the latter class of items increase the overhead expense of a store materially.

This is graphically illustrated in the following table published by the W. B. McLean Manufacturing Company:

Month	First cost	Selling cost	Carrying cost	Total cost	Sales price	Percentage of profit	Per cent of loss
First	$10.00	$2.36	$ .44	$12.80	$15.00	14⅔	
Second	10.00	2.36	.88	13.24	15.00	11⅔	
Third	10.00	2.36	1.32	13.68	15.00	9	
Fourth	10.00	2.36	1.76	14.12	15.00	5⅞	
Fifth	10.00	2.36	2.20	14.56	15.00	3	
Sixth	10.00	2.36	2.64	15.00	15.00	0	
Seventh	10.00	2.36	3.08	15.44	15.00		3
Eighth	10.00	2.36	3.52	15.88	15.00		5⅞
Ninth	10.00	2.36	3.96	16.32	15.00		9
Tenth	10.00	2.36	4.40	16.76	15.00		11⅔
Eleventh	10.00	2.36	4.84	17.20	15.00		14⅔
Twelfth	10.00	2.36	5.28	17.64	15.00		17⅔

The theory upon which this table is constructed is this. Suppose it is estimated that the expense of keeping $15.00 worth of merchandise in the store for one month is $.44. (This figure will vary for different stores, but it is believed to be an average.) That is to say, the value of the space occupied by the merchandise represented by rent, also the insurance, depreciation, heat and light used by or for this merchandise is $.44 a month, and allowance for it is made in the selling price. This $.44 is entirely distinct from the $2.36 selling cost. This $2.36 covers clerk hire, expenses of wrapping, delivery, advertising, etc., which occur only when the merchandise is sold. *The $.44 is incurred monthly regardless of whether or not the merchandise is sold.* Thus, if the merchandise is not sold for two months there is a carrying charge of $.88. Because only $.44 has been allowed for, the additional $.44 must come out of the expected net profit, which accordingly is reduced from 14⅔ per cent to 11⅔ per cent. Three months' carrying charges are three times $.44 or $1.32, thus reducing expected profits from 14⅔ per cent to 9 per cent. As the table shows, the merchandise, if it is kept long enough, is sold at an actual loss.

Turnover or Stock-turn

"Turnover" refers to the number of times a year a merchant turns his capital. If his inventory is $10,000 and the total purchases of goods amounted to $50,000 for the year he has turned his stock 5 times.

The Harvard Bureau of Business Research, several years ago, investigated 187 retail drug stores. The stock turnover in these stores averaged only 2.3. On the other hand, to show that more turnovers are entirely practicable under skilful management, the Liggett stores in 1924 report the following turnovers in the several departments. The figures are the ratio between the cost of goods and the sale price.

Drug department	8 turnovers
Package medicines	11 turnovers
Fancy Goods—(perfumes, etc.)	10 turnovers
Hospital supplies	8 turnovers
Cigars	13 turnovers
Candy	14 turnovers
Soda	50 turnovers

Immediately one is impressed by the importance of this phase of management and it must be recognized that the greater the number of "turnovers" the higher the proportional per cent of profit.

Expenses must include salary and rent. Some business men delude themselves into thinking that they evade certain overhead charges because they own the store building and do not allow for any salary for themselves in their accounting. To be sure they do not actually lose any more cash by such accounting methods than if they did take these items into consideration and ignored their resulting low net profits but it should be plain that if they owned a building which they did not personally occupy they would expect a rental and if they worked for somebody else they would expect to draw a salary. Modern business methods demand inclusion of rental and proprietor's salary in the overhead expense. It is also worthy of note that failure to include a rental charge and salary of the proprietor in the cost of doing business naturally increases the income tax on the business. If the proprietor should become incapacitated and be compelled to employ a substitute the salary of the substitute would immediately add a heavy load to the overhead unless this item had been carried previously. The question of how much salary a proprietor should draw may best be answered by determining what his services would be worth in another establishment or what it would cost to replace him. The proprietor's salary should not be excessive as he can depend on the net profit of the business for extra income, but it should be adequate for his current needs.

Cash Discounts

The business man should strive to secure for himself, as soon as possible, a position in which he will be able to discount his bills. The 1 per cent and 2 per cent and sometimes more, allowed for cash in ten days, amounts to a great deal in a twelve month period. It sometimes represents the difference between just "making ends meet" and a comfortable margin of profit. Cash discounts and trade discounts on quantity purchases are two different things as will be seen a little later in this discussion. The former are desirable, the latter may or may not prove advantageous.

The following table indicates the value of cash discounts:

½	per cent in 10 days, net	30	days is equal to	9 per cent a year
1	per cent in 10 days, net	30	days is equal to	18 per cent a year
1½	per cent in 10 days, net	30	days is equal to	27 per cent a year
2	per cent in 10 days, net	30	days is equal to	36 per cent a year
2	per cent in 10 days, net	60	days is equal to	14 per cent a year
2	per cent in 30 days, net	60	days is equal to	24 per cent a year
2	per cent in 30 days, net	120	days is equal to	8 per cent a year
3	per cent in 10 days, net	120	days is equal to	10 per cent a year
3	per cent in 10 days, net	60	days is equal to	21 per cent a year
3	per cent in 30 days, net	60	days is equal to	36 per cent a year

Relation of First Costs, Overheads and Profits to Sales

In discussing the general principles of business in an earlier chapter, the subject of sales being made the basis for business analysis, was briefly discussed. It seems difficult to make it clear to some who are in business that the modern basis for calculating profits, expenses, etc., is upon the amount of sales, considering the latter as one hundred per cent.

This, of course, is contrary to the method of calculating profit taught in common schools and explains the frequent discussions on this point and the difficulty of making it understood. By the older method a hairbrush bought at 60 cents and sold for 90 cents would have been considered as yielding the proprietor 50 per cent profit (using the cost as 100 per cent); but by the accepted method of estimating profit and in which the sale price of 90 cents is taken as 100 per cent, it becomes evident that the gross profit of 30 cents is only 33⅓ per cent, instead of 50 per cent. Of course, no more money is made in either case but it is very important at the outset to understand the basis of the "profit and loss" statement.

The reason for the universal adoption of this policy is found in the fact that the amount of sales is readily available and may be used daily as the basis of comparison with the business of other days. It would not be easy, in fact practically impossible without an enormous amount of labor, involving an inventory, to know the cost of the goods sold on any one day.

The following table shows the per cent of profit on cost and on selling price:

5	per cent added to cost is	4¾	per cent profit on the selling price
7½	per cent added to cost is	7	per cent profit on the selling price
10	per cent added to cost is	9	per cent profit on the selling price
12½	per cent added to cost is	11⅛	per cent profit on the selling price
15	per cent added to cost is	13	per cent profit on the selling price
16⅔	per cent added to cost is	15¼	per cent profit on the selling price
17½	per cent added to cost is	15	per cent profit on the selling price
20	per cent added to cost is	16⅔	per cent profit on the selling price
25	per cent added to cost is	20	per cent profit on the selling price
30	per cent added to cost is	23	per cent profit on the selling price
33⅓	per cent added to cost is	25	per cent profit on the selling price
35	per cent added to cost is	26	per cent profit on the selling price
37½	per cent added to cost is	27¼	per cent profit on the selling price
40	per cent added to cost is	28½	per cent profit on the selling price
45	per cent added to cost is	31	per cent profit on the selling price
50	per cent added to cost is	33⅓	per cent profit on the selling price
60	per cent added to cost is	37½	per cent profit on the selling price
65	per cent added to cost is	39½	per cent profit on the selling price
66⅔	per cent added to cost is	40	per cent profit on the selling price
100	per cent added to cost is	50	per cent profit on the selling price

The Correct Way to Figure Profits

SHORT CUT TABLE FOR FINDING THE SELLING PRICE OF ANY ARTICLE

Cost to do business	NET PER CENT PROFIT DESIRED																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30	35	40	50
15%	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	65	60	55	50	45	35
16%	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	64	59	54	49	44	34
17%	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	63	58	53	48	43	33
18%	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	62	57	52	47	42	32
19%	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	61	56	51	46	41	31
20%	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	60	55	50	45	40	30
21%	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	59	54	49	44	39	29
22%	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	58	53	48	43	38	28
23%	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	57	52	47	42	37	27
24%	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	56	51	46	41	36	26
25%	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	55	50	45	40	35	25

Rule—Divide the cost (invoice price with freight added) by the figure in the column of "net rate per cent profit desired" on the line with per cent it costs you to do business.

EXAMPLE:

If goods cost	$60.00
Freight	1.20
	$61.20

You desire to make a net profit of 5 per cent.
It costs you to do business 19 per cent.
Take the figures in column 5 on line with 19, which is 76.

76 | 61.2000 | $80.52 = the selling price
60 8
400
380
200
152

The percentage of cost of doing business and profit are figured on the selling price.

PROOF

Profit	5%
Cost	19%
Total	24%
Basis	100%
If Profit and Cost is	24%
Balance is	76% represents Cost

If 76% is Cost, or $61.20,
1% would be 76) 61.2000 (.8052
60 8
400
380
200
152

Now if 1% is .8052, 100% would be 100 times .8052

$80.52 Selling Price	100
.24 Profit and Cost	or 80.5200 Selling Price
32208	$80.52 Selling Price
16104	19.32 Profit
$19.3248 Profit	$61.20 Cost

SHORT CUT TABLE FOR FIGURING NET PROFITS

If your cost of doing business figured on sales is represented by one of these figures, and you mark your goods at one of these percentages above delivered cost, your percentage of net profit is represented by the figure at the junction of the two columns.

%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
25	10	9	8	7	6	5	4	3	2	1	00	1 Loss	2 Loss	3 Loss	4 Loss	5 Loss
33⅓	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	00
40	18⅔	17⅓	16⅔	15⅔	14⅔	13⅓	12⅔	11⅔	10⅔	9⅔	8⅔	7⅔	6⅔	5⅔	4⅔	3⅔
50	23⅓	22⅓	21⅓	20⅓	19⅓	18⅓	17⅓	16⅓	15⅓	14⅓	13⅓	12⅓	11⅓	10⅓	9⅓	8⅓
60	27½	26½	25½	24½	23½	22½	21½	20½	19½	18½	17½	16½	15½	14½	13½	12½
75	32⅚	31⅙	30⅚	29⅙	28⅚	27⅚	26⅔	25⅚	24⅚	23⅔	22⅔	21⅔	20⅚	19⅔	18⅚	17⅔
100	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25

Explanation—If your cost of doing business is 15 per cent of your gross sales and you mark a line at 25 per cent above cost, your net profit is 5 per cent on sales, as shown in the diagram. If your cost of doing business is 18 per cent and you mark a line at 60 per cent above cost, your net profit is 19½ per cent on sales.

Source of Supply

The Wholesale Druggist—If pharmacists were compelled to depend upon the individual manufacturers for their supplies of materials and merchandise, their business would be much more complicated than it is. Imagine for a moment upward of 3000 items being supplied to the individual retailer by the manufacturers. Not only would it mean hundreds of accounts to open, hundreds of checks to be written each month, hundreds of orders to be sent to as many concerns, but also a vast amount of correspondence and bookkeeping which would overwhelm the ordinary shopkeeper. Most of this burden is avoided by purchasing from wholesale druggists, often referred to as "jobbers". There are about 500 wholesale drug houses of one type or another in the United States and they are so located, geographically, as to place every drug store within easy reach of at least one of them. These wholesale houses carry vast stocks of items, sold in drug stores, estimated as between 30,000 and 40,000, and it is possible to buy practically everything from them or through them. This very greatly simplifies the problem of securing supplies for the retailer and also enables the wholesaler, who gives good service at reasonable prices, to do a very satisfactory business.

Coöperative Buying—In recent years there have sprung into existence various organizations of retailers organized for the purpose of buying rapidly selling products in sufficiently large quantities to obtain the wholesaler's discount and thus supply their members with these articles at reduced prices, thereby

increasing their profit by eliminating the "middleman". These organizations first took the form of buying clubs and more recently developed into coöperative wholesale houses. Under the coöperative scheme the retail druggists desiring the buying privilege purchase a specified number of shares of capital stock and agree to pay their bills weekly. In return they obtain an extra discount on the goods and a dividend on their capital stock if the company makes money. This amounts to a considerable saving in a year and there are some 15,000 or more druggists who are taking advantage of this opportunity. However the regular wholesale houses—usually referred to as the "Service Wholesalers"—enjoy the advantage of being able to sell a wider variety of goods and by extending credit for thirty days or more retain a large proportion of the retailers as customers.

As a rule, a retailer is not able to obtain all of the goods he needs from the coöperative concerns because some of the manufacturers refuse to sell to such houses. He is therefore obliged to buy from at least one service wholesaler or direct from certain manufacturers. Very often the service wholesaler is used merely as a convenience to supply those items which the retailer cannot obtain from his coöperative house. Much has been written and said as to the fairness of the coöperative method of obtaining supplies but it is clearly evident that the ideal method of supplying goods from manufacturing pharmacist to wholesale druggist and wholesale druggist to retail druggist and retailer to consumer is being violated by all groups. We have manufacturers selling direct to wholesalers and often to the public by mail or through establishments other than retail drug stores, thus ignoring the interests of their regular wholesale and retail distributors. We have wholesalers who manufacture or put up the same products as the firms for which they are selling agents and who sell to general stores as well as to pharmacists and in some cases directly to the public. It is therefore not surprising to find organizations of retailers also functioning as wholesalers and manufacturers. The various factors that enter into competition in the drug trade, such as price cutting, special manufacturers' discounts to large buyers, chain store organizations, etc., have brought about this confusion of interests and there is very little hope that the orderly, single procedure of supplying the consumer with all manufactured goods via wholesaler and retailer will ever become the only method of distribution in the drug business any more than in any other line, even though there are powerful influences at work to improve the present situation. A wide-awake retailer naturally takes advantage of all the opportunities offered him to obtain merchandise at a reasonable figure so that he may make a fair and honest profit. As long as he does not violate the code of ethics and the dictates of his own conscience he is within his rights and is using good business judgment in doing so. He should be fair in his dealings with all sources of supplies and bear in mind that unfair methods are often reciprocated.

Direct, Indirect, and Quantity Buying—Some retailers do a sufficiently large business to become preferred customers of certain manufacturers. This means that they obtain better discounts on direct purchases than are usually allowed by the manufacturer, in return for a guarantee to purchase a certain minimum volume of the manufacturer's goods within a given time. Arguments can be presented pro and con as to whether this procedure is better or not than indirect buying, through a wholesaler, as the goods are wanted or needed. What really decides the argument is whether there is more profit in a particular case when goods are bought from the wholesaler in the quantities needed from time to time and at the long price, or when a certain amount of capital is tied up for a period in order to obtain the special discount. Figures alone will tell the

story. Any pharmacist who has been in business for a sufficient time and has kept records can answer the question for himself by a simple calculation.

The same kind of a calculation is involved in determining whether it is profitable to make a quantity purchase of a fairly good-selling proprietary article. It is assumed that the sale of the article totals $10.00 per week and that the cost of this quantity is $6.00 with a net profit of $1.00, or 10 per cent on the selling price. In 25 weeks this would represent a net profit of $25.00 and the investment would at no time exceed $6.00. Should the manufacturer now offer an extra 10 per cent on a quantity purchase, which would be sufficient to last for 25 weeks, the net profit would rise to $1.60 per week.

The profit on 25 weeks sale of this item would total therefore $40.00 on an investment of $135.00 whereas in the other case the total profit is $25.00 on an investment of $6.00. It is apparent immediately that the total profit is greater in the case of buying in quantity, but that the percentage of profit is greater on the small quantity purchase. In the latter case, in 25 weeks, there is a profit of almost 30 per cent in the merchandise investment while in the other case it is over 400 per cent.

If the proprietor has limited capital it would be far better, of course, for him to buy in small quantities and distribute his purchases over as many items as possible in the hope that he could obtain a similar rate of return on them. On the other hand, if the proprietor has sufficient capital, the quantity purchase should prove attractive because of the greater total profit and the fact that a 30 per cent profit in 25 weeks is a far higher return than he probably could get by employing his surplus funds outside of his business.

But of course there would be many other factors to consider, as storage space, breakage, depreciation, danger of obsolescence, etc.

Extra discounts often sound attractive but when all the facts in the case are considered they may, in some instances, show an actual loss instead of a gain over the profit made on small purchases as needed and each proposition should be carefully analyzed before entering into it.

When a new line or even a single item in a line has been added to the commodities to be sold, care should be taken that the entire force of the store becomes acquainted with it. The buyer's foresight and judgment in providing salable merchandise may become a liability instead of an asset if there is no coöperation in selling or popularizing new goods that have real value. Knowledge of new things on the part of clerks must not be assumed. It must be imparted, for even the best clerks often fail to familiarize themselves with all new developments. Clerks coming from another store should be well schooled in the policies and methods of their new employers and it should be insisted that methods and policies that do not conform to the organization which they have joined must be discontinued.

If there has been an error in judgment or something unusual has arisen in marketing conditions to prevent the movement of merchandise as rapidly as anticipated, steps should be taken to move the goods by means of greater advertising, special sales, or instructions to the clerks to specialize on the sale of the overstocked item. Occasionally it is possible to resell overstocked goods to other dealers or to return them for credit to the source of supply.

Merchandise ordered in quantity on the representation of salesmen who are promoting a local advertising campaign, should be purchased with a written guarantee covering the salesman's promises and the proviso that payment be deferred until the advertising is in actual progress, or that the goods may be returned for full credit if the advertising does not materialize. Often pharma-

cists are induced to stock unknown goods on the strength of a salesman's promise which does not materialize, therefore this precaution must be taken.

It is unwise for a pharmacist to permit his store to be advertised as a source of any product unless he conscientiously feels that he can endorse it. The manufacturer's object in advertising a local pharmacy as the source of supply of his article is to capitalize the local reputation of the pharmacist for his own benefit. This is not objectionable if the product is a meritorious one, for in that case all parties, including the customer, are benefited. However, if the article is one of questionable value and origin the pharmacist is just as culpable as the manufacturer if he permits his name to be used publicly in connection with it. He cannot escape the accusation that the use of his name amounts to a virtual endorsement.

Prescription Service

The prescription department, located usually at the rear of the store, should be provided with sufficient room for the storage of materials and for a proper compounding space for more than one man. In stores with a high ceiling it may be found advisable to locate the prescription department on a balcony or mezzanine floor but this is not practical unless there is sufficient prescription work to keep one or more men constantly in the department. Stairways to such mezzanine floors may be built in circular form to wind around a post so as to consume little floor space. A dumb waiter can be arranged for service to this mezzanine floor from the wrapping counter.

The maintenance of sanitary conditions and scrupulous cleanliness are among the first requisites of proper care of a prescription department. Too often small, dirty, and unsanitary quarters are allotted to prescription work. Such conditions are not conducive to accuracy, neatness, or cleanliness in dispensing. The most progressive type of pharmacist will so arrange and equip his prescription department as to make it a show place. This is good advertising and inspires confidence. The prescription counter should not be used as a convenient place for unpacking boxes and cartons nor should this department be a loafing place for visitors to the store. There should be a gate of some kind between the store and the prescription department enabling the man in the prescription room to see the front of the store and yet acting as a barrier to those who have no business behind the counter. The gate should be so arranged as to make it possible for clerks to either see through or over it and avoid danger of collision with other clerks about to enter the prescription room. The gate should be at the side and not in the center in the ordinary establishment, although there are plans in which the center gate or opening to the prescription department is preferable.

Various arrangements can be made in supplying fixtures for the prescription department. Those who desire to hide the operator from the view of the customer can do so by selecting partitions to accomplish this end. On the other hand those who take pride in the appearance of their prescription department and wish to open it to the full view of the public can install low partitions which enable the prescription clerk to see the front of the store and at the same time give the customer a glimpse of the activities behind the counter.

There are advantages and disadvantages in having prescriptions filled in full view of the customer. If the customer sees the pharmacist looking for an item or hesitating over a prescription before pouring out the proper quantities of the ingredients, he is apt to become nervous or suspicious of the pharma-

cist's knowledge and ability to fill the prescription properly. The advantage is that it shows the customer there is nothing about prescription work that is secret or that the pharmacist is not willing to have his customer see. A number of stores doing the largest prescription business in their respective towns have their prescription departments so arranged as to give the customer a full view of where and how the prescriptions are compounded.

In most stores where prescription business amounts to anything the system of providing the customer with a duplicate check, bearing the number which is immediately attached to the prescription, is in vogue. This prevents errors in delivery and inspires confidence in the care exercised by the pharmacist. It conveys the impression of systematization, which is helpful.

It goes without saying that a stock of reliable, fresh, standardized drugs should be kept on hand and that proper storage facilities for various preparations should be provided. The refrigerator is a necessary fixture in a high class prescription department not only for the storage of biological products which are discussed fully in Part XIV but also for other pharmaceuticals which may be injured by high temperature or which appear better when kept cool. Provisions must also be made for keeping certain products dry and away from light, and others moist and warm. In this matter the pharmacist must depend upon his professional knowledge and in planning a prescription department, containers, shelf room, and location of the stock should be based on that knowledge. An index of the items on hand should be prepared and kept up to date. It is well to number the shelves and also to number the containers, in addition to labeling them, so that everything can be kept in place even though it is put away by a junior assistant. By means of a card index or a book in which the items are entered in alphabetical order they can be located readily by relief clerks unfamiliar with the stock or by the regular force. If one depends on a look around the shelves to find some odd tablet or pill it will often not be found and failure to find it at once leads to reordering or sending out for it when, as a matter of fact, the product may be somewhere on the shelves. With the many thousand items that make up a prescription stock it is no longer possible for even those with a good memory to remember the location of each item. The card index or a substitute for it is therefore at once economical and safe.

When marking the price of a chemical or drug product on the label in the prescription department it is customary to figure the cost per ounce and if the quantity is less than an ounce to figure it to the cost per grain. In this connection it should be remembered that the ounce used in purchasing is the avoirdupois ounce of 437½ grains and not the apothecaries ounce of 480 grains.

It is well to obtain the manufacturers' literature on all new products and to look it over carefully so as to be able to discuss the pharmacy and chemistry of the new products intelligently with the physician who may prescribe them. Such information can frequently be obtained most satisfactorily by a talk with the detail men or salesmen of the manufacturing houses. There should be someone instructed to obtain information particularly on new prescription products and, while it is essential that all members of the staff keep up their general information, it is inexcusable to have no one on the staff who knows about the latest therapeutic products. Fluctuations in the price of chemicals and pharmaceuticals should be watched carefully so that any increases in the prices of materials entering prescriptions are promptly noted. It should be the business of the buyer to follow at least one good market report regularly and keep those who have to do with pricing prescriptions informed of the changes.

Pharmaceutical Products

Under this heading come simple drugs and chemicals, hospital supplies, proprietary products, including lines of "home remedies" manufactured by various concerns.

Simple drugs and chemicals such as senna leaves, chamomile flowers, sulphur, Epsom salt, etc., should be kept ready in packages for immediate distribution upon call. The old time paper package frequently made up while the customer waited, by scooping some of the material out of a drawer and weighing on the scale in the front of the counter, is a thing of the past. People have been told so often that packaged products are more sanitary than the same substance bought loose, and most of our food products are supplied in that fashion, that they are no longer content with receiving paper packages of drugs. It is of course required of a good clerk that he be able to fold a neat paper package and the public appreciates the neatness of the package but, for the convenience of the customer, packages of drugs and chemicals should be sold in paper cartons, tin boxes, or bottles. Such boxes fit into the medicine closet in the home and continually keep the name of the distributor before the person using them. In some sections people are given to much self-medication and the package trade in drugs and chemicals is large. It can be made a very profitable trade if rightly handled and if a careful selection has been made of standard products even though these cost a little more. Crude vegetable drugs should be kept in metal containers to prevent the ravages of insects and rodents. The packaging of simple drugs and chemicals can be carried on during the spare time of the various members of the store force or the drugs and chemicals can be purchased from wholesale or manufacturing houses in packages all ready for sale. These products may be kept in drawers or in a wall case behind the wrapping counter. It does no harm to keep them near the rear of the store as this causes the customer to follow the clerk to the wrapping counter where he has an opportunity to talk to the customer while reaching for the item and wrapping it, and it also brings the customer within view of other merchandise which he may purchase but would not have thought of, had it not been called to his attention.

The handling of proprietary articles or so-called "patent medicines" takes a considerable share of the pharmacist's time but frequently does not yield him a fair profit because many of these remedies are sold at cut prices. It has been conservatively estimated that there are in the neighborhood of 30,000 different patent medicines on the market. Many of these have only a local sale but others are distributed over the entire country and because of national advertising are in great demand. Every druggist has to carry a fairly complete line of these products to satisfy the particular demand of his neighborhood. With the exception of the so-called "agency lines" of proprietary products in which the druggist usually has a special interest, the tendency is not to give patent medicines very much display room. It is assumed that they will be asked for when wanted and therefore do not require display and, in fact, much display is not desired for them by the druggist because he does not profit greatly by their sale. It is a matter of economy however to keep these medicines where they can be wrapped quickly and the usual place is behind the wrapping counter at the rear of the store. Surplus stock may be carried in cupboards or closets in the prescription or storeroom or in the top of display cases at the rear of the store. Small package patent medicines such as headache tablets, corn cures, laxative tablets, etc., should be carried in drawers with adjustable and removable partitions so spaced as to divide the stock in each drawer.

The agency lines such as Rexall, Nyal, Penslar, SanTox and others occupy a different position with the pharmacist because they are usually sold at the full price and the agencies are given only to certain stores, thus making the line exclusive for any given territory. When these products are advertised to the public the pharmacist holding the agency profits directly from the sale of goods in the line and also because of the decrease in the unprofitable business in other patent medicines used for the same purpose. There is no labor connected with handling patent medicines excepting the ordering, unpacking, and placing them on the shelves ready to be handed out. The fact that the pharmacist as a rule has no special interest in the sale of proprietary medicines should not keep him from giving good service in the distribution of these products, as the public judges service not by the manner in which the retailer sells an item in which he is interested but by the manner which he assumes in his dealings as a whole. The maintenance of fresh stocks, keeping the packages properly enclosed or otherwise keeping them free from dust, are just as essential here as in any other class of merchandise.

It is now common practice for pharmacists to paste a price sticker on every package of patent medicine—such stickers bear the name of the pharmacist and have space for inserting the selling price. While excellent protection is afforded by the food and drug laws of Federal and State Governments against fake remedies, new products are constantly being put on the market and sometimes their manufacturers are not as scrupulous as they might be. It is therefore advisable to carefully watch the claims and methods of marketing followed by introducers of new remedies. If the claims are palpably false the pharmacist should not lend his name to their advertising or sale. Any proposition to advertise the pharmacist in connection with a patent medicine should be looked at from the ethical standpoint before it is viewed from the standpoint of financial returns and permission to use the pharmacist's name should be refused unless it can be demonstrated that the product is a worthy one.

In opening and stocking a new store where the demand for certain proprietary products is entirely unknown, the wisest procedure is to order only from one-twelth to one-fourth of a dozen of each commonly sold patent medicine as a great deal of money can be tied up in dead stock of this kind if not purchased conservatively. The lure of special discounts and free goods should be resisted until definite information is at hand as to the sales possibilities of any article. So often it happens that a proprietary product which has a large sale in one section of the city is only rarely called for in another section.

Patent medicines are the favorite mediums for price cutting on the part of chain store organizations and other down-town stores. They are singled out because they are extensively advertised and the price is printed on the package, as a rule. When a reduction of some magnitude is made the glib-tongued salesman can show the customer how much cheaper he sells his goods by a comparison of the printed price and the actual price charged. This system of cut prices has undoubtedly added to the disrepute in which some patent medicines are held by pharmacists and efforts are being made by manufacturers to prevent price cutting because they realize that when a pharmacist is compelled to sell any item at cost, or a little above cost, it is natural for him to recommend something else on which he makes a decent profit.

Hospital Supplies

Comparatively few pharmacists realize what great possibilities there are in building up a business on hospital supplies which include such things as absorbent cotton, gauze, various antiseptic and sterilizing agents, catgut, surgical

instruments, sick-room appliances and similar necessities. As a rule a minimum number of items under this class are carried in stock for emergency purposes but it is a fact that the stores which become known as headquarters for supplies of this type are usually the ones that are sought out in case of necessity. Very often several other neighboring stores are passed in order to get to the one which is known to have the articles wanted in stock.

This is a distinct type of service which every pharmacist should be prepared to render. It is not necessary to tie up much capital in stock of this character if a real effort is made to acquaint the neighborhood and particularly the medical profession with the fact that it is available. Many pharmacists bid on the supplies ordered by hospitals in their communities and virtually act as buyers of these items for the hospital authorities. A reasonable profit can be made in this field as well as in any other.

Rubber Goods—Atomizers, rubber gloves, hot water bottles, syringes of various kinds, nipples, rubber tubing, bed sheeting, rubber bandages, oiled silk, finger cots, etc., constitute a part of the stock of the rubber goods department and very often the business in this line is large enough to warrant someone devoting considerable time to it. Rubber goods are among the most profitable items sold in the drug store. Proper display in a suitable case and an occasional window display no doubt help sales of these items. In recent years it has been possible to obtain a manufacturer's guarantee for practically all articles coming in this class, and the methods of manufacture have been so improved that flaws in the goods are very rare. They can therefore be sold with confidence and with a "money back" guarantee or an exchange guarantee which inspires confidence. The location of this department is usually toward the rear of the store where people have an opportunity of examining the goods privately and without haste. There are stores in certain neighborhoods where hospital supplies are added to this line and where trusses, crutches, and similar items are also handled. If the pharmacist goes into the business of selling trusses, a separate room is, of course, necessary. Whoever has charge of this department should be well acquainted with the uses of the various articles sold, should be qualified to do some fitting of trusses, and should give proper instruction as to the best methods of preserving the rubber and also what is most economical for the customer to buy. The selling of trusses in a pharmacy is much more frequent in a location some distance from the larger cities, for in the latter special dealers are usually found, well equipped to permit an assortment of the various supplies in this line and with trained attendants for taking measurements and making fittings. If a pharmacist finds an opportunity for such business in his community it will be to his advantage to become the agent for one of the well-established firms, which already has gained the confidence of physicians, and learn from them all about assortments and even the proper methods for fitting, measuring for, and handling this line of surgical goods.

Tobacco Products

Cigars, cigarettes, and other forms of tobacco have come to be a part of the regular stock of the average pharmacy. There was a time when the so-called drug store cigar came in for considerable criticism and was made the butt of many a vaudeville joke. However, modern methods of keeping cigars and handling them have lifted this prejudice and have in fact made the drug store a more desirable place from which to purchase tobacco goods than many of the old time cigar stores.

The smoker wants his tobacco neither too dry nor too moist and he appreciates quick service and the ability to obtain his particular brand of tobacco. Comparatively few drug stores display or handle chewing tobacco because as a rule they do not care to cater to the class of trade that purchases it. A small stock is frequently carried for the convenience of other tobacco customers but no particular drive is made for this kind of business.

The cigar, cigarette, and tobacco trade often leads to trade in pipes, pouches, humidors, fancy cases and holders for cigars and cigarettes, cigar cutters, tobacco jars, etc.

There is no more particular trade than the cigar trade. A man will often walk several blocks out of his way to get the particular cigar he wants. A study of the tastes of customers will be an asset to the pharmacist who wants to make the tobacco trade profitable. He can have a special brand of cigar made up under his label or become the exclusive agent for certain brands which will help to build a reputation for him. Proper fixtures are of considerable help in this connection. A good display of cigars, with proper atmospheric conditions maintained, cannot help but please the eye and the taste of the customer. Cigars should be kept at a humidity of 68 degrees and at a temperature of about 65° F. Slight variations are of course immaterial. Thermometers and hygrometers are not expensive and should be kept in the cigar case and used. Tobacco should not be permitted to become dry, for even though it is remoistened it will not have the original flavor. There are various types of moistening devices. Most of them depend upon some absorbent medium which takes up a quantity of water and gradually loses this by evaporation, keeping the case moist in the meantime. Electric moisteners have been placed on the market but on the whole have not met with great success. The amount of moisture in a case may be increased by warming the water placed in the case with electric lamps. Lining of cases has been suggested as a method of maintaining proper humidity but it is a question whether this has any effect as the opening and closing of doors and reaching into cases after stock causes many changes in the air in the case during the day. The only way proper conditions of moisture can be insured is by carefully watching the case and supplying additional moisture whenever necessary.

Cigarettes are an important feature of the tobacco department and are sold in very large quantities. They may be displayed in wall cases or in top display cases placed on the regular show cases. These move so rapidly as a rule that the foil in which they are wrapped acts as a sufficient protection to make them reach the customer in good shape. The same is true of packaged tobacco.

A separate mailing list of cigar customers is desirable so as to keep them informed concerning the addition of new brands and to advise them of special sales or quantity offers. It is quite possible to cultivate and encourage a box trade in the cigar business and this adds considerably to the profits of the department. Where the tobacco trade is sufficiently large it pays to have an expert in charge of this part of the business. A periodical devoted to the tobacco trade should be among the journals subscribed for by those interested in building up this department of the business.

Effective display at the tobacco department is very profitable to the store. For instance, men are said to buy 76 per cent of the box candy. In addition to this they buy shaving supplies and hair tonics. If these are all kept within easy reach of the tobacco department, very many more profitable sales will result at that department. The small margin derived from tobacco and cigarette sales may be counteracted somewhat by the larger margin on men's toilet goods. Men, as a rule do not go shopping to see what they can see.

They make their purchases where it is most convenient and consequently the items that interest men must be placed where they are accustomed to buying.

Confectionery—The amount of candy sold in the United States during a year is enormous and a large part of it is sold in drug stores. The sales of confectionery in stores which handle it amount to about 5 per cent of the total volume of business. Under the general heading of confectionery there is included both box and bulk candy, fruit tablets, cough lozenges, cake chocolate, chewing gum, and other items. The gross margin on confectionery approximates the standard figure of 33⅓ per cent on the selling price and the rapid turnover of this business makes it a very profitable asset, provided the store is so located as to be able to cater to the candy consuming public. Much of the business on candy is attracted by proper display and inasmuch as this is a line which deteriorates and under certain conditions becomes unsalable, it is important for the pharmacist to give some attention to proper methods of preservation as well as display in handling confectionery. There are some stores in which a penny business is developed and where bulk candy is sold to a much larger extent than package candy. The package trade is to be preferred because it does not require the great care necessitated by bulk candy to keep the display from looking mussy and unattractive and it also does away with the pilfering of the stock which is often indulged in both by clerks and customers. Package goods are usually so attractive that they will enhance a display although the actual sight of tempting chocolates or bon bons will be a greater inducement to the purchaser than a pretty box. For this reason an opened package, particularly one which is very attractive, is an asset to any display. Bulk business very often leads to a good package business also, and it has an advertising value from that standpoint.

The possibility of developing a candy business depends somewhat on the character of the competition in this line. For example, if there is a high grade confectionery store within a short distance of the pharmacy a considerable part of the candy business will naturally go to that establishment. In such cases it pays the pharmacist to take on a line of superior package candies for which he may be able to obtain an exclusive agency, thus drawing a trade to his store which will not be tempted away by the confectionery establishment as long as the package line is well advertised, reasonable in price, and of a sufficiently good quality to be sought out by customers.

Where the stores are equipped with soda dispensing tables it is possible to display candy either under the glass top of the table or in the wall cases in front of which the tables are placed. It is unwise and unsanitary to display bulk candy in such a way that it may be handled by customers or exposed to dust and flies. Slant front show cases are better for the display of candy than straight front cases. In making window displays of candies it is important to shield the window from the sun so as to avoid discoloring chocolates or causing other pieces to collapse. Usually a candy window is provided with dummy packages furnished by the manufacturers thus giving the effect of the display without subjecting any of the stock to deterioration. In some localities, as for example, at the seashore and in very warm climates, it is extremely difficult to keep chocolates in good condition during the summer. Many pharmacists discontinue handling certain candies during this season, especially in bulk, or they specialize on confectionery put up in metal containers which are more apt to preserve the candy than the ordinary porous pasteboard or paper box. Some pharmacists have installed refrigerator display cases which are kept cool either by means of an electrical device or by the presence of ice in the upper or lower portion of the case. However, it has not been found very practical to properly

refrigerate an ordinary large show case, such as is usually used for the display of candy. High temperatures soften chocolates and when the temperature drops, the cocoa butter in the chocolate solidifies and causes a discoloration. The melting point of cocoa butter is around 91° F. but the ideal temperature for keeping chocolates is considerably below that. Some candy manufacturers claim that their products will keep at as high a temperature as 85° F. without discoloration, provided there is no sudden chilling. The ideal temperature for preserving chocolates is in the neighborhood of 70° F.

Refrigeration of candy is sometimes objected to for the reason that the rapid change of a package of candy from the low temperature of a refrigerator to the high summer heat of the atmosphere causes the chocolate to turn gray. The dampness of a refrigerator may also cause molding of the candy.

Reserve stocks of candies may be kept in a cool basement or other storeroom during very warm weather and the display during that period can be made up of dummy packages.

The turnover of candy stock is usually very satisfactory. In most stores it averages from six to nine times a year as compared with the average total stock turnover of approximately three.

It is advisable to place the candy case somewhere near the soda fountain or the cigar case as soda fountain and cigar customers are frequently also candy customers or can be made candy customers by placing before them an attractive display. The man buying cigars for himself is apt to think of candy for the ladies if he sees a display of confectionery. The fountain customer has his mind on sweets and is in a receptive mood to purchase candy if it is close at hand. At one time, drug store candy was not considered of as high a quality as candy purchased in a confectionery store. This was in all probability due to the fact that candy bought in a drug store acquired the odor and taste of drugs. Sugar, and confectionery in general, absorbs odors and if the drug store is charged with odors of pungent drugs and the candy is not properly protected against such absorption, it is certain to have a "druggy" taste. However, the modern candy case prevents this absorption of odors, if it is kept closed when sales are not being made. The newer methods of packing candy and covering the containers with impervious paper prevents the absorption of odors to a large extent and candy purchased from drug stores no longer has the objection that was once offered. As a matter of fact the drug store has become an acknowledged source of high grade candies because so many pharmacies have received exclusive agencies in their territory for some of the best lines.

Special days, such as St. Valentine's Day, Mother's Day, Hallowe'en, Washington's Birthday, Easter, and Christmas can be taken advantage of for the purpose of selling candy and special sales of a particular package for the particular day will add much profit to this department.

Stationery and School Supplies—The department devoted to stationery and school supplies can be made a very large one if the store happens to be so located as to attract a great many school children or high school and college students. If there is a school of any kind close by, the pharmacist has an extraordinary opportunity in this direction. Where there is no school in the immediate neighborhood the stationery business will be largely along the line of writing paper, correspondence cards, special cards at various seasons of the year, such as Easter, Christmas and New Year cards, and various accessories, such as fountain pens, pencils of the automatic type, sealing wax, and so on.

If a pharmacist happens to be the only one, in a small town where there is no progressive stationery store, he can make his establishment headquarters for information regarding the correct use of correspondence cards, invitations

to various functions, etc. He can obtain the agency for an engraving house which will supply him with samples of various styles of engraving, and an excellent business can be built up in supplying visiting cards, wedding invitations and announcements, and similar items. Here again the importance of display cannot be over-emphasized. Showing the various styles of cards and engraving and indicating that they are the styles advocated by high-priced houses in large cities, also being acquainted with the correct form and procedure for each social occasion and ready to give help when asked for, should make it possible for the pharmacist to build up this business. In the larger cities there is not so much opportunity for it, unless the store is located in a neighborhood where the people do not have the opportunity to shop in the down-town districts. The stationery and school supply line should be very profitable because it is clean, requires comparatively little attention, and turns over rather rapidly. It is not advisable to show the styles of cards, letter paper, envelopes, etc., from stock packages. It is much better to arrange a set of sample sheets of paper and envelopes of different colors and qualities, neatly on a paper or in a folder which can be shown for style, thus keeping the stock in the packages clean, neat and free from finger prints.

Soda Fountain—It seems almost impossible to think of a pharmacy without a soda fountain. As a matter of fact, in a recent investigation of what drug stores sell, out of 1000 stores picked at random only 678 operated soda fountains. When it is borne in mind that 956 out of 1000 in this investigation sold candies, 948 sold cigars and tobacco, and 996 sold stationery, the soda fountain in the drug store is not as universal as seems to be generally supposed. The question has often been asked how the drug store came to sell soda water, and, undoubtedly, this was an outgrowth of the fact that the original carbonated water was made from CO_2 gas, generated by the interaction between marble dust or, later, sodium bicarbonate and sulphuric acid, which involved a mixing process that the ordinary storekeeper would not undertake. It has not been many years since the old-style soda fountain, with its apparatus for generating carbon dioxide with which to charge the water, was a drug store fixture. The desire to improve the taste of the carbonated water led to the use of fruit syrups with the charged water and this in turn led to the introduction of the ice cream soda which it is said was developed during the Centennial Exposition in Philadelphia in 1876. Soft drinks and soda water have been popular for many years, but of course the sale of these non-intoxicating products has increased very largely since prohibition laws have been in effect. Improvements have been brought about in the building and equipment of soda fountains so as to make them more efficient, more durable and more easily operated, and the soda business has in many cases been extended to include light lunches, such as hot drinks, bouillon, sandwiches, cake, pies, etc. Once the public begins to demand articles in the food line it is difficult to know where to stop in meeting the demand. A soda fountain located in an accessible place for people who want light lunches is almost compelled to add other articles of food in order to maintain its business.

Where the soda business is large enough, it is of course profitable to conduct it as a separate department of the store with someone in charge who is held responsible for profits and losses. There is no harm in having a soda fountain under the same roof with a prescription department if both are conducted according to ethical principles of business.

Various factors enter into the location of the soda fountain in the store. Those located in a transient section near railway stations, amusement parks, or at summer resorts, would be served best by having the soda fountain at

the front of the store or very close to the front where it can readily be seen by the passing crowds. An attractive fountain will show off to better advantage at the front where the light is good, than elsewhere. Of course, if the fountain is located at the front of the store, which is considered the most valuable space, it must pay a proportionate share of the rental and the soda business must warrant this extra expenditure.

When the fountain is located toward the center of the store it can be used to draw trade to other departments by compelling fountain customers to pass the candy case, cigar case or toilet article counter. Where a quick lunch is served in addition to the usual fountain drinks, it is sometimes preferable not to have the fountain located right at the front where people can be seen through the store windows by passersby. Furthermore, a more central location does not interfere with merchandising at the front of the store and does not crowd the entrance at certain times and repel customers for other departments.

Soda fountains are not very often located in the rear of the store but in neighborhood sections where there is not a large fountain business, it may be advisable to locate the fountain at the rear, because it adds privacy and in case there is a side entrance it makes it easy for fountain customers to come and go without interfering with other departments while adding to the tendency of neighborhood customers to make the pharmacy a meeting place for discussing the news of the day, etc., at their leisure while sipping a soda or eating a plate of ice cream. The soda fountain should not be used to encourage loafing around the store but in certain districts it is to the interest of the pharmacist to cultivate the desire of neighbors for a place to meet occasionally, and if handled judiciously, the fountain, under such circumstances can be made a splendid asset. If a customer is required to walk the full length of the store to reach the fountain, there is, of course, greater opportunity for additional sales.

In most stores the fountain is located at the side with wall space acting as an accessory for display and storage and usually for a mirror which adds to the beauty of the fixtures. In large stores the fountain is sometimes located in the center either in the form of a hollow square or in the shape of an L. It is inadvisable to install this style of fountain excepting where there is plenty of room, so that no other department will be crowded as a result of the installation. Inasmuch as every portion of this type of fountain is in plain view of customers everywhere in the store, it requires additional labor to keep it spotlessly clean and in order, so as to avoid the general appearance of disorder which would result if it were not properly cared for. Fountains located in the center of the store detract to some extent from the wall case displays.

Very often separate rooms or porches adjacent to large stores at vacation resorts and elsewhere are used for fountain service. In such cases it is necessary of course, to have someone to give attention to the tables but there is an advantage in having soda customers segregated, especially if the business is very large. The disadvantage here is that people do not see the rest of the store while enjoying a soda. Some form of entertainment in the way of a victrola or radio outfit may add to the enjoyment of a special department of this kind.

In purchasing a soda fountain, preference should be given to the apparatus which is most easily kept clean and least apt to get out of order, other things being equal. If the store is a new one, it is possible to make the fixtures harmonize with the fountain or vice versa. If the store is already equipped with fixtures and a new fountain is purchased this should harmonize with the furniture as much as possible. Ordinary tables can be used in some localities whereas in the better neighborhoods and in transient sections the table with a

display top is given preference. Too much ornamentation is not advisable as it gives rather an unfavorable impression and adds to the labor of cleaning. Simple designs which are easy to keep clean are best in the long run.

The space back of a soda fountain can be used to display confectionery and other attractive articles and a mirror and some colored glass are usually a part of the equipment for ornamentation. If possible, there should be easy access to the basement where the soda fountain and the surplus stock of ice cream, etc., are kept. If a dumb waiter can be arranged it is found to be of considerable help.

The soda fountain should act as a magnet to draw people to the store and it therefore has a twofold purpose. It is not only a profit producer itself but is an advertising medium in that it brings people into the store where they may see other things or remember other items,in other departments, which they buy. In a busy section it is customary to provide for standing room at the fountain and tables for those who wish a more leisurely service. In other localities the front of the fountain is provided with seats. This will usually attract more women customers than would otherwise be the case. Men are more apt to want quick service and prefer to stand. The matter of seating is an individual problem with each store and must be worked out according to the particular requirements.

The soda fountain equipment should be adequate for the volume of business that must be transacted in a certain location and it should be of a type that will always give a neat and clean appearance. Nothing will destroy a soda business or a business in any food product more quickly than a disorderly and dirty service counter or the presence of clerks who are not neat and clean. Much soda business is also destroyed by the odor prevailing about many fountains. There is no excuse for a condition of this kind as proper cleaning of the ice cream cabinets and the apparatus in general will prevent disagreeable odors. There should be hot running water available for cleaning purposes. To do away with the trouble of cleaning glassware, paper cups and dishes have been adopted very largely in busy stores, although some of the largest stores continue to use thin glasses which they claim are preferred by most customers. Such stores, however, provide adequate facilities elsewhere for cleaning the glasses and dishes which are returned to the fountain clean and dry.

In the management of the soda fountain in a number of stores the cost of supplies is carefully maintained within 50 per cent of the sales.

This figure is readily checked each week and is of great value in maintaining a profitable business. If costs exceed this per cent it is an indication of unnecessary waste or perhaps an undue quantity of syrups, cream, or ice cream is being served or perhaps the clerks are partaking too freely of the service at the expense of the proprietor.

The type of fountain to be selected cannot be decided upon without giving considerable study to those available at the price which the pharmacist is warranted in spending. A great deal of money can be tied up in a soda fountain which will never be justified by the business that can be done in a particular locality. To prevent such mistakes it is wise to consult soda fountain experts, more than one if possible, and carefully survey the local conditions before buying.

If the soda business is being run as a profit producer, plans should be made to keep it going all the year. There are many cold drinks demanded in the winter time and the sale of ice cream in one form or another is not stopped by the coming of cold weather, furthermore, it is possible to add a few hot drinks,

such as chocolate, coffee, tea, and perhaps bouillon, which will appeal to quite a number of people at various times of the day. Of course, if it is found to be unprofitable to handle hot drinks in the winter and the cost of keeping the apparatus going and supplying the necessary materials is excessive it is unwise to continue this development, although the question of service and convenience should be taken into consideration before discarding any feature which a portion of the customers of the store have become accustomed to and which therefore has a certain advertising value.

The life of a soda fountain is not dependent so much upon the possibility of wearing out but rather upon how soon it may become out of date. The average soda fountain becomes obsolete within five years, and to use the older type of fountain after that period very often makes it a liability. Depreciation on the soda fountain should therefore be charged up at the rate of twenty per cent a year.

Toilet Articles, Perfumes, etc.—The business on toilet articles, cosmetics, etc., has grown to enormous proportions in recent years and many pharmacists have taken advantage of the opportunities for additional profit and service offered along this line. Few, if any, retail pharmacists manufacture more than one or two specialties in the line of toilet articles and while some have such products manufactured for them and labeled with their name, the greater portion of this business is on advertised goods. Lip sticks, compacts, powders, and the various accessories and varieties of these are in great demand and the favorite brands vary with the neighborhood and with the section of the country in which the store is located. Much of this business is controlled by the national advertising of the manufacturers in popular magazines, newspapers and other mediums. Of necessity the pharmacist should have on hand the most popular brands and, where the quality is equal, it is to his interest to push those brands which yield the greatest profit. Experience indicates that it is not advisable to spend very much time in overcoming the prejudices which customers for these items have already formed so that the degree of sales resistance to any particular item is also a factor to be considered in stocking it. Even though the profit may be large, if the sales resistance is great, it is better to be satisfied with a smaller profit and have satisfied customers. The packages in which toilet articles are put up are usually quite attractive and if well displayed they are bound to produce business without very great effort on the part of the pharmacist. There is keen competition in toilet articles with department stores, and unfortunately the profit in some of the leading items is lowest because of cut prices and the necessity of meeting competition. In the same department where face powders, face creams, massage creams, hand lotions, powder puffs, vanity cases, etc., are displayed it may pay to add such items as complexion brushes, nail buffers, orangewood sticks, manicure scissors and knives, nail files, cuticle remover, tooth paste, tooth powder, antiseptic solutions used as mouth washes, perfume atomizers, etc.

The sales of perfumes and toilet waters although taken over largely by the department stores in some localities still constitute quite an item in the average drug store. Proper display and the right atmosphere, in the particular section of the store where these items are stocked, play a large part in the possibility of building up this business.

Miscellaneous Items—As has been pointed out previously, the location of the pharmacy and the fact that it is open sometimes as long as eighteen hours out of the twenty-four, and frequently does not close at all, makes it a convenient point of distribution for all kinds of merchandise, so that the

pharmacist of to-day finds it very difficult to know what to handle and what not to handle. He is offered agencies for all kinds of articles, many of which are entirely foreign to the objects of conducting a retail drug store. As an example of the extremes to which the matter of using the drug store as a distributing center is carried, we might cite the fact that a pharmacy in a large hotel in New York City is reported to carry shirts and pajamas for the convenience of travelers in emergencies. Among the items which are carried to some extent in various pharmacies are bathing caps and shoes, books, paints, wall paper, cameras and photographic supplies, jewelry, glassware, cutlery, leather goods, pictures, ivory and celluloid goods, magazines, musical supplies, souvenirs and novelties, optical goods, razors, sport goods, and vacuum bottles.

It has long been customary for the pharmacy to be headquarters for brushes of various kinds including tooth brushes, hand brushes, hairbrushes, hand scrubs, bath brushes, etc., sponges, chamois, and various other items that are usually classified as sundries. These articles yield a good profit and when reliable lines are handled it is possible to build up a satisfactory trade in them.

The Inventory

Value of Inventory—It is impossible to determine correct annual profits, to make out income tax returns correctly or to file accurate corporation tax reports without taking an annual inventory of the stock of a pharmacy. There are no short-cuts if the record is to be accurate. Furthermore, the taking of an inventory, if properly prepared for and carried out systematically, is not impossible or even a terrible bugbear, as believed to be by most retail druggists. Of course if one attempts to write down the items from one end of the store to the other, then price them and afterwards extend the totals, all at the same time, and keep the store open and wait on customers, there is every reason to give it up in disgust. But when the taking of an inventory is accepted as a requirement and conducted systematically, it can be accomplished in a comparatively short time. The value of an inventory lies not alone in the revelation of what the store is worth and how many times the stock has turned in the year but it gives much more information. The proprietor has an opportunity to know the stock. It often shows what to avoid this year that caused difficulty last year. If he wants to sell, he will know what his stock is worth and what the store should bring. Should there be a fire, the inventory will give an honest basis for adjustment. It is always well to have the inventory in duplicate, one copy being preserved in a vault outside the store so as to be intact in case of fire, theft or other loss.

Most proprietors like to have their business year run parallel to the calendar year. This brings inventory time around the last week of December which is usually a busy period and a very inconvenient time for taking inventory. There is nothing compulsory about the date. The business year can just as well be adjusted to end in the summer or at some other slack season when there would be more time for inventorying. But no matter when it is taken, it should be taken at least once a year.

Methods of Taking Inventory—Very often the annual inventory results in the discovery of unsold stocks of merchandise which should be gotten rid of quickly in order to release capital or take advantage of price situations. The taking of an inventory is greatly facilitated if the stock is systematically arranged. In large organizations it is an easier job as each department is usually in charge of an individual who is thoroughly familiar with all articles on sale and who has them well classified.

The Liggett stores use their inventory as a means of control upon a number of business factors. Consequently, their inventory must be frequently taken and must represent accurate facts. To facilitate this, the stock of every store is printed upon sheets in the order in which the item appears upon the shelf, and separate lists are made up for each department. This greatly facilitates the taking of the inventory since the items can be called off in the order in which they rest upon the shelves and the quantity entered upon the sheet with the sales price, which is supposed to be written upon every package.

Notice that in this organization the inventory is taken at the *selling price,* although it is usually the custom to price items at cost. The inventories just referred to are taken at least twice a year, at irregular intervals, by a so-called "inventory team", consisting of a captain and six men. The largest Liggett store can be inventoried completely by this team within a few hours, without interfering with the regular business. Taking an inventory in this way is, of

FIG. 465

NAME OF DRUG	Where Kept	Cost	Amount on Hand	Selling Prices					
				1 dr.	1 oz.	2 oz.	4 oz.	8 oz.	16 oz.
Ichthalbin									
Ichthyol, ammonium									
sodium									
paste, unna's									
Ignatia									
tincture									
Indian hemp (see cannabis indica)									
Indian physic (gillenia)									
Indian turnip (arisæma)									
India-rubber, crude									
Indigo									
Infusorial									

Illustration of the N. A. R. D. inventory aid

course, only possible when a large organization and a number of stores are involved.

In a smaller store, or group of stores in which there is a division of the business into departments, an inventory may be rather easily taken by distributing ruled sheets to those in charge of the various departments, several days before the inventory is to be taken. These individuals write up the items in their departments in the order in which they are placed upon the shelf. When the inventory day comes, one person can call off the quantities and the second write them on the sheet, thus completing the task in each department in the course of several hours. The sheets are then collected, the cost inserted by the buying department, and the totals determined by the bookkeeper. This method is applicable to almost any business and is one of the most efficient plans.

Several organizations in the drug trade have offered special printed forms which are useful in making up an inventory. The National Association of Retail Druggists offer a small pamphlet in which many of the common items are printed, with space for entering quantities for several years in succession (see Fig. 465). The American Druggists' Fire Insurance Company presents its customers with inventory sheets upon which the individual items may be written and with space provided for quantity entries for ten years (see Fig. 466). Either of these would be of help when taking an inventory. If the

proprietor has little or no help and an actual physical inventory has been taken at some date within a reasonable time and the relationship between the cost of goods and sales for the preceding year has been determined accurately, it is possible to calculate approximately the present value of the stock by adding to the inventory the cost of goods bought since the inventory was

FIG. 466

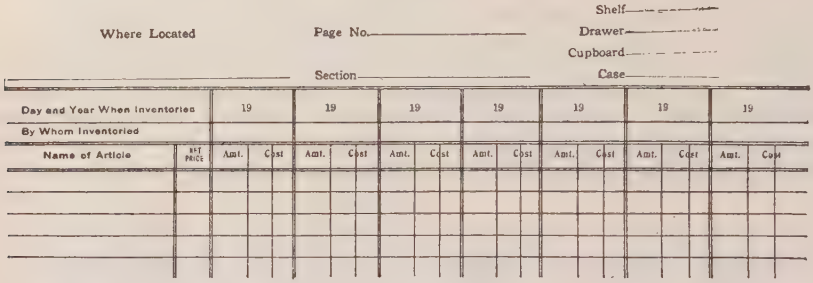


Illustration of the inventory sheets of the American Druggists' Fire Insurance Company (one-half size)

taken, and subtracting from it the estimated cost of goods sold since the actual inventory.

The following will illustrate the calculation:

If the per cent relation last year was:		
Sales	100 per cent	
First cost of goods	65 per cent	
Expenses	25 per cent	
Net profit	10 per cent	
And if the last actual inventory was		$7,000.00
And goods bought since the last actual inventory had cost		$3,000.00
The total value to account for would be		$10,000.00
Now the sales since the last actual inventory were	$4,600.00	
And as the goods sold cost 65 per cent of $4,600.00 or		$2,990.00
Therefore, the present inventory, by calculation (using the law of averages), would be		$7,010.00

This method is not recommended, but in case of necessity will give a fair idea of the value of stock on hand.

There are many items in the stock of the average pharmacy that justify the complaint that taking an inventory in a drug store presents unusual problems, but most of the difficulty lies in trying to take a correct account of open packages and partially filled containers. The inventory should be as exact as possible but there are occasions when only an estimate of the contents of a bottle of tablets or pills, or of some chemical, is justified. The experienced eye can quickly note whether the container is half full or one-quarter full, etc. If a stock container is used for the storing of chemicals and powdered drugs, an empty container of the same type, placed as a tare on one side of the scale, with the partially filled container of the substance to be inventoried on the other, the approximate weight of the contents can be readily determined with sufficient accuracy for the purposes of the inventory. In the case of

liquids a measuring stick is sometimes employed. This can be prepared for standard quart, pint, and half pint bottles by taking an empty bottle, adding an ounce of water, inserting the dry stick until it rests at the bottom of the bottle, taking it out and making a mark at the top of the moistened section, and continuing the process, ounce by ounce, until the measuring stick for that

FIG. 467

Dozen Price	1/12	1/6	1/4	1/3	5/12	1/2	7/12	2/3	3/4	5/6	11/12
.40	.04	.07	.10	.13	.17	.20	.24	.27	.30	.34	.37
.50	.05	.09	.13	.17	.21	.25	.29	.34	.38	.42	.46
.60	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55
.75	.07	.13	.19	.25	.32	.38	.44	.50	.57	.63	.69
.80	.07	.14	.20	.27	.34	.40	.47	.54	.60	.67	.74
1.00	.09	.17	.25	.34	.42	.52	.59	.67	.75	.84	.92
1.20	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00	1.10
1.25	.11	.21	.32	.42	.53	.63	.73	.84	.94	1.05	1.15
1.50	.13	.25	.38	.50	.63	.75	.88	1.00	1.13	1.25	1.38
1.75	.15	.30	.44	.59	.73	.88	1.02	1.17	1.32	1.46	1.61
2.00	.17	.34	.50	.67	.84	1.00	1.17	1.34	1.50	1.67	1.83
2.10	.18	.35	.53	.70	.88	1.05	1.23	1.40	1.58	1.75	1.93
2.25	.19	.38	.57	.75	.94	1.13	1.32	1.50	1.69	1.88	2.07
2.40	.20	.40	.60	.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20
2.50	.21	.42	.63	.84	1.05	1.25	1.46	1.67	1.88	2.09	2.30
2.75	.23	.46	.69	.92	1.15	1.38	1.61	1.84	2.07	2.30	2.53
3.00	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75
3.25	.27	.55	.82	1.09	1.36	1.63	1.90	2.17	2.44	2.71	2.98
3.50	.30	.59	.88	1.17	1.46	1.75	2.04	2.34	2.63	2.92	3.21
3.75	.32	.63	.94	1.25	1.57	1.88	2.20	2.50	2.82	3.13	3.44
4.00	.34	.67	1.00	1.34	1.67	2.00	2.34	2.67	3.00	3.34	3.67
4.20	.35	.70	1.05	1.40	1.75	2.10	2.45	2.80	3.15	3.50	3.85
4.25	.36	.71	1.07	1.42	1.77	2.13	2.48	2.84	3.19	3.54	3.90
4.50	.38	.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75	4.13
4.75	.40	.80	1.19	1.59	1.98	2.38	2.77	3.17	3.56	3.96	4.35
4.80	.40	.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	4.00	4.40
5.00	.42	.84	1.25	1.67	2.08	2.50	2.92	3.34	3.75	4.17	4.58
5.25	.44	.88	1.32	1.75	2.19	2.63	3.06	3.50	3.94	4.38	4.81
5.50	.46	.92	1.38	1.84	2.30	2.75	3.21	3.67	4.13	4.58	5.04
5.75	.48	.96	1.44	1.92	2.40	2.88	3.36	3.83	4.31	4.79	5.29
6.00	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50
6.25	.53	1.05	1.57	2.09	2.61	3.13	3.65	4.17	4.69	5.21	5.73
6.50	.55	1.09	1.63	2.17	2.71	3.25	3.79	4.34	4.88	5.42	5.96
6.75	.57	1.13	1.69	2.25	2.81	3.38	3.94	4.50	5.07	5.63	6.19
7.00	.59	1.17	1.75	2.34	2.92	3.50	4.08	4.67	5.25	5.84	6.42
7.50	.63	1.25	1.88	2.50	3.13	3.75	4.37	5.00	5.63	6.25	6.88
8.00	.67	1.34	2.00	2.67	3.34	4.00	4.67	5.34	6.00	6.67	7.34
8.25	.69	1.38	2.07	2.75	3.44	4.13	4.81	5.50	6.19	6.88	7.57
8.50	.71	1.42	2.13	2.84	3.55	4.25	4.96	5.67	6.38	7.08	7.79
8.75	.73	1.46	2.19	2.92	3.65	4.38	5.11	5.83	6.57	7.29	8.02
9.00	.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25
9.25	.78	1.55	2.32	3.09	3.86	4.63	5.40	6.17	6.94	7.71	8.48
9.50	.80	1.59	2.38	3.17	3.96	4.75	5.54	6.34	7.13	7.92	8.71
9.75	.82	1.63	2.44	3.25	4.07	4.88	5.69	6.50	7.32	8.13	8.94

Table for determining the cost of fractions of a dozen

particular bottle has been completed. At inventory time, it is only necessary to place the stick along the side of the bottle and determine quickly how many ounces of liquid it contains. Of course, there must be a different stick for each type of bottle. If the bottle is uniform in width it is not necessary to prepare the stick by dipping it into a bottle to which an ounce of water at a time is added. One can simply determine the length of stick required to measure an ounce and then divide the stick into sections according to that measurement.

For example, if an ounce of liquid in the bottle measures half an inch, the stick can be divided into half inch sections, each representing an ounce.

In the case of pills and tablets where a bottle is known to hold 100 tablets when nearly filled the remaining number can be estimated by the amount of space in the bottle. The same is true in the case of powders, although, of course the specific gravity of the powders must be taken into consideration and where the quantity is fairly large it is best to weigh it, using an empty bottle to balance the container.

When the inventory sheets are prepared in advance and it is only necessary to call off the items and quantities, leaving the pricing to be done later, it is not a very difficult matter to run through the stock of a store in the course of a day. Whether or not to close the store while inventory is being taken is a question that must be determined by each storekeeper. Sometimes a Sunday or a holiday is used, or the store is closed on a day when it would not be very busy anyway, giving notice to the public that prescription and emergency service are being continued but that the other departments are temporarily closed. It is also possible to avoid closing the store by taking the inventory at night and using sufficient help to cover the store in a given time. The store force can be divided into teams, one man calling off and the other writing down, with one team starting at one section, another at a different section, and a third at still another location. In this way the work can be expedited. In the larger stores this is carried out very quickly.

While alphabetical lists of the items in the drug store stock are valuable, especially when it comes to pricing—the price lists being arranged alphabetically—for purposes of rapid inventorying the lists arranged according to the location of the various articles in the store are preferable.

In some large establishments arrangements are made for weekly or monthly inventories of individual departments. What amounts to a perpetual inventory can very readily be arranged in bulk stockrooms if one has the personnel and the facilities to carry it out. In such a case the stock in the storeroom is listed on a card fastened to each bin or section. Whenever anything is removed the quantity is subtracted and when anything is added this is likewise noted. The card therefore shows not only the contents of the bin but the actual quantity of each item which should be there. The amount of stock on hand can thus be noted at any time.

A table of extensions (see Fig. 467) is useful in rapidly calculating the cost of fractions of a dozen.

CHAPTER LXXXIII

METHODS OF EXCHANGING COMMODITIES OR SERVICE FOR PROFIT

The methods of exchanging service or commodities for profit in any profession or business involve advertising and selling. Both advertising and selling are subjects of special and extensive study on the part of those interested in merchandising and it is only possible in these pages to call attention to some of the applications of these arts to the commodities and service offered in the retail pharmacy. For extensive information on advertising and selling problems the student is referred to the bibliography of the subjects given at the end of this chapter.

Advertising

Under the heading of advertising may be considered any fair means employed for the purpose of convincing people of the value of a point of view, a service or a commodity, and in the case of the latter two, endeavoring to arouse the desire for utilization or possession. When advertising takes the form of a word of mouth or printed word message in behalf of a cause—political, social, or economic—it is generally referred to as propaganda. During the World War the word propaganda achieved a more or less sinister meaning which it has not entirely lost. It was used to designate in an uncomplimentary way the efforts of foreign powers to present their cause to citizens of this country by means of special publications, lectures and the circulation of stories for newspaper publication in such a way as to malign their enemies and endeavor to secure our support. As a matter of fact, propaganda of one kind or another is essential to the promotion of any just cause. The objection to the term and to propaganda itself has no foundation as long as it does not represent unfair and reprehensible methods or activities.

If physicians through their medical organizations take steps to issue articles to the newspapers condemning the use of proprietary medicines or self-medication in general they consider this proper and legitimate propaganda in the interests of the public health. Manufacturers of proprietary medicines on the other hand look upon such publicity as propaganda directed to the destruction of their business and in favor of bringing patients to the doctor's office. The interpretation depends entirely on the point of view and it can be seen at once that there is no fault to be found with propaganda as such but rather with the point of view which the propaganda attempts to popularize. Propaganda is a form of advertising, usually in the nature of reading matter, which is taken advantage of by all kinds of advertisers and is considered legitimate as long as no attempt is made to spread information which would be seditious or inimical to the welfare of the people.

Every year during the national and local election periods the managers of the various political parties issue reams of propaganda in behalf of their candidates to various publications and much of this matter is served to the public in the form of newspaper and magazine stories. The average citizen does not realize that most of this matter which he reads in his daily paper is prepared in the office or by the direction of the campaign committee and is naturally colored to suit their specific purpose. In the Baltimore Sun of November 23, 1923, there appeared the following statement by Frank R. Kent,

a well-known Washington correspondent which gives an interesting side-light on this subject:

> "Every one of the active presidential candidates today—and some who are apparently though not actually, inactive—has a publicity machine of his own hard at work. McAdoo has one, Underwood has one, LaFollette has one, Hiram Johnson and Henry Ford have theirs, and President Coolidge has his. The public is not supposed to be aware of the existence of these machines and, as a matter of fact, is very largely unaware of them. The insiders of the political game know about them. The Washington newspaper correspondents and a good many managing editors know about them, but it is the custom not to mention them, pretend they do not exist, to keep the covers on the publicity machine. Most of the stuff—interviews, speeches, statements, articles, little human interest stories and the like—that you see in the newspapers and magazines about these candidates these days look like spontaneous news. It is nothing of the sort. On the contrary, the great bulk of them are the canned products of a nationally geared publicity machine, designed solely to promote a presidential candidacy."

Large scientific organizations and in fact all kinds of organizations whether they be religious, technical, educational, or political now maintain publicity bureaus whose sole duty it is to send out, periodically, information regarding their specific work so as to keep the public informed of what is going on in their sphere and endeavor to create a favorable reaction toward that work. Such favorable reactions often lead to philanthropic bequests for education, for scientific research, or for other purposes. This is not considered advertising in the same sense that a billboard announcement or a paid advertisement in a newspaper is considered advertising. It is really free as far as the cost of space is concerned but it is costly nevertheless because the machinery for preparing and issuing such information runs into considerable money.

With so many publicity bureaus constantly issuing material to the newspapers there is very little opportunity for the individual to get into the day's news unless he does some outstanding thing and attracts favorable or unfavorable attention. There are some individuals who maintain their own publicity bureaus. Noted musicians, actors, moving picture stars, pugilists, politicians and others all have their so-called press agents who issue stories, interviews, or news items about them whenever they desire to attract public attention. It has been generally believed that this kind of advertising is more valuable than the paid advertising because the reader does not classify it as advertising in his mind when he sees it and reads it. On the other hand there are now millions of people who are more quickly attracted through paid advertisements than through the reading columns of newspapers and magazines. This is in reality a tribute to advertising because it indicates that in many instances it has outgrown its former position of being considered a necessary evil in newspapers and magazines. In the past it was generally assumed that the advertiser departed considerably from the truth in explaining the great merits of his products. Today not only is there truth in advertising but more and more advertisements have real literary and artistic merit and frequently give extremely interesting and valuable information. A respectable newspaper or magazine will not accept advertisements that are not in accord with the facts.

The old belief in the great value of obtaining advertising through a story or the mention of a name or a product in the reading pages of a newspaper or magazine causes many advertisers to still demand so-called "reading notices" in newspapers, magazines, and other advertising mediums. The better class of publications have discontinued this practice but in small town papers one still finds in the personal columns and elsewhere short statements extolling some remedy or some individual or concern in a manner to give the impression

that it is an editorial comment. Very often such "reading notices" are paid for at a regular rate.

Pharmacists may benefit to some extent by propaganda work in their behalf but it must of necessity be limited very largely to a discussion of the merits of the profession as a whole, the service rendered, the discoveries made and the legislation fostered or opposed. There is nothing of a selling character in such propaganda, but benefit comes to the profession through the increased knowledge and respect which the public may acquire as the result of reading about what is being done by the profession. Individual pharmacists are in a position to reap the benefit of publicity resulting from their own activities in civic or professional lines and it is entirely proper for them to keep the newspapers in their locality advised of various accomplishments. Very often reporters make periodic visits to those who are apt to furnish occasional news.

Paid Advertising—In general there are two types of paid advertising. (The term "paid" is here used to denote the fact that the advertising appears in space which is purchased.) The first type is intended to sell specific products or services and the second to sell ideas about individuals, industries or members of industries. Let it be imagined, for example, that there are no talking machines of any kind on the market and that such a machine has just been invented. The first step on the part of those who are convinced that talking machines have a great future in the American home and who have backed that opinion by putting their money into an organization to manufacture talking machines would be to sell the American people the idea of getting a certain amount of pleasure out of the ownership of such a machine. They would have to demonstrate the fact that a voice could actually be reproduced and that it would be entertaining as well as educational to bring the voices of noted singers, the music of celebrated artists, and the funny stories of well-known comedians into the home whenever desired. This part of the introductory work would be entirely educational and the advertising in this case would be strictly educational in nature. Having completed the campaign of education and by demonstration convinced a sufficient number of people that talking machines are a good thing to have, the problem now turns into one of selling a specific make of talking machine and as a result there are advertisements, extolling the merits of the Victrola, the Sonora, the Pathé machine, and others, each endeavoring to point out in what particulars it is superior to all other talking machines and endeavoring to sell that particular brand.

In the matter of advertising drug store products to the public a similar example could be cited. A campaign of education to convince people that it is proper to clean their teeth or that it is advisable to use antiseptics for cuts, bruises, etc., is purely an educational proposition. On the other hand the advertising of a particular tooth paste, or tooth powder, or liquid dentifrice is a selling proposition. The advertising of a particular antiseptic solution for use in cuts, burns, bruises, etc., is likewise a sales effort.

Institutional Advertising—We have examples of various industries pooling their resources for the purpose of conducting campaigns of education which will benefit the entire industry but which do not attempt to create sales for any particular product. The national campaign conducted by the florists with their well-known slogan "Say It With Flowers", a similar campaign conducted by paint manufacturers with the slogan "Save the Surface and You Save All" and the endeavor to popularize the idea to "Try the Drug Store First" and that "Your Druggist is more than a Merchant", are all examples of this type of educational or institutional advertising. Such advertising does not attempt to sell a single product or brand of products but rather to convince the public of the value

of making a more frequent purchase of flowers, the preservative value of a coat of paint for a house or the fact that the druggist is offering professional service and that he is most apt to have the things usually associated with pharmacy which might otherwise be purchased at department stores or other establishments. Such advertising is usually followed up by the selling type of advertising in the locality where the individual member of the business or profession is located. A local florist, a local painter, or a local druggist can profit by tying up his advertising with this national goodwill advertising if he desires to reap the full benefit of it. The national campaign tells the people that druggists are more than merchants. The wide-awake individual druggist then identifies himself as the one who is talked about in this national campaign.

At this point the question might be asked when should advertising be of the educational type and when should it be designed to sell goods? The answer to this question would be that whenever an entirely new idea or a new thought regarding products or a service are to be communicated to the public, it is necessary to "sell" the idea first. If the central idea about the product already has been popularized and the individual purchaser is not any longer deciding whether he wants the thing or not but rather which brand of the thing is best, then the advertising should be of a selling nature. There are times when both kinds of advertising can be run simultaneously to advantage. In fact, large advertisers sometimes run them in the same advertisement, the one to keep the public informed of new developments or to keep it "sold" on an old idea and the other to stimulate the sales of a particular product one wishes to dispose of.

Factors Involved in Advertising—The actual publication of an advertisement, no matter what form it may take, involves first a marshalling of facts on which the advertisement is to be based, secondly, the preparation of the advertising "copy", third, the reproduction of the "copy" in acceptable form through an advertising medium. Following the appearance of the advertisement there should be a checking up of results as far as that may be possible.

Preparing Copy—The need for information about the idea or product to be advertised before an attempt is made to write anything about it cannot be overemphasized. Many small merchants while realizing the importance of advertising consider the preparation of the advertisement as merely so much space to be filled with words or illustrations but anyone who has made a study of the subject or even one who has had a fairly good general education is immediately able to characterize an advertisement as good, fair or poor, if it is on a subject about which he understands something. It therefore behooves the merchant to make the space, which he buys in some advertising medium, of real value to himself, by attracting the attention of the reader and holding his interest sufficiently to enable him to absorb the idea which he is trying to convey and to act upon the suggestion to purchase. No one can write effective advertising copy without a knowledge of the facts about a product and some knowledge of the likes and dislikes of people as well as the workings of the average mind. There are some people who instinctively possess the ability to write in a manner that appeals to the multitude. Such people are comparatively rare and are not as a rule found among small storekeepers. To the latter the preparation of advertising "copy" is more or less of a burden. In recent years there has come into being a profession of advertising writers whose life work it is to make a study of how to convince the public through the printed word and who have schooled themselves or have been schooled to write accordingly. The average storekeeper if he is asked to write an advertisement about a

product will, as a rule, look up what has been written about some competitor's product and by changing words and sentences and perhaps adding an argument here and there, produce something which has very little originality about it. What he should do and what a real advertisement writer would do would be to sit down and make a note of all of the talking points that he can think of about the product after a study of its composition and uses. He may then consult the literature and advertising of competitors and see what they say about similar products. Finally he will interview customers who have used the product in order to get not only favorable comment but also unfavorable comment, if there is any. It is important to know both the advantages and shortcomings of a product before one starts to write about it. Having made a record of all of this, it is now possible to write a series of arguments in behalf of the product which will counteract as much as possible, the arguments against it and forcefully state whatever may be said in favor of it.

It will be found when all of the facts have been collected in this way that there is more than sufficient material at hand for a great deal of printed advertising. It is not wise to use all of this information in one advertisement. Of course, when one is writing a booklet about a product all the information can be included, but when one is limited to a small space only one or two arguments can be taken at a time and driven home. By having all of the facts at hand, a series of advertisements can be written at one sitting which will be sufficient to last for several months and after that they may be altered to suit new conditions and used again as the stock arguments will of course remain the same. Anyone who follows the national advertising of popular products knows that it is largely repetition of one or two salient points that makes the advertising effective. Occasionally new thoughts may be expressed but there is always a recurrence of the stock arguments which, once having been impressed on the public mind, are recalled again and again by continuous repetition until they become as much a part of everyone's general knowledge as the days of the week.

Naturalness is most desirable in advertisements. The copy should reflect the personality of the proprietor. By imparting his own individuality to advertisements the proprietor achieves the same effects that he does in personal contacts with his customers.

In writing advertisements and circular letters the proprietor is apt to be influenced by the large number of people he is addressing and his style consequently takes the form of an oration. He should not do this. He should remember that, in spite of his large audience his advertisements are read one at a time by individuals. His style should be personal and not oratorical.

The word "copy" has been used in these paragraphs frequently. Its meaning in the parlance of writers and printers is the manuscript that is turned over to a printer to be set into type. What the writer produces is "copy" to the printer. After the "copy" is set in type, the printer "pulls" a "proof", usually on a long sheet of paper. The "proof" is corrected by the author and returned to the printer who makes the corrections in the type and then "makes it up" into pages, or if it is a display advertisement he sees that it is properly inserted in the space contracted for.

With the facts at hand the writing of advertising copy is largely a matter of stating the facts tersely and in good English that may be understood by the average twelve year old child. One need not be an expert writer in order to prepare a fairly good advertisement if these requirements are met. Very often a fact or a story told in the advertiser's own language and in his own way is far more effective than the flowery language employed by an alleged expert

copy writer. We have many examples in the advertising of the day in which the individuality of the advertiser is the outstanding characteristic and its greatest asset. With the advertising copy there should be sent to the printer a layout indicating how the matter is to appear in the space available. Some merchants are artistic and have their own idea about how they would like to have certain matter appear in print. The printer on the other hand may have an entirely different idea and very frequently if no directions are given for a layout, what would ordinarily be a very good piece of copy, is spoiled by poor display and poor arrangement of the type. To guard against this, a pencil layout indicating the ideas of the writer should accompany the advertisement. One need not be an artist to make such a layout. There are printers who set type as directed to fill space. There are others with some imagination and a sense of the artistic. Fortunate indeed is the advertiser who secures the service of the latter. He can often turn poor copy into effective advertising by his expertness in producing a pleasing effect. Printing service of this kind is worth the extra fee that may be charged.

It is, of course, an advantage to the advertiser to know something about size and style of type and art work. Such knowledge can be acquired by home study or courses on the subject. There are some excellent books on these topics. By going through the printer's book of type faces and stock illustrations and also by a study of the advertisements in our national magazines and newspapers many ideas will suggest themselves.

Advertising Agencies

Reference has been made to the fact that there exists a group of professional advertising writers and it is, of course, well known that much of the writing and placing of advertising is now in the hands of advertising agencies. The service which an advertising agency renders to its clients is manifold and when the agency is a large one its activities lead into practically all the avenues of commerce. There are small agencies which are comparable to the one-man drug store in that the proprietor usually takes care of all the departments of the business and then there are larger organizations in which the work has multiplied to such an extent that each department of the business is in charge of some expert.

The business of the advertising agency includes research work connected with the collection of facts on which to base the advertising; space buying, which includes the task of obtaining the best positions in newspapers and magazines for the insertion of the advertising; copy writing, which includes the preparation of the actual advertising copy, the layout and the art work; placing of the advertising, which includes advice on what are the best mediums for the client and how much money should be devoted to each in order to obtain maximum results; checking, or recording the actual appearance of the advertisement in the newspapers and magazines before it is paid for, and tabulating returns. As a rule when an advertiser entrusts his work to an advertising agency, it costs him no more than if he were to place the advertising direct but he receives in addition, the service of the agency in the preparation of his copy. This service can be supplied because the newspapers and magazines allow the advertising agent a commission usually about 15 per cent, on the advertising placed by them. Where the amount spent for space is very much, the commission runs into a respectable figure. On small accounts it does not amount to much and if there is much service to be rendered, the agency charges the client a fee for that service. There are localities where

advertising agents do not receive commissions from newspapers on local advertising and in this case the agency usually adds 15 per cent of the amount spent as a service charge for preparation of copy and placing the advertising.

Unless a merchant or professional man is acquainted with advertising methods and takes a special interest in the subject and has the time to devote to it, it is really more economical to turn the advertising over to a reliable agency and have them take care of it. They will, of course, confer with the advertiser in order to get his ideas but the actual work of preparing and placing the advertising is taken off his hands. It is unsatisfactory for an advertiser to leave his advertising problems entirely in the hands of an agency especially if his work is professional as is that of the pharmacist. The agency does not as a rule have the professional viewpoint and it is incumbent upon the pharmacist to impress this viewpoint upon his agent and to keep constantly in touch with him and to insist on approving the copy before it is used. Only in this way can technical errors be avoided. An advertising agency may be expert in the technic of advertising but it cannot be expected to be expert in pharmacy. This much at least must be supplied by the pharmacist and he must remain in constant touch with the situation.

The function of the advertising agency is to supply the technical knowledge of advertising. The function of the advertiser is to supply the facts about the business to be advertised. The relationship is similar to that of a lawyer and his client.

Advertising Allowance—The amount of money spent for advertising by retail druggists has been variously estimated and will naturally vary with the type of store that is being conducted. It is safe to say that the amount justified for general advertising should not greatly exceed 2 per cent of total sales and only by carefully checking the results and on indication that a larger expenditure is warranted should more than this be set aside for advertising.

Advertising Mediums—Advertising mediums may take the form of newspapers, magazines, circulars, billboards, signs and cards, letters, window displays, counter displays, theater programs and programs of church affairs, street car cards, calendars, and any other means by which a printed message can be conveyed to the public.

For the advertising of the average retail druggist this list is naturally narrowed to a few of the mediums named while larger concerns may use all of them. Obviously it would not pay the small neighborhood druggist to advertise in a newspaper covering an entire large city. On the other hand, it might be very profitable for him to advertise in a newspaper which covers his section of the city only, or if he is located in a small town where there is a weekly or even a daily paper, advertising in this publication can be made of considerable value. The deciding factor will be the percentage of the circulation of the newspaper which reaches people who are in a position to deal at the store if the advertisement attracts their attention. In a city of a million or more inhabitants it is not uncommon for a single newspaper to have a circulation of some two or three hundred thousand. The advertisement of a neighborhood druggist in such a paper might be read by many of its readers but less than 1 per cent of these readers live within walking distance of his store, consequently, 99 per cent of the amount spent for advertising might be considered waste.

As a general rule it may be stated that newspaper advertising is profitable for the average drug store in a small town newspaper, in a strictly local newspaper and only in the metropolitan newspaper when the store is located in a central section where a large proportion of the readers of the paper are able

to take advantage of the commodities or service offered for sale. The same is true of magazine advertising. It must also be remembered that magazines are usually monthly publications and unless they happen to be purely local publications it would not pay to advertise a single drug store by this means because there could be no satisfactory return. On the other hand for coöperative advertising of all the stores in a state, or in a group of states, the magazine offers splendid opportunities because magazines as a rule are read eagerly and while the reader is at leisure and has time enough to absorb the information given in the advertisement. The educational and institutional type of advertising is therefore well placed in a magazine by groups of pharmacists. Similarly chain stores or organizations of retailers marketing popular articles which are for sale only in certain stores in different cities can profit by advertising in magazines.

Street car advertising may be profitable in the line of cars which passes a store but it would not be profitable when extended to cover an entire city unless the store is located in a central section where it is available to all shoppers while they are "down town". Billboards can be used on roads leading to a town where the drug store is located but in the large cities they are of no special value for the advertising of an individual store. They are of great value in the advertising of drug store products, however.

Show cards and signs used on counters and in window displays are very effective and constitute one of the best advertising mediums of the average store. Advertisements in programs of neighborhood church affairs are considered more or less of a donation. Theater programs are not considered very good advertising mediums unless the store is located adjacent to the theater or in the theater building. Every retail pharmacist has the opportunity to constantly keep before his customers information regarding his service or products by the method of wrapping with each package a circular on something that he wishes to call attention to. Many pharmacists do not take advantage of this opportunity but there are stores in which there is always a supply of circulars on the wrapping counter so that whenever a package is wrapped up a circular is automatically enclosed. Much of this advertising may go to waste but if only one circular out of five, or even ten, is read, it may create a sale or add to the prestige of the store. It is wise to change these circulars frequently and not to depend entirely on manufacturers of proprietary products of one kind or another to furnish all of the circulars used. The opportunity is so good that the pharmacist should really take advantage of it to the fullest extent by preparing his own circulars recommending certain of his own products. It is easily demonstrated that advertising of this kind creates a demand for a product and if the product has merit, it will of course be repeated and talked about and thus gradually acquire a local reputation.

Ready-made circulars imprinted merely with the druggist's name cannot take the place of individually prepared circulars any more than slot machines can take the place of personal salesmanship. Imprinted advertising matter is far better than none at all, but the added effort and cost required for individual advertising matter is amply repaid if any care at all is used in its preparation and distribution.

In a neighborhood community the pharmacist has an opportunity to become acquainted with all of the customers in his territory and this gives him an opportunity to do a great deal of advertising by word of mouth. This opportunity should not be overlooked but even if he does meet his people face to face very often the habit of circularizing the neighborhood either with a printed circular or handbill or by means of a letter is a good one. People who

cannot be reached by the ordinary methods of advertising can be reached by mail. For the price of printing or mimeographing a letter and a two cent stamp one is able to take a message right into the home of the individual and at least call his attention to the contents and discuss business subjects for which the opportunity may never be given in any other way. If this kind of advertising is resorted to it ought to be given sufficient attention so as to accomplish worth while results. Letters should be dignified, not too long, yet long enough to tell their story completely and of sufficient interest to warrant their reading. If the pharmacist makes it a practice to send out a letter once a month to his customers it is quite certain that the first and second letter will be looked over but if there is nothing in them that is worth while, subsequent letters will be thrown in the waste basket very promptly. On the other hand, if the letters get the reputation of having something worth while in them they will be looked forward to and will always command attention. One can judge the habits of the average citizen fairly well by personal action under similar circumstances. Pharmacists are flooded with all kinds of mail advertising in the form of letters, circulars, broadsides, etc., and in practically every case it is possible to mention a few outstanding concerns whose advertising and whose letters are read and even looked forward to while the vast majority are given very little attention. Mail advertising therefore should be given very careful consideration and, if it is indulged in, should be prevented from becoming a waste, by careful study of what people would like to know and what may interest them. A haphazard letter may pull occasionally but for permanent success it is necessary to give this form of advertising the same amount of attention as one would give a customer on his personal visit to the store.

Kinds of Advertising—From the standpoint of the people to whom the advertising done by the pharmacist is directed, we may divide the subject into that which is intended for the general public and that which is intended for physicians, dentists and veterinarians.

Unfortunately, the average pharmacist does very little advertising to physicians, dentists and veterinarians. Usually the proportion of such advertising done varies directly with the amount of professional work carried on in the pharmacy. Pharmacists who are interested in building up their prescription business and making this the main feature of their work naturally do considerable advertising to the medical professions. Others leave this field entirely to the manufacturing pharmacists and their detail men.

Detail Work with Physicians—The modern method of keeping physicians informed of the advances in therapeutics, the marketing of medicinal products, etc., is to send a representative, known as a detail man, to the physician and thus give him first-hand information about the composition and merits of the product and the relief following its use. Such detail men must establish their identity with the physician and gain his confidence before they can make very much headway. It would seem therefore that the local pharmacist who has every opportunity of coming in daily contact with physicians would have a much better opportunity of acting as his own detail man for U. S. P. and N. F. products than the representatives of manufacturing houses, but it is also true that the average retail pharmacist does not take the time to do this. Physicians can be educated to look upon the pharmacist as their source of information instead of upon the literature and talk of the traveling detail man. Naturally, the pharmacist who attempts to do this kind of work must keep himself informed constantly of the developments in medicine and pharmacy, but he will find

that, once his physicians realize he has such knowledge, they will become his very warm friends and patrons.

Supplementing the personal visits of the pharmacist to explain and to give information on U. S. P. and N. F. products as well as on his personal service there should be periodic letters, on topics of interest designed to keep the physician informed of what the pharmacist has to offer in the way of improved prescription service, etc. Manufacturers will frequently offer to send letters on the pharmacist's letter head to a selected group of physicians, advertising the pharmacist and at the same time calling attention to the fact that he has in stock certain preparations which the manufacturer may be exploiting at the time. In such cases the pharmacist should insist on seeing the letter before it is sent so that he will not be called upon to endorse anything blindly. The manufacturer, of course, pays the expense of preparing and mailing the letter, the only expense to the pharmacist being the cost of his letterheads and envelopes.

Advertisements in weekly or monthly bulletins of local medical societies are helpful. They identify the pharmacist at once as one who is interested in cultivating the acquaintance and patronage of doctors. A pharmacist who is interested in developing his prescription service should read the *Journal of the American Medical Association* and, perhaps one or two other good medical journals so as to keep himself informed of new developments in therapeutics and pharmacology. It is good advertising to be able to speak to the doctor about new medicinal preparations, knowing the angle from which the subject was treated in the publications which the physician himself reads.

Giving physicians a percentage rebate on prescriptions or presents of various kinds in exchange for their help in building up the pharmacist's prescription business is contrary to the Codes of Ethics of both professions and the codes should be followed to the letter on this point (see page 9). There is no harm in occasionally presenting a physician with something as an expression of goodwill or in allowing a reasonable reduction in price on items for his personal use, but it is not necessary or proper to sell things to the physician at factory cost without figuring in the pharmacist's overhead. That would really be selling the item at a loss and no one is expected to do that.

It should be remembered at all times that the physician is a busy man and that even those who are most favorably disposed toward the pharmacist personally, cannot be expected to carry in mind the details of the latter's service. This can only be fixed in his mind by the results which he sees or hears. Constant reminders are therefore not out of order but really necessary.

Advertising to the Public

In his advertising to the public the pharmacist should feature service rather than price on articles of merchandise as well as on drugs and prescriptions. The "service buyer" is always more valuable to the store than the "price buyer". It is true that chain stores and other organizations located in transient sections feature price and often cut the prices of standard nationally advertised goods so low that the average pharmacist cannot compete with them. It is best not to try to compete with chain organizations on the basis of price but to turn the attention of the customer in an entirely different direction, namely, that of service. Independent pharmacists who have succeeded in attracting public attention to their service are rarely bothered with the price question. Where there are so many side lines it is difficult to adopt a general policy that will fit all departments, but a few general rules can be laid down.

Service is intangible but none the less real. It is the force which draws

people to one store in spite of the attractions of competitors. It may express itself in a passion for cleanliness and order in the store. Attentive, well mannered and well informed employees give a store a reputation for service. Prompt deliveries by intelligent messengers accomplish the same purpose. A willingness to pass the time of day with sociably inclined customers also helps. A stock up to date and constantly supplemented by new merchandise is a compelling factor. In fact, the customer's sentiments about service can be summarized in the following sentence, "I like to trade at Blank's because they have such a nice store and are always so pleasant and you can always depend on them to have what you want." A store with a sufficient group of customers expressing sentiments of that kind has little to fear from unethical competitors.

It is not desirable for the average pharmacist to advertise "ready made" medicines too strongly if he expects the coöperation of physicians. Physicians are opposed to self-medication and rightly so. They do not object to the featuring of household remedies as has been well demonstrated in a recent national advertising campaign by a pharmaceutical manufacturer, but they are opposed to the general endeavor of medicine manufacturers to create the impression that every ailment can be cured by some concoction of drugs. Good professional practice requires that not only the attitude of physicians but the ethical basis of such procedures be taken into consideration and that nothing offensive shall be displayed or otherwise given great prominence in the pharmacy.

The pharmacist must bear in mind that in many national advertising campaigns he is at the end of the chain which is expected to link the public with the manufacturer. A national advertising campaign will be unsuccessful if the product advertised is not available or if it does not have the support of the dealer who sells directly to the public. Many a good product has been a business failure because of lack of coöperation on the part of the retailer and some mediocre articles have acquired national prominence because of the support given them by the dealer. The pharmacist's judgment as to whether to support or withhold support from a national campaign should be based on the quality and utility of the product rather than upon its profit possibilities exclusively. He should not permit the use of his name in promoting it unless he is sure that the preparation has merit.

The pharmacist must always remember that the people who trade at his store are *his* public and that if he does not cultivate their goodwill and establish his identity with them he will simply be known as a dispenser of nationally advertised products and a convenient source of a large variety of goods. No national advertiser can establish a reputation for an individual pharmacist. This he must do himself and for that reason he must prepare and issue a certain amount of advertising of his own in which he and his service are the central themes. The methods of advertising to the public have been discussed to some extent under the various advertising mediums in foregoing paragraphs, and it has been pointed out that advertising by means of circulars and other literature wrapped with packages and an occasional personal letter are very effective for the average store.

Mailing Lists—In order to carry out such individual advertising, the pharmacist should have an up-to-date mailing list of the people in his vicinity. Such a mailing list can be obtained from a register of voters in the election district, from city directories, from organizations which make a specialty of supplying such lists, or it can be built up by the pharmacist himself. The latter procedure is somewhat tedious but it is perhaps the most satisfactory. It

will insure that the mail or other matter goes directly to people who are interested. The pharmacist starting out in a new neighborhood can request his customers to fill in a card giving name, address, telephone number, etc., on the pretext of wishing to keep the name on file for deliveries or for the mailing of something desirable in the way of a gift. A contest of some kind can be run which will require the participant to fill in an information blank at the same time that a guess is made of the number of pills in a large container or the weight of some substance. There are many other forms of contests which have been devised from time to time to attract attention, and arouse interest and they accomplish much for the pharmacist who has only a limited sum to spend for the information which he will receive as a result of such a contest. Once the mailing list is obtained, it is well to divide it into male and female groups so that if information is to be sent out on face powder, for example, it will go only to the women in the group, and if cigars are to be the subject of a letter it will only go to the men. A close watch should be kept on the new arrivals in the neighborhood, not only from the standpoint of being able to give information on this subject but that the new people may be given some sort of a welcome, personal if possible, and if not, at least by means of a letter telling about the neighborhood store and how it serves the community.

The distribution of samples of products that are for sale is good advertising, provided the samples are placed in the hands of the proper people. Samples of drug products, for example, should never be handed to children. On the other hand, samples of toilet preparations or confectionery are very welcome and can be distributed quite indiscriminately with good results. The use of trading stamps and premiums as well as rebate cards recording the sale of certain quantities of merchandise and allowing credit for a given percentage of the amount spent, are very valuable in certain cases, but wherever there is a premium of any kind offered people are apt to suspect that it is made up in some other way at their expense. This is, of course, true. No merchant can afford to give away something for nothing. Wherever this seems to be done the merchant actually goes to some expense. That expense may be charged up to advertising. It is a question whether the same amount of money spent in more legitimate advertising would not bring as great a return in the long run.

Window Displays—Window displays are, of course, among the best advertising mediums which the pharmacist possesses. The window has been called the "eye of the store" and it can have a great influence on the success of the business. Some pharmacists have a reputation for always having attractive windows and their displays are the talk of the neighborhood. In transient sections window display space is often rented out to manufacturing concerns who wish to popularize something by means of a demonstration or an attractive display, and in such cases the pharmacist should be very careful that the display is one which he can conscientiously endorse and which will not in any way interfere with his professional standing. There is nothing wrong in renting out window display space to those who want it and very often it helps considerably in meeting the expense of the establishment. However, this should not be done to such an extent as to interfere with the individuality of the store. The art of window dressing is one at which many spend their entire business lives and much useful information may be obtained from books on advertising, by studying the displays of large department stores and other concerns where experts dress the windows or by taking a special course in the subject.

The first impression made on the passerby by a pharmacy is created by the appearance of the windows. If the windows register friendliness, cleanliness,

quality, dignity, or beauty, the impression will naturally be favorable. If on the other hand, they register slovenliness, carelessness, filth, cheapness, or ugliness, the impression is decidedly unfavorable. The favorable qualities can be provided readily.

One of the chief functions of the window is to attract attention. There must be some feature which will cause the casual passerby to observe the window. This may be brought about by special lighting, attractive and unusual colors, a special sign, a moving object or a living object. Many features will suggest themselves to anyone who is actually engaged in "dressing" a window.

Window lighting and construction have already been discussed on page 1313.

No display will attract more attention than a moving object—especially if there is some mystery about it, such as the continual flow of liquid from a bottle, but most attractive of all is the introduction into the window of a demonstrator, who carries out an operation requiring special skill.

After attracting attention, there must be some central feature of the window on which the attention of the passerby is focused to the extent of converting his interest into a desire to own the article advertised. If the window fails in this it is not 100 per cent effective. The window decorator should be his own most severe critic. He should mingle unobserved with the people who are attracted and listen to their comment. Many a valuable suggestion is thus gained. Of course the articles displayed should be seasonable, reasonably priced, and of a nature to make an appeal to a large percentage of those who pass the store.

The following suggestions are taken from the "Calendar of Seasonable Window Displays" printed in the *N.A.R.D.* Journal:

January—Clinical Thermometers—Hot-water Bottles—Prescriptions—Atomizers—Soap—Sick-room Supplies—Garden Books—School Supplies—Camphorated Oil.

February—Cough and Cold Medicines—Lincoln's Birthday (special)—St. Valentine's Day (special)—Chest Protectors—Tooth Brushes and Dentifrices—Corn Remedies—Garden Seeds—First-Aid Packets—Candy—Medicinal Soaps—Spirit of Peppermint.

March—Wall Paper, Paint, Brushes—St. Patrick's Day (special)—Manufacturing Display—Sponges and Chamois—Housecleaning Helps-Stationery—Veterinary Remedies—Condition Powder—Bird Seed—Fish Food and Aquaria—Solution of Magnesium Citrate.

April—Varnish—Outing Goods—Easter (special)—Perfumes—Toilet Preparations—Cameras—Dog Remedies—Dye Stuffs—Combs and Hairbrushes—Skin Lotions—Cleansing Preparations—Borax—Soda Fountain Opening—Clean-up Week (special).

May—Thermometers and Barometers—Decoration Day (special)—Medicinal Herb Display—Insecticides, Paris Green and such—Olive Oil—Fountain Pens—Fly Paper—Food Products Exhibit (tea, cocoa, honey, gelatin, maple syrup)—Moth Balls, Camphor—Baby Week (special).

June—Vacation Needs, Toilet and Medicinal—Cameras and Supplies—Soda Fountain—Flag Day (special)—Nursery Supplies and Baby Foods—Seidlitz Powders—Razors and Strops—Outing Goods—Liniments—Fishing Tackle.

July—Talcum and Face Powders—Fourth of July (special)—Stationery—Prescriptions—Cigars—Spraying Apparatus and Sprays—Rubber Goods—The Leading Advertised Summer Merchandise—Skin and Freckle Lotions—Rat and Roach Killers.

August—School Supplies—Soda Fountain—Old Home Week (special)—Spices and Flavors—Fly Paper—Soap, both Toilet and Laundry—Shoe Polishes and Clothes Cleaners—Talking Machines—Souvenirs—Trusses—Remedies for Summer Ailments—Insect Powder.

September—Labor Day (special)—Fair Day (special)—Tooth Brushes and Dentifrices—Novelties—Hair Tonic—First-Aid Packets—Paraffin Wax and Canning Specialties—Shaving Paraphernalia—Corn Remedy—Candy—Manicure Goods—Bath Supplies—Honey.

October—Columbus Day (special)—Hallowe'en (special)—Crêpe and Tissue Papers—Books and Magazines—Farm Supplies and Remedies for Fall and Winter—Prescriptions—Gymnasium Supplies—Cosmetics and Grease Paints—Hot Drinks—Soaps—Olive Oil.

November—Rubber Goods—Election Day (special)—Thanksgiving Day (special)—Stationery—Special Winter Remedies—Chest Protectors—Shoe Insoles—The Leading Advertised Winter Merchandise—Liniments.

December—Cigars—Candy—Games—Christmas and New Year's Cards—Perfumes—Christmas (special)—Flavoring Extracts—Musical Goods—Toilet Articles in Sets—Toilet Sets—Gifts—First-Aid Packets—Talking Machines—Cold and Cough Remedies.

A desirable addition to any display is cards (see page 1384), giving the price and other information in a few terse sentences. This has proved to be important, as often a prospective customer is fearful that the price will be prohibitive, and no matter how attractive the display, he will not come in and ask the price for fear of the embarrassment that would follow his not buying on account of the high price. Again drug store merchandise often requires a word of explanation to make it suitable for display. A small auxiliary display of the goods shown in the window should be arranged inside the store near the entrance so that the passerby who has been attracted by the window will see the same thing when he comes inside and can go to it immediately for his purchase.

Displays of a single item are best because they do not distract attention. However, the modern store window is so valuable that it becomes necessary very often to display several articles related to each other and sometimes even unrelated articles. By building up such displays in sections and making them sufficiently attractive so that they will not appear jumbled, several items can be advertised at once and the number of chances of attracting people are multiplied. When there is a mixed display, it is well to focus attention on some central idea, price or product for the purpose of carrying the passerby beyond the point of interest. Once a passerby has been persuaded to come inside of the store the salesmanship there displayed will decide whether he will purchase something in addition to what he came for. Very often the lure of a sample or a small gift with a purchase, or a bargain price, or an especially attractive article will induce people to come into the store.

Planning the Window—Before starting to decorate, the window should be planned, at least roughly. This may be done on paper. The goods that are in stock will largely determine the display. Many firms are offering special window display material with their goods. Such material will usually add to the attractiveness of the window, but must be used with discretion, for it may not conform with the ideals of the store.

Several fundamental things about the show window must be right. The window glass must be clean, and if there is any tendency for the window to "sweat" this must be corrected. Sweating, and in cold weather, frosting, are caused by the air inside of the window being warmer than that on the outside. It may be remedied easily by drilling holes in the bottom of the window, below

the glass, and also at the top, above the glass, so that air from the outside may circulate. In modern store construction this equalization of temperature is taken care of in the building of the show window.

The rear of the window should be closed by means of glass doors or frames. This is important, as the window can easily become dirty from dust of the store if it is not enclosed. The enclosure should be of glass or the storeroom will be unnecessarily darkened. Provision should also be made for preventing direct sunlight from reaching the interior of the window by the use of shades or awnings. Sunlight will quickly injure candies, rubber goods, fine packages, decorations, etc.

Everything that goes into the window should be attractive. The bottom of the window should always be raised six to eight inches above the lower edge of the glass. Supports should be used to raise the display from the bottom of the window. These need not be expensive; small bamboo stools are especially useful when combined with shelves of plate glass, enabling the building of a pyramid, which gives one of the most attractive forms of display. The same stools and plate glass may be used in many other combinations. Wooden boxes of assorted sizes are also useful and may be permanently covered with burlap or other material. Ready made display units of various kinds are also on the market.

There should be no hesitancy in spending a part of the advertising money for draperies, or for coverings for the bottom of the window. Crêpe paper in attractive colors may often be used. Cheesecloth can be bought in many shades and can be arranged to give good effects where the windows are not too large, and the grade of the merchandise offered for sale justifies the expense. More costly cloths, even velvet, are often used for special displays, such as perfumes.

Harmony in the color scheme should be kept in mind and if the color combinations in natural flowers are observed, no better guide can be secured for perfect harmony. The draperies, or other hanging materials, if inflammable, should be fireproofed by the use of a fireproofing solution. This is especially important if cotton is used in the window for Christmas or Easter display. Many serious fires have started in display windows.

Sodium tungstate solution, or a solution made according to the formula given below, may be sprayed on the material to render it fireproof:

Ammonium Sulphate	8 lbs.
Ammonium Carbonate	25 lbs.
Boric Acid	3 lbs.
Borax	1.7 lbs.
Starch	2 lbs.
Water	12 gal.

One cardinal principle which the window trimmer should always keep in mind is that whatever story the window is designed to tell it must "get over" instantly into the consciousness of the passerby, as it takes but a few seconds to pass the window and usually there is but a fleeting glance bestowed upon its contents.

A window display which is crowded will fail to give this effect. It is better to have a smaller display, but attractively arranged, than to crowd the window so that no one thing stands out prominently.

Windows should be changed regularly—at least once a week—and special occasions, such as holidays, local events, and seasonal occurrences should be taken advantage of to make appropriate displays. It is well to make this the

duty of one man in the store, who will work out the details, following the policy and suggestions of the management. Frequently some clerk will be discovered who has special abilities along this line, or can be induced to make a study of it.

Factors to be Considered in Writing Advertisements

While this chapter cannot take the place of a course in advertising writing and is not intended to do so, it would probably be considered incomplete without some detailed discussion of the human factors which must be kept in mind in addressing an appeal for business to the public. In previous paragraphs some of the mechanical details of the production of an advertisement have been discussed. We now come to the actual writing. What is it that makes one piece of advertising copy "pull" and another "fall flat"? The answer to this question is constantly keeping the advertising writer on his mettle. When the cost of space runs into thousands of dollars it is necessary to say something in that space and in such a way that it will be read and bring action and thus make the expenditure bear fruit. The pharmacist's problem is the same, only on a smaller scale. Usually the first thing which must be done is to forget professional language when addressing an advertisement to the public. In preparing advertising for physicians the technical language is not objectionable although the chances are that of two advertisements of equal merit, as far as context goes, the one written in the simplest language will "get over" more effectively even with the physician. With the public it is axiomatic that the more simple and direct the language the easier will the advertisement be understood and the quicker will it produce results.

The story is told of how an advertising writer asked a chemist in a soap manufacturing concern to give him a short paragraph about the virtues of a particular soap that was to be advertised to the public. This is what the chemist wrote: "The alkaline element and vegetable fats in this product are blended in such a way as to secure the highest quality of saponification along with a specific gravity that keeps it on top of the water, relieving the bather of the trouble and annoyance of fishing around for it in the bottom, during his ablutions."

When the advertising writer got through with this statement and passed it on to the public, it consisted merely of the two now well-known words: "It floats".

It is this ability to boil things down to the essentials that is so necessary for successful advertising today. With thousands of products vying for public attention through the printed word there simply is not time enough in the life of the average human being to read a long story. A few striking words, a catchy phrase, an outstanding illustration—these are the things that get over. One has only to look at the billboards, street car cards, and magazines and newspaper advertisements to realize that the "big sellers" are advertised with striking illustrations and short pungent sentences, paragraphs, or slogans.

To portray the essentials in this manner is no easy task. It represents the hardest kind of work. Horace Greely, the noted editor, was once asked to write a short editorial on some subject of popular interest and he replied that he did not have the time to write a short editorial. He could readily produce a long one but the short one would take much more time than he could afford to devote to it. The same is true of advertising. The short, smooth, well-rounded and appealing phrases of the professional copy writer are not "just dashed off". They are the result of condensing and recondensing longer statements and of patient effort in selecting words of the proper shade of

meaning, yet understood by the average twelve-year intelligence, which, psychologists report, represents the average of learning of the American public the country over.

The Appeal—Assuming that the one who is to write an advertisement has obtained all of the facts upon which to base the copy there must of necessity be a selection of those which are most important. Judgment as to which are the most important facts depends in the first place on the public that is to be reached. If the advertisement is to be written for men, or for women or for children, respectively, it will be different than if it were written for all three groups, so it might well be said that, after the gathering of the facts, the next most important thing in the preparation of advertising is to determine to whom it is to make its appeal. Having decided on this point it is necessary to bear in mind the peculiarities and the viewpoints of each particular group of people and to lay the proper emphasis on the points which will appeal to them. This involves a study of the habits, customs, reactions and viewpoints of men, women, and children, and long experience in dealing with these groups in the daily contacts of the drug store is a valuable asset here. The important thing to remember is that the writer of the advertisement must not get the idea that a statement which would convince him, an argument which would to him sound entirely logical or which he could easily comprehend, will have the same force, logic, and conviction with a woman buyer or with a man who is entirely uninterested, or with a child. Trying out the copy on representatives of the types to which it is to appeal is a very valuable aid in this work. The more critical the test individual may be, the better for the writer of the advertisement, provided the criticism is constructive.

Types of People—It is also important to bear in mind that people are more or less easily classified into groups based upon their habits of buying and their methods of acquiring knowledge or information.

It is not difficult for one who has been in contact with people to recognize three distinct types as far as buying is concerned. There is one group which acts entirely upon its own initiative. An individual belonging to this group will consider the merits of a product and make his own decision independently of any other individual. He is of the type which will originate things. He is not afraid to try something new if it makes an appeal to him. For lack of a better name we might call this group the initiators, those who do things before somebody else does them or in spite of what somebody else does. The "initiators" are, of course, a minority group. Advertising copy of the kind which explains the usefulness of an article and the technical reasons for its superiority will appeal to this group.

Every business man recognizes immediately the very large percentage of buyers who are influenced by what others say, or do, or wear. All you have to tell this type is that the style this year is so and so and they immediately accept that as final and regulate their buying accordingly. This is the group which is influenced by the testimonial type of advertising. If some social leader or the wife of a prominent national politician uses a certain face cream this group will use the same product, not because they have investigated its merit but simply because they imagine that the use of the product puts them in the same class with the prominent person who is advertised as using it. The advertisement in national magazines and newspapers of the testimonial type, whether they be the cheap testimonial letter of the sufferer in some small town who has been cured of ailments by taking a bottle of some advertised remedy, or the respected preacher or school teacher who has been benefited by eating three cakes of

yeast a day, indicate the effectiveness of this kind of advertising. It is nothing more than taking advantage of the fact that most people regulate their habits and their activities by what the large majority are doing. They are not initiators but followers. The terms "proved safe by millions", "thousands of users in all parts of the world", "has been used for twenty-five years", etc., so familiar in various advertisements are simply a recognition of the great influence exerted upon the majority of the people by what the mysterious beings known as "they" are doing or saying.

There is a third group which, like the first, is a minority group. This group neither initiates nor does it follow the example of others immediately. It is a more conservative group than the second. It waits until things are definitely proven and settled. It does not take kindly to anything new. It looks with skepticism on the things that the majority do until such time as it is satisfied that what the majority is doing is really a good thing. This group must be convinced, not only by the attractiveness of a package, not only by the utility of an article or the low price, but by conclusive proof that all of these attributes really make the product worth possessing; then they will buy.

It is plain to be seen that advertising which is to have a value with all the people must contain statements that will carry conviction to the various groups just enumerated. In the case of new things, it is most important to attract the first group. If they are convinced and begin to use the product they furnish the basis for methods and statement which will attract the larger second group. In other words they become the mysterious "they" group. "*They* say it works all right." "*They* say it is a good show", etc., are the comments which spell success for the advertiser. The third group will come along in good time and even if they never come, the advertiser's success will be insured if he can get the first two.

Another way of grouping people from the standpoint of absorbing knowledge of products or reacting to advertising is very similar to the general grouping of students from the standpoint of teaching at colleges and schools. Educators recognize the type of student who learns best by hearing his instructor explain the topic. Another learns best by studying from a text, that is, by reading and seeing things in print. A third type learns best by actually doing things. This has given rise to the threefold method of instruction followed in the colleges, namely, lectures and recitations, textbook study, and laboratory work. Every student learns something by all three methods, but every student also learns best by one of the three. People in all walks of life are very similar. Some will be convinced by the talk of a good salesman, others like to read about a product and make up their minds as to its value on what they see on the printed pages of a circular or booklet. Still others can be convinced only by actually handling the product; they are unable to visualize its advantages from a mere talk or a printed description; they must see it and handle it in order to be convinced.

The writer of advertising, knowing that people fall into these groups will not only describe his product, but will issue an invitation to the reader to come and see the thing being advertised and offer to let it be tried. He will also offer to send a representative to explain the proposition. In this way the entire group is covered through printed advertising. Those who are convinced by the printed word alone will buy at once; those who prefer to talk it over with someone have the opportunity of signifying that fact, and those who want to handle the product are told that they can do so if they wish.

The writer of advertising must also remember that a definite fraction of

every income must be set aside for the necessities of life, including food, clothing, and shelter. If there is a balance after these necessities are provided for it may be spent for what are considered luxuries. A decision must be made as to whether the product or service advertised comes under the head of necessity or luxury. When one is advertising a necessity, the utility of the product, its economy, and its value can be stressed. When one is advertising a product that will appeal to the "free dollars" of the public rather than to their "mortgaged dollars" the appeal will be entirely different. Pride of possession, the distinction of ownership, and the pleasure to be derived from its possession are points which may be stressed.

Medicines, dental preparations, prophylactics, etc., are classed as necessities but many if not most of the articles now sold in the pharmacy, do not come into the necessity class.

The writer of advertising for drug store merchandise can resort to a range of appeals almost as wide as the variety of merchandise he offers for sale. He may attract the reader by the utility of an article. He may stress the environmental appeal in which location, climate, or custom will be featured to attract attention and create desire. He may appeal to the senses, emotions, and instincts, such as touch, taste, smell, sight, sound, happiness, sorrow, love, self-preservation, curiosity, economy, and beauty. It is not difficult to think of various kinds of modern drug store merchandise which can be sold by an appeal to any of the foregoing senses, emotions and instincts.

Appeals may be made to the imagination of the reader but such appeals must not take too much for granted. Very often they miss their mark because they assume too great an average intelligence.

Appeals involving memory tests, and advertisement or slogans set in rhyme, while very attractive, do not as a rule make lasting impressions. The public memory is remarkably short. Only by constant and frequent repetition are pertinent facts, names, or illustrations kept alive.

Association of advertising with news of the day, with the seasons, or with national events tends to emphasize it and should be taken advantage of at every opportunity. Linking the unknown to something already well and favorably known facilitates the progress of the former on its journey into the consciousness of the individual.

The habits of a community play a large part in its reactions toward various advertising appeals. A knowledge of these habits is a great asset in formulating the appeal. Habit is a rigid master over its human slaves and it is far from the line of least resistance to endeavor to break down habits in an effort to popularize something.

In recent years the policy of "satisfaction or your money refunded" has been in vogue almost universally. Starting with mail order advertising it has gradually permeated all forms of advertising and is either stated or implied wherever an effort is made to sell anything through advertising. This has in a large measure restored confidence in advertising.

The use of illustrations to convey in an instant the story of products which it would take many hundreds of words to tell is to be commended and the use of color is likewise an asset.

Enough has been said on this subject to indicate that the writing of successful advertising requires a fair knowledge of human nature, a knowledge of the workings of the human mind and its reaction to various stimuli, and most important of all, an intimate knowledge of the subject upon which one is writing.

SALESMANSHIP

Knowledge of salesmanship is essential for success in every line of endeavor. It has already been pointed out in this section that every professional man as well as every business man has either a service or a commodity to sell and his material success depends upon his ability to sell these to the greatest advantage.

Much of what has been said in the chapter on advertising applies with equal force to selling because advertising, after all, is a method of selling. The classification of minds, the classification of people according to habits of thought, customs, and reactions to various stimuli is just as applicable in sales work as it is in advertising. In selling, the salesman usually faces a customer and talks to him directly rather than at long distance. Circumstances and individuals must be "sized up" in a selling interview and the right thing must be said at the right time. In direct sales work the personality of the salesman cannot be hidden behind a screen of clever words or striking illustrations. It stands out by itself either to make or break a business transaction.

Selling involves three factors, namely, the salesman, the goods or service offered for sale, and the buyer. The goods and service sold in a pharmacy have been discussed in another chapter. The buyer has been discussed at length in the chapter on advertising. He is the average citizen who comes to the pharmacy for his needs. He is the same individual to whom we address our advertising appeal. There remains for discussion the salesman and his methods.

In the one-man pharmacy the proprietor is, of course, the only salesman but as the store grows and becomes departmentized, the selection of a proper sales personnel becomes one of the most important duties of the management. A pleasing personality is most desirable. The ordinary attributes of honesty, sincerity, willingness to work, a certain amount of ambition and loyalty are essentials. Many of these essentials can be cultivated and improved in the sales person after he joins an organization. His personality is, as a rule, fixed and difficult to change. The proprietor should set an example to his sales force in matters of cleanliness, neatness, promptness and in the courteous treatment of customers. These are absolute essentials for successful selling.

It has frequently been said that good salesmen are born and not made. This is true to a certain extent but it is also true that those who do not have natural selling ability can cultivate it by careful application and self-analysis. Very often one who has conscientiously and carefully studied the underlying principles of salesmanship will surpass a so-called natural born salesman in his record of efficiency. This is due to the fact that those with natural ability often neglect to keep abreast of the times and refuse to take advantage of the opportunity afforded for increasing their knowledge of salesmanship. Natural born salesmen are apt to have whims and fancies. They work when the spirit moves them and wait for inspirations. The ordinary salesman who is constantly working to improve himself and to increase his ability takes advantage of all opportunities, studies the underlying laws and principles and applies them persistently and consistently whenever possible. His methods may be crude at first but they become more polished with experience.

In some cases selling constitutes merely taking or filling orders. If a sales person hands out a package of something that has been asked for, he is making a sale but he is not necessarily a salesman in the modern sense of that term. If, however, he is asked for an article and he sells something to the customer that has not been sold before, or if he sells a better article than the customer intended to buy, or if he sells something to the customer which the latter has

previously bought somewhere else, or if he sells more of an article than the customer originally intended to buy, then he is practicing salesmanship. To do this the salesman must be a convincing talker. He must have the power of persuasion. He must inspire confidence in the buyer. He must be able to tactfully overcome prejudice and obstacles to a sale, and finally he must retain in practicing all of the arts enumerated, the goodwill of the customer. If, by selling more than the buyer intended to purchase in the first place, the buyer is antagonized and avoids the store in the future, the salesmanship has been detrimental rather than helpful. If, by selling the buyer an article of better quality than he intended to buy, the latter leaves with the conviction that a service has been rendered him because of the greater lasting quality of the article and its consequent economy, the salesmanship has been successful. A salesman can very easily overplay his rôle and instead of making friends for a store create enemies. Constant vigilance on the part of the proprietor or manager is necessary to enforce the selling policy established for a store. It is necessary to thoroughly train new clerks in the sales policy of the store and impress them with the fact that they represent the proprietor in their contact with customers and that they must not let their personal likes and dislikes govern their attitude toward buyers.

Commissions—In order to keep up the interest of the sales personnel in achieving a greater sales volume, it is common to add a commission or bonus to their salaries based on personal effort in disposing of a particular class of goods. Usually the specialities offered are made subject to such commissions. This has the effect of stimulating the sales person to make an effort to dispose of some of this class of merchandise, but care must be taken that no unfair and detrimental methods are used in an endeavor to have the customer purchase the specialty rather than some other product which is really wanted. The percentage of commissions allowed on sales varies with the class of merchandise and the normal volume of business done.

Sales Personnel—For the prescription and drug department, registered pharmacists and college men who are studying pharmacy should be given preference. The salesmen or clerks in the departments must be able to talk intelligently about professional matters. It is very unsatisfactory to place people without proper knowledge of drugs behind the drug counter. At the soda fountain or cigar case or at perfume and toilet goods counter or in the stationery department and elsewhere, it is not necessary to employ people who have studied or are studying pharmacy, but they in turn should know the merchandise which they are selling. It should be insisted upon that they make a study of it and instructions should be given them not only as to which are the profitable items, but what are the merits or defects of each item in the list. In a large store there will of necessity be a mixed group of sales people and it is necessary to establish harmonious relations between them and to cultivate a spirit of loyalty toward the management.

Exclusive Agencies—When it is possible to secure exclusive agencies for good advertised lines this should be done. An individual retail store can often profit greatly from the prestige enjoyed by advertised goods, not only through sales of the advertised articles, but also by other sales made to customers thus attracted to the store. An effort should be made to supply the customer with exactly what he wants. The practice of substitution of inferior but more profitable merchandise for standard advertised products is to be condemned. If the nationally advertised article is not sold at a profit there is, of course, good reason for wishing to sell something else in its place, but even if there is little profit in the thing asked for, it should be supplied on demand. If the

customer gives the salesman an indication that he wants something like a nationally advertised product and the pharmacist has something that is really more valuable, or at least as good, there is no harm in offering it, but no deception should be practiced. The transaction should be to the interests of both buyer and seller.

Profits—In previous chapters selling expense has been considered in connection with the pricing of merchandise. There are still some merchants who cling to the belief that everything they take in over and above the actual cost of merchandise is profit, in spite of the fact that it costs considerable money for rent, light, heat, clerk hire, and for their own maintenance. These expenses are usually grouped under the heading of overhead and it is axiomatic that the actual cost of an article is the amount paid for it plus the overhead. Anything above the sum of these two figures is considered profit. The terms "gross profit" and "net profit" have been used in the past. Gross profit is supposed to be the amount received for an article from the buyer, less the cost paid to the manufacturer or wholesaler. Net profit is the term applied to the difference between the amount received from the buyer and the sum of the cost of the article plus the overhead. More recently the term margin has been employed to indicate what was formerly known as gross profit. The term gross profit is no longer used in modern accounting. It really has no meaning as far as actual profits are concerned. Whether the percentage of margin or net profit is figured on the cost or on the selling price of an article does not make very much difference but it is important to know whether or not a transaction yields a net profit or margin. The fallacious method of figuring profits so commonly met with among business men is in all probability based on problems still found in the common school arithmetic books which assume, for example, that when an article costs $2 and is sold for $3, the profit is $1. Nothing is further from the truth because it is necessary to add to the cost of the article which is $2, a definite sales cost which may be a very large portion of the $1, that is assumed to be all profit. It seems to be a difficult matter to disabuse the mind of the average young man who goes into business of this faulty mathematical calculation of his primary school days.

Modern Selling—In recent years selling has assumed an aspect that is entirely different from the views held fifty years or more ago. We have graduated from the period of haggle and barter to a period of fair and fixed prices; from tricks of the trade to open square dealing; from the attitude "let the customer beware" to "let the customer be satisfied"; from the closed deal to "money back if you want it"; from merchandise of uncertain quality to guaranteed merchandise; from misleading labels to correct marking and branding; from advertising bombast to accuracy in word and print; from the dingy shop to the attractive and well-lighted store. All of this means that a new type of salesmanship has been born and is constantly being developed. Sharp trading is taboo. Honesty is indeed the best policy.

Price Cutting—Various schemes have been used in an endeavor to appeal to the "something for nothing" instinct of the average citizen for the purpose of increasing sales. One of these schemes is price cutting. Merchants who have been unable to draw trade away from established dealers on competitive service often attempt to do so by reducing prices. Stores located in transient neighborhoods frequently offer well-known nationally advertised products at or near the wholesale cost in order to attract trade. In other words, they advertise these items for sale at an actual loss, for, when an article is offered at less than the sum of its cost plus the cost of selling it, every sale of that article means an actual loss of money. The theory on which these cut price sales are

based is that people are attracted because of the low prices of advertised articles and thus get the general impression that the store is one at which low prices prevail on all goods. It is natural for the public to want to buy things at the lowest prices. The public does not reason far enough to understand that whenever the store loses money on one item it is necessary to make it up on another or go out of business and that the cut prices are merely a bait to draw them into the store where, if possible, they will be sold more profitable merchandise.

An occasional sale of shop worn merchandise, or of a large volume of some popular article at a price somewhat below the regular selling price is not objectionable but continual sales of leading articles at prices which mean an actual loss, just for the purpose of attracting trade and selling them something else is neither fair nor honest. The retailer who employs this method of attracting trade is really using the reputation and goodwill built up by others through national advertising for his own selfish ends without rendering any service excepting, possibly, to hand over a package of the advertised article when it is insisted upon. It will be found that in stores where advertised merchandise is sold at cut prices the clerks are instructed to sell substitutes for these articles whenever possible, thus making a profit for the store. It is well realized that if the advertised article were sold at the cut rate there would be a loss. Manufacturers of advertised merchandise are beginning to learn that the goodwill of the dealers toward their products is being jeopardized on account of the price cutting evil and that it is becoming harder for them to sell to the public because of the lack of coöperation of retailers who naturally would rather sell something on which there is a fair margin. They are therefore making an effort to control the resale price. There has been legislation before the Congress of the United States for a number of years, the purpose of which is to compel the selling of articles at prices printed on the package so as to assure fair competition. Such legislation, commonly referred to as price maintenance legislation, has been opposed by many large manufacturers but has the unqualified support of numerous retail organizations. Recently many manufacturers have declared themselves in favor of price maintenance. As a matter of fact, it is possible for a manufacturer to exercise some control over the prices at which his merchandise is sold without any new legislation. He can refuse to sell to the persistent price cutter. No one can compel him to sell to anyone if he does not care to do so. Certain well-known manufacturers have followed the policy of restricting sales for a number of years and have been sustained in their action by decisions of the United States Supreme Court.

Recently there has been a concerted effort on the part of retail druggists' organizations in some sections to force manufacturers to become active in maintaining resale prices. These organizations issue "courtesy cards" to salesmen of concerns, which, upon investigation are found not to offer special discounts to chain store organizations or department stores, and who do not sell to price cutters and otherwise protect the retailer's interests. If a salesman wishes to do business with a retailer belonging to the organization and does not have the "courtesy card," it is supposed to be notice to the retailer that the salesman's firm is not in sympathy with the retail organization's interests. It is claimed by some that such procedure on the part of the retail druggists' organization is in violation of the laws of the country with regard to restraint of trade but others believe that there is no violation of law in the scheme. It is a question that will undoubtedly be decided at some time by the Federal Trade Commission or by the courts.

Special Sales—In recent years there have come into existence, in our large cities, organizations known as "Better Business Bureaus". These organizations are maintained by advertising associations and others interested in retaining public confidence in sales propaganda and advertising. Agents of the Better Business Bureaus investigate advertised sales in department stores and elsewhere to check up the quality and values offered. If a store should advertise a special sale on clothing for example, in which it were said that the material from which the clothing is made is wool and that the price represents a reduction of 25 per cent and upon investigation the agent should find that the material was only partly wool and did not really represent a 25 per cent saving, the store would be called upon to reimburse its customers or be exposed and have its advertising refused by the better newspapers. "Let the buyer beware" no longer governs merchandising transactions and it is well for the pharmacist to realize this and to make sure that whenever he offers anything at a reduced price that it is really something of value and that the reduction is bona fide. It is good advertising to occasionally run a sale at which things are offered at less than the usual prices, as this provides an opportunity to dispose of shop worn and out-dated merchandise or to dispose of a large quantity of some item in a short space of time. It is essential in running such special sales to have a time limit fixed and to resume sales of the special items at the regular prices as soon as the advertised period of the sale has expired.

In line with these special sales there has come into being a type of sale known as the "one cent sale". This was introduced by a chain store organization and has been taken up to some extent by other retailers. The principle of the one cent sale is to offer two packages of an article for one cent more than the regular price of one package. Naturally a marked buying advantage of this kind finds considerable favor with the public. The one cent sales are usually conducted over a period of two days and during that time business is very brisk. Those opposed to the one cent sale say that it injures the buying public by loading them up with unnecessary quantities of merchandise. It injures the drug business in general by concentrating business into a short period of time and producing a corresponding dull period following the sale. It also is said to create a wrong public impression of the actual value of the merchandise offered, the reaction being that if the retailer can sell two of any article for the price of one, he must make an enormous profit when only one item is sold at its regular price. It is said to injure the seller because it raises a doubt in the mind of the buyer as to the legitimacy of his general merchandising methods. In favor of the one cent sale it is said many new customers are brought to the store. The head of a chain of stores has stated that a careful count and analysis shows only about 40 per cent of the items disposed of in one of these sales are bought by regular customers, the remaining 60 per cent being sold to the customers of competitors, thus drawing the latter away from their original buying centers to the new store. The one cent sale is said to make people buy when under ordinary conditions they would not be in the market for anything. It is believed to be good advertising, because it enables the pharmacist to get two pieces of his controlled merchandise into the hands of customers in place of one, thus insuring continuous allegiance to that product. It gives the customer the impression that the retailer is doing something for him.

In addition to bringing new customers to the store, the advertising, which the one cent sale makes possible for the several weeks before it is actually conducted, is of lasting benefit. There are so many ordinary sales these days and so many pharmacies advertising service and quality that one has to do some-

thing startling in order to attract more than passing attention. The one cent sale is believed to offer an opportunity of that sort. It is talked about both before and after and there is no question but that it brings people from a very large radius to the store. As has been stated, the one cent sales were inaugurated by a chain store organization and of course special controlled merchandise is sold to the units of this chain at special prices so as to assist in making the sale worth while. Outside of what is accomplished by these sales in actual profit, increased business, and the attraction of new customers, there is, of course, the value of acquainting the public with a line of products that is controlled by the chain of stores running the sales. When people have two packages of an article on hand they will certainly use them, and, having become accustomed to it to that extent, they will probably continue to use it and must naturally go to the store where the product is sold. As the line is controlled it can, of course, be obtained only in the stores of the particular chain.

Sales Management—When a store is well departmentized and certain individuals are placed in charge of separate departments it pays to establish a sales quota for each department and to make an effort to have the head of the department meet that quota or exceed it. A salesman or group of salesmen will always work better when they have a definite objective before them and of course the quota must be large enough to require an effort to meet it and yet not too large to make it impossible for them to meet it. A bonus can be based on whether the quota is reached or exceeded, or, commissions can be so arranged as to start after the quota has been passed.

Sales people should be trained never to lose an opportunity to sell as much of the store's wares as possible to any given customer. Everyone entering the store is a potential buyer of more than what he came in for. Attractive displays, a short but convincing talk, or, a suggestion here and there, will do much to increase the day's receipts. *Companion sales* are insisted upon in certain classes of stores and while it is never good policy to insist on selling too much there certainly is no objection to suggesting to the buyer of a tooth brush that he might also need tooth paste or powder, and to the buyer of soap that he might need a wash rag, or to the buyer of iodine that he might need some absorbent cotton or gauze, and so on.

If the average sale of a small store is thirty cents per customer and there are 200 customers during the day it means a day's business of $60.00. If each sale is increased only ten cents per customer it would mean a day's business of $80.00 and would probably spell the difference between prosperity and "poor business" with the average pharmacist. The time to think about increasing the average sale to the individual customer is when the individual is in the store. Once he is gone the opportunity to increase the day's receipts is reduced by just that much. Pharmacists often complain that when they take a day off and hire a relief clerk in their places receipts fall off considerably. Assuming that the relief clerk is honest there is a natural reason for the falling off. The pharmacist knows his trade and just what he can sell to each individual. He endeavors at all times to increase each sale, whereas the relief clerk is not known to the customers nor does he know them well enough to overcome a natural timidity with strangers. He is therefore more apt to simply supply what is wanted without going to the trouble of making further suggestions.

It is necessary in selling to know something about the manner in which people react to various ideas advanced by the salesman. All that has been said under advertising as to appeals to the senses or emotions, etc., is applicable here. The salesman must know how to exercise tact in all situations. Tact has been facetiously defined as "the unsaid portion of what one thinks". It

involves adjusting one's self to the customer's circumstances, to his particular intelligence, and to his environment in making the proper suggestion that will lead to increased sales. Customers range from very rich to very poor, from very old to very young, from ignorant to highly intelligent, from very active to very indolent, from ultra-careful to indifferent, and in between these extremes, there is, of course, a large group with varying degrees of carefulness and indifference, activity and indolence, ignorance and intelligence, age, and financial conditions.

Disputing with the customer is considered very bad form even though the customer may be wrong in his convictions. This does not mean that the salesman should lose his self-respect and not insist on the truth but it should be done in such a quiet way as to indicate that there are two sides to the question and that even though the customer seems to be on the other side from that taken by the salesman, there is no hard feeling over the matter but just a friendly and natural difference. Some stores work on the basis that the customer is always right, believing it to be better from a business standpoint not to argue about anything but to always satisfy the customer.

Various authors of books on salesmanship and students of the subject, have analyzed the steps taken in making a sale. Upon analysis a sale may be divided into four distinct steps: 1. The pre-approach; 2. The approach; 3. The demonstration, and 4. The close of the sale. On the part of the customer, the sale is divided into five steps, which are first, attracting attention; second, arousing interest; third, converting general interest into self-interest; fourth, creating the desire or wish to possess, and fifth, acquiring the article. Anyone who has failed in a sales effort can recall the various steps and determine just at which point the buyer lost interest. A search for the reason is thus simplified and once this is determined, the subsequent sales effort can be designed so as to avoid the error of the first effort.

Buyers may be classified as refined, sociable, argumentative, cautious, conceited, conservative, deceitful, tricky, intellectual, religious, overbearing selfish, and pessimistic. Each particular type must be met in a certain manner calculated to impress them. It is a common saying that the salesman who knows how to please a crank can please anyone, and, there are, of course, distinct appeals which work best with each one of the class of buyers enumerated. To master these is the work of many years. In fact salesmanship involves continuous study of types and situations. Deliberate planning and constant attention to details will solve the most knotty sales problem.

Deliveries and Sales Service—A delivery service of some kind is necessary in connection with any retail pharmacy. This may range from a mere errand boy service to regular automobile delivery. If a large delivery business is a natural consequence of the location of the pharmacy and the kind of business it enjoys, provisions must be made to maintain it adequately. It should be prompt enough to be worth talking about as a special service feature in connection with prescription business and yet it must not run up costs to such an extent as to make it prohibitive.

The Telephone—The telephone is a great asset to any retail business and many pharmacists have built up a good trade with families far away from their store by giving prompt, courteous and efficient attention to telephone calls and orders. Telephone customers should not be kept waiting for an answer to their "ring" or to their inquiries. A cheerful voice over the wire makes friends for the store. The speaker should imagine that the customer is before him and never venture to say anything over the telephone which would not be said to the face of the customer. A record of telephone orders should be made

immediately after they are received. Nothing should be left to memory. Convenient blank memorandum forms, close to the telephone instrument, should be provided. It is well to instruct every clerk who answers the telephone to give the name of the pharmacy rather than the usual greeting of "hello".

Items not in Stock—If a customer calls for an item that is not in stock and is either new or not generally carried, it is good business to offer to order it. In the event that the offer is accepted all possible information about the product should be obtained from the customer and information as to the customer's residence should also be secured so that he may be notified when the article arrives. An excellent blank form for this purpose is used in Petty's Pharmacy, Newark, N. J., and is reprinted here:

REPORT OF SALE MISSED

Name of Article?.....

What is it used for?.....

Made by?.....

Made where?.....

Nature of Article?.....

Name of Clerk asked in stockroom?.....

Date..... Clerk's Name.....

Remarks:

TO NOTIFY AS SOON AS RECEIVED

Customer's Name.....

Street Address.....

Town .....

Please make report for each sale missed.

Selling by Suggestion—In addition to making sales by personal contact with customers, the pharmacy which is well located, well advertised and which has attractive window and counter displays will enjoy considerable sales volume resulting from the impersonal contact of the customer with the store. A store can be so arranged that suggestive salesmanship is stimulated to the highest degree. Stock can be so arranged that anyone coming inside the door to wait for a street car or consult a directory or for any other purpose will find some attention-compelling features which will lead up to a sale. Good orderly display of merchandise will accomplish this end. For instance, all preparations which relate to the treatment of the teeth may be attractively grouped so that when a customer buys a tooth brush it will be possible for the clerk to ask quite naturally: "Have you ever tried this mouth wash which we are specially recommending?" or a tooth paste of exceptional merit may be referred to, etc. Other allied toilet articles or general merchandise which lend themselves to suggestive salesmanship should be grouped. Suggestive salesmanship involves good display of merchandise with prices in plain view; convenient arrangement of cases and other fixtures so as to group the things wanted quickly where they are readily accessible; judicious use of counter signs telling a complete story briefly and attractively.

SHOW CARDS AND SHOW CARD WRITING

Attractive show cards can accomplish much in the way of suggestive selling. In the average pharmacy, so many goods are on display that it is difficult to make a show card stand out. It must either bear a striking illustration or a catchy phrase. Sometimes the size of the card or the distinctive lettering on it creates the desired effect. The preparation of show cards is not as difficult as might be imagined by those who have had little or no experience in their preparation. However, as is the case in all other arts, perfection is only obtained by constant practice. The quality of the materials used has considerable bearing on the final product. There are show card writers who are sufficiently artistic to get good results even with poor materials but the average amateur in this work needs all of the advantages which good materials provide. If the

FIG. 468

Illustrations of brush lettering

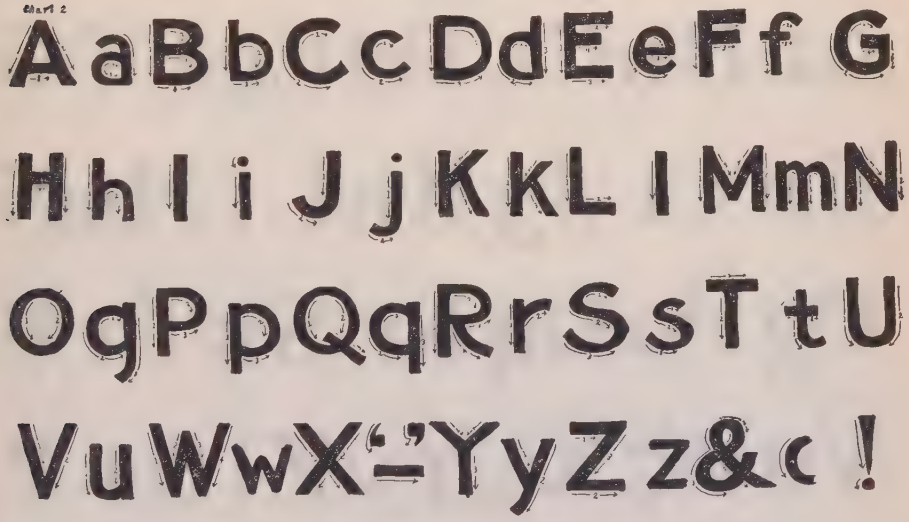
pharmacist has to do his own show card writing or if one of his clerks is delegated to do it, the materials necessary are brushes, lettering pens, paints and inks, cardboard of various colors, and perhaps some discarded advertising material which can be used in making illustrations by cutting to the outline of the picture and pasting it on the show card.

Brush Lettering—When using brushes to make signs it is necessary to obtain special brushes that have been made for lettering. The ordinary soft camel's hair brush is not satisfactory. "Red Sable Show Card Lettering Brushes" are very satisfactory. They may be obtained either flat or round. For the beginner the flat brush is best. These brushes range in width from $\frac{1}{8}$ to $1\frac{1}{4}$ inches and are sold according to width. The $\frac{1}{4}$ inch, $\frac{3}{8}$ inch, and $\frac{1}{2}$ inch brushes are probably sufficient for ordinary work. The necessary supplies for this work can be obtained at art or paint shops. Brushes should be washed out thoroughly in water after using, and the surplus moisture should then be squeezed out by gentle pressure, sliding the thumb and forefinger toward the brush point. A brush should not be allowed to dry out without having the color

washed out of it, nor should it be allowed to stand upright leaning on the hairs. When brushes are properly cared for they will last a long time and, as a matter of fact, they improve with constant use. If paint has been permitted to dry in the brush, the hairs should not be bent as they may have become brittle and will break off; the soiled brush should be placed in water and permitted to soften, after which it can be washed out again. When not in use, brushes should be kept lying flat or resting on the handle in a jar with the brush end upward. If a brush is permitted to rest on the hairs, the latter will curl and the brush will be unfit for further use.

Pen Lettering—Pens for show card work are of special construction and are obtainable in many sizes. The R. Esterbrook and Company's drawing and lettering pens, numbered 1 to 4, will meet the needs of the ordinary show card work. Pen holders, water, white and colored chalk, a hand ruler, a piece of art

FIG. 469



Single stroke, stump letters

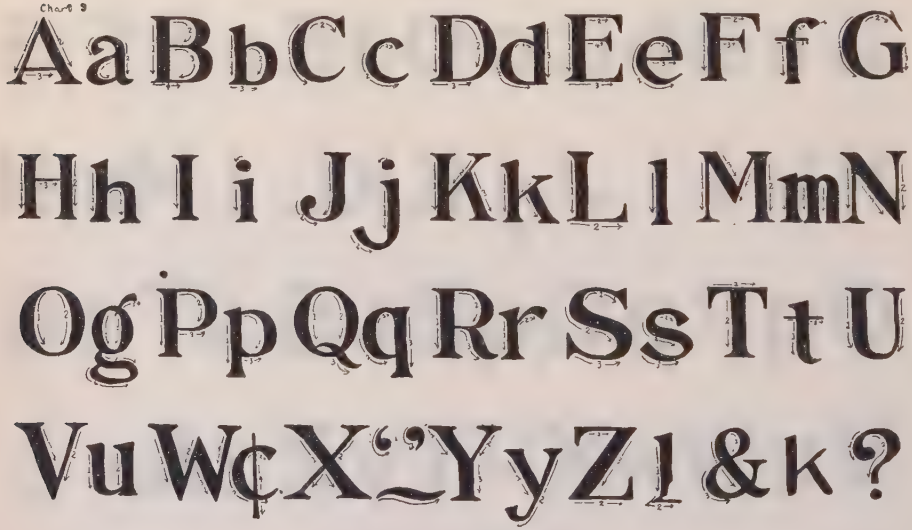
gum, sticks of charcoal, some thumb tacks, cardboard, Carter's or other water paints, and a piece of chamois skin, will complete the outfit. Oil paints should not be used for show card work and the brushes should not be permitted to come in contact with such paints or with any fat or grease. For show card work, paints that are especially adapted should be used. They may be obtained in all colors and are supplied in small glass jars at paint and art shops.

White cardboard is the best for show cards. It can be purchased in various thicknesses. The thinest cardboard, satisfactory for show card purposes, is four ply, but this is really too thin to be durable. Six ply is a more satisfactory cardboard to use and ten ply is as good as is necessary. Of course the cost increases with the thickness of the cardboard.

A rough layout can be penciled on the card and erased with the art gum after the lettering is completed and dry. One of the objects to be accomplished by a beginner in this work is to train the eye as well as the hand. It will be found that constant practice will make it almost unnecessary to have more than a very sketchy outline of a card in order to produce well-proportioned

results. In the accompanying illustrations are shown letters made with a brush and with a lettering pen. Fig. 468 gives the brush strokes involved in ordinary lettering. The beginner can take some plain paper about 12 x 18 inches and fasten it on a flat surface over a smooth table top or a card about 22 x 28 inches and then lay the sheet out into 1¼ inch squares. The brush is dipped into the show card paint after the latter has been stirred thoroughly with a stick and the brush is then stroked on the edge of a saucer until most of the paint is released. This is done several times until a fair amount of paint has been transferred to the saucer. The brush is now dipped into clean water and the stroking process on the saucer repeated until the paint has been reduced to the proper consistency. The brush is now carefully stroked to and fro through the paint and water until they are well mixed and the brush is thoroughly saturated with paint. The brush should not be twisted in the

FIG. 470

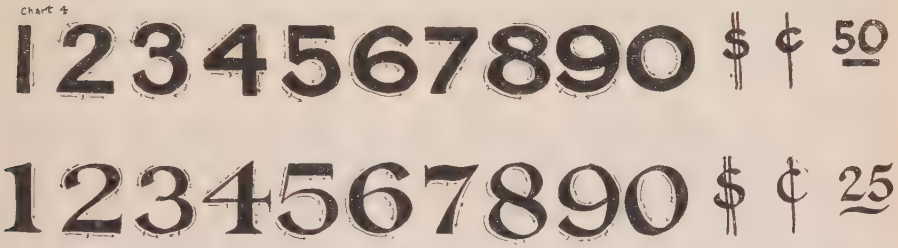


The Roman alphabet

paint but pulled through on its flat sides. The flat sides are then wiped on the edge of the saucer and the brush is wriggled on a piece of paper until it assumes a flat chisel shape. It is now ready for lettering. The brush should be held gently but firmly between the thumb and forefinger. The other part of the hand is allowed to rest on the table. The beginner should start in boldly to make the strokes outlined in Fig. 468. It is not advisable to be overcareful or to watch detail at this point. The important thing is to gain confidence and the ability to make the strokes rapidly and evenly. It is well to follow the directions of the strokes as indicated in the illustration. The letter A consists of thin lines whereas the letter B is made up of thick lines. This requires manipulation of the brush so that the "chisel end" is perpendicular to the body when making the letters A and B. In making letter B, the position of the "chisel end" of the brush in relation to the body is not changed but the handle should point to the right. The letter B is made by dragging the brush to the right. It should be remembered that the hairs of the brush are always

to be dragged and never pushed. The handle of the brush should always point in the direction in which the stroke is being made. Vertical and diagonal strokes, both straight and curved, are made from top downward. Horizontal

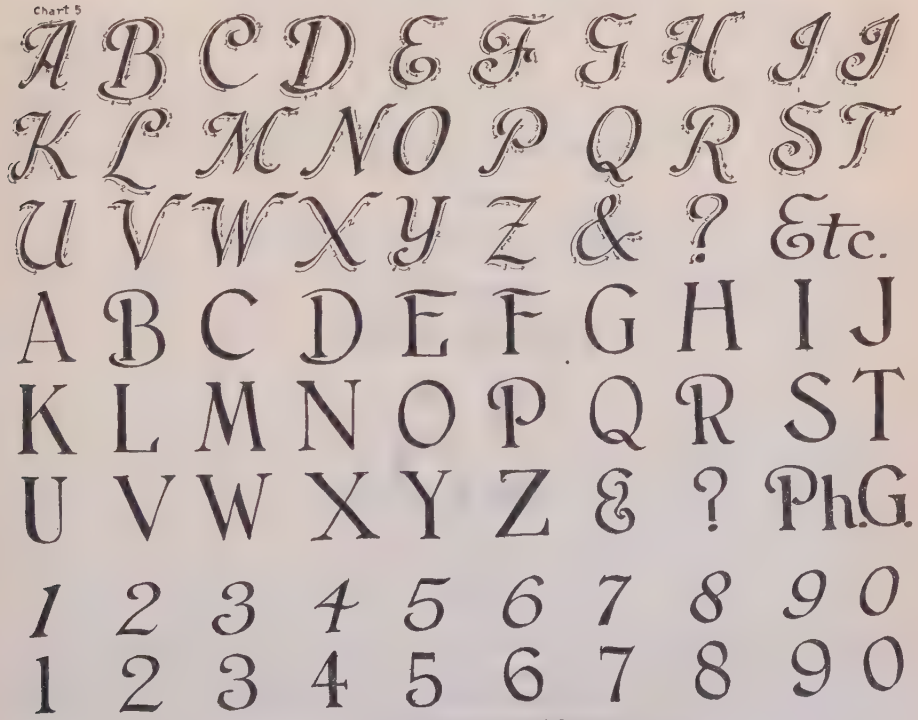
FIG. 471



Various styles of figures

strokes, both straight and curved, are made from left to right. The brush should be saturated with paint all of the time. It is impossible to work properly with the tip of the brush alone. There should be pressure on the brush at the

FIG. 472

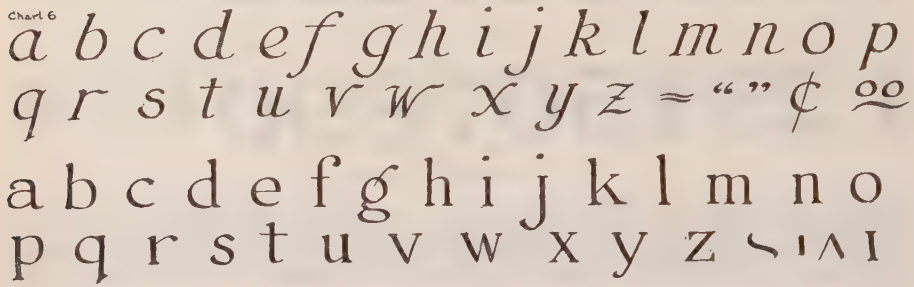


Various styles of letters and figures

start of the stroke and as the end is neared, the pressure is released, first slowly and then suddenly. It will be necessary occasionally to straighten out the hairs of the brush by stroking it on a piece of paper.

The letters C and D are made by holding the brush at right angles to the position required in making the letters A and B. Letters E and F are similar to letters A and B, the difference being that they are oblique. The letters from G to N present little difficulty after letters A to F have been mastered. Letter O introduces curves which may be found somewhat difficult at the start. The brush should be held in the same position as when making letters C and D,

FIG. 473



Illustrations of pen lettering

pressing a little at the start and increasing the pressure as the curve is rounded, and releasing the pressure at the end. The letter P involves the same technic only in the opposite direction. Letters Q and R are combinations of O and P, the only difficulty here is to join the component parts properly. This requires some practice. The so-called single stroke, stump letter is outlined in chart Fig. 469. This is a very satisfactory and legible letter, one which even an inex-

FIG. 474

Typical price card

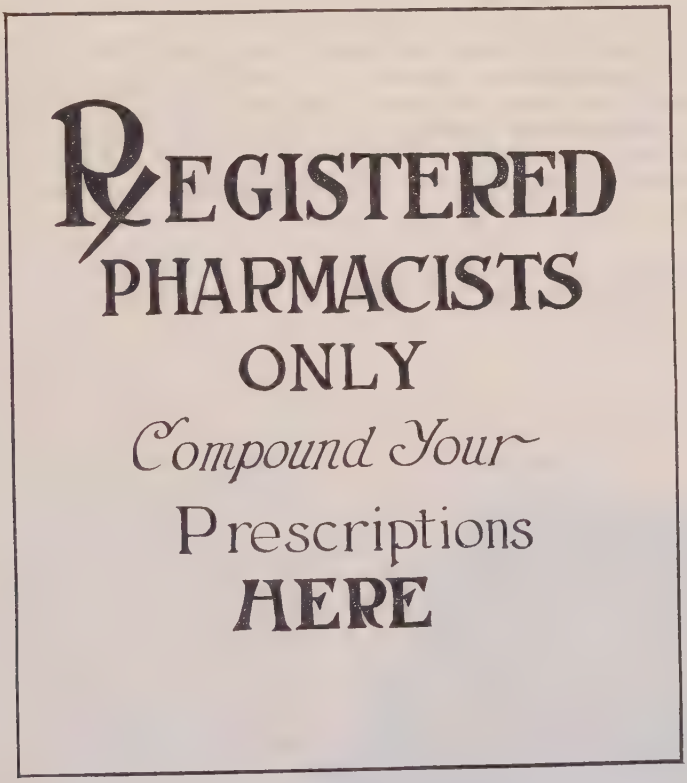
perienced show card writer can use without much difficulty. After the main strokes indicated by the arrows have been made, the ends of the letters can be evened up by drawing the flattened brush across them. Lower case or small letters are about two-thirds the size of capitals.

In Fig. 470 a Roman alphabet is presented with the various strokes indicated. In order to make the spurs on these letters, the brush is first swung to the right or left and lifted gently but suddenly and then the same stroke is repeated, swinging the brush to the opposite side and again lifting it gently but

suddenly. A hair line is then drawn with the "chisel end" of the brush to complete the outline of the spur and any white space remaining is filled in. It is essential to put the spur on the letter while making the regular strokes. It should not be put on after the outline of the letter has been completed. Figs. 471 and 472 represent other styles of letters.

Pen Lettering—Fig. 473 represents letters made by the use of a lettering pen instead of a brush. The beginner will find the lettering pen much more satisfactory to use than a brush, his hand will be steadier and there will be

FIG. 475



Typical show card

less difficulty in following the lines as indicated by the arrows. The method of working is exactly the same as described in the case of the brush. The reason why the brush is preferred for some signs is because it makes a heavier letter and is, of course, much more satisfactory for very large work. The pen does not hold enough ink or paint to make its use satisfactory in large or heavy letters. The same colored paints that are used for brush lettering can be used for pen lettering but it must be thinned until it flows readily by adding water. For black lettering with a pen, it is best to use a preparation known as "Letterine" or "Higgins' India ink".

The Layout of the Card—Do not crowd the letters on a show card. The total margin should always equal the width of the lettered section to get the

best results, that is, if the card is 12 by 14 inches, the margins at the top and bottom should each be 3½ inches (total margins equal to one-half the length) and the side margins should be 3 inches each. Fasten the card to the table so that the edge of the card is along the table edge, and holding the sharpened piece of charcoal firmly against the end of the ruler, grasp the ruler firmly with the other hand, extending the index finger, and draw the desired guide line with the charcoal, guiding it and keeping it straight by running the extended index finger along the table edge. The line may be placed in any position on the card by grasping the ruler in different positions. Of course the line is always drawn parallel to the table edge. It is desirable to draw these charcoal guide lines for margins and also to indicate the height of letters. They may readily be erased after the paint is dry, by the use of the chamois skin.

Figs. 474 and 475 illustrate the possibilities of even black and white cards and the addition of color on the border or the use of an appropriate and attractive picture in one corner, will notably increase its value. Attention might be called to the advantage of using a safety razor blade, preferably one with a single knife edge, for cutting out an illustration. When pictures are pasted on the card they should be covered with a piece of clean paper and all wrinkle rubbed out.

CHAPTER LXXXIV

ACCOUNTING AND THE NECESSITY FOR PROPER ACCOUNTS

It should not be necessary to urge the keeping of accounts upon those who entrust their prosperity to the exigencies of business. Accounts should mean as much in the control and direction of business as a chart and compass to the captain of an ocean liner.

When business is small, the necessity for records of accounts is not so apparent. The captain of a ferryboat rarely needs his compass, yet he has it and must know how to use it if the emergency should arise. Facts show that a small and unprofitable business and a failure to keep and appreciate the importance of proper accounts so frequently parallel each other, that one of the laws of success would seem to read, "Keep proper accounts".

Of course requirements vary greatly, but the safe guidance of any business is dependent upon financial records which are only obtainable from "books of accounts".

Bookkeeping enters two clearly defined divisions of a business but the final record in both fields must become a part of the complete statement to show the proprietor the degree of success attained.

One division of accounts referred to above covers the basic financial transactions of every business such as capital invested, purchases of merchandise, the expense of conducting business, and a record of sales including a regular statement showing their relation to profit.

The second kind of accounts is only required when credit is allowed to customers. They consist of a detailed record of purchases on credit, the crediting of payments "on account", and a frequent summary, in detail or total, showing accounts unpaid. Such a statement is usually accompanied or followed by a special effort to make collections.

Fig. 476

Cash register

If a strictly "cash" business can be conducted, this second class of accounts is eliminated. In many small businesses a record of the credit accounts is the only systematic accounting done. The immediate need forces this accounting upon the business and the proprietor will take the time for the benefit of his customer, primarily, but fails to find time for the first class of records which are chiefly for his own benefit.

Bookkeeping, which provides a systematic record for the proprietor of the status of the business, will first be considered.

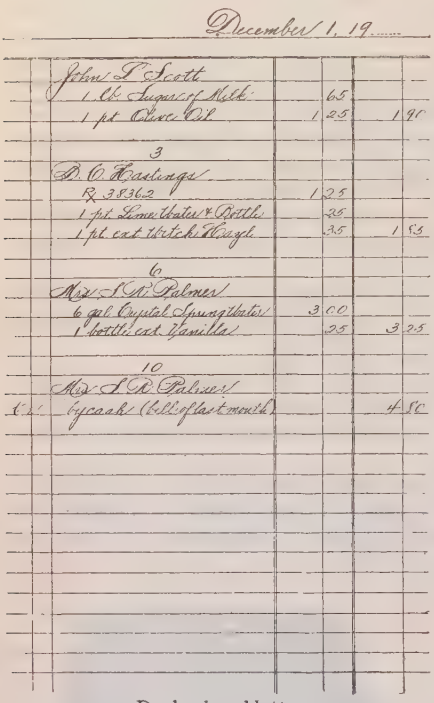
Standard systems, either *single entry* or *double entry*, are taught in practically every high school and business college, therefore, no attempt will be made here to fully explain these generally known systems.

A brief outline of typical business transactions will, however, be carried through a set of standard bookkeeping records to enable the student quickly to

review the training already received in regular bookkeeping (see page 1395). These records require the cashbook, a daybook, and a ledger; also subsidiary records such as are kept in the check book and bank book.

The adaptation of special systems to a retail drug store has greatly simplified the securing of these very important records.

FIG. 477


December 1, 19....

John T. Scott
1 lb. Sugar of Milk .65
1 pt. Olive Oil 1.25 1.90

3
R. C. Hastings
Rx 38362 1.25
1 pt. Lime Water & Bottle .25
1 pt. cat Wetch's Cough .35 1.85

6
Mrs. L. R. Palmer
6 gal. Crystal Spring Water 3.00
1 bottle cat Vanilla .25 3.25

10
Mrs. L. R. Palmer
6 cases Coke (bill of last month) 4.80

Daybook or blotter

One such system, devised by E. Fullerton Cook, with the coöperation of Harold J. La Wall, an expert accountant, is also illustrated (see page 1403). This system has been developed through direct contact with the needs of retail drug stores and has been in operation in a number of drug stores for the last ten years, with much satisfaction to the proprietors. Columnar records are the basis of the system. It has the advantage of greatly reducing the writing needed for records, but its greatest value is in placing before the proprietor all of the vital figures in his business without the necessity of a formal closing of the books and the preparation of the statement of losses and gains. Those who have had experience know that such a statement is not easily prepared from an old-fashioned set of books and consequently is frequently postponed until the facts are too late for service.

Valuable bookkeeping aids are given by the use of "cash registers". The readings taken from these machines at the close of each day's business, make it possible for the proprietor to readily obtain facts concerning sales and petty expenses, that they may be available for subsequent analysis. In the case of one successful retail druggist his cash register readings twice a day tell him what clerks are on the job; what clerks are falling down; what department is weak; and even what is wrong with his window displays. They also give him accurate comparisons that are valuable. A National Cash Register of the counter cabinet type with four cash drawers is shown in Fig. 476.

Accounts Necessitated by Credit Customers

When credit has been granted, and customers are buying drugs and merchandise on account, it is of vital importance that the proprietor keep an accurate record of every such sale. The importance of this cannot be overestimated as the facts will show that few retail businesses exceed a 10 per cent net profit at the close of the year, and the failure to charge a dollar sale would therefore, necessitate $10.00 worth of additional sales to overcome this single loss. The first step, however, is to provide a proper book or books in which to make the original entry when the sale is completed. The smaller stores have been accustomed for years to use a daybook or "blotter" in which the details of the sale are entered when the transaction is completed. This detail

includes the name of the customer and this is followed by the itemized sales (see Fig. 477). This is termed the "book of original entry", and whatever form it may assume it occupies the same position before the law, *i. e.*, it constitutes legal evidence of the authenticity of the sale, should that be questioned.

FIG. 478

CREDIT SALE

Dec. 1 19__

Clerk 2

Charge to John L. Scott

Address 6125 Market St.

1 lb. Sugar of Milk		65
1 pt. Olive Oil		125
		190

Charge slip

Instead of the daybook, it is customary in many stores to use the small "charge" and "credit" slips (see Figs. 478 and 479). The slip, after writing up the sale, is rung up on the register, under the "charge" key, and deposited in the drawer.

FIG. 479

RECEIVED ON ACCOUNT

Dec. 10 19__

Clerk 4

Rec'd from Mrs. S. R. Palmer

Address 5840 Clinton St.

By cash		
Bill of last month	4	80

Credit slip

In larger stores, a duplicate or triplicate system of sales slips is sometimes used, the original usually going to the customer direct, the second going to the accounting department, and the third remaining in the sales book as a check against the original. Great varieties of such forms are now used in department stores, all sales, whether cash or credit, being so recorded.

When the "original entry" has been made, the details of the sale must be

assembled in a book called the "ledger". Original entries are made in the daybook chronologically, but in the ledger they are assembled systematically under the names of the customers so that the status of any account may be known in a few moments.

When the credit period is past or on the first of each month, a bill is sent to the customer setting forth in detail the items which have been charged and the prices. It is desirable that this statement should be issued promptly, business custom having established the first of the month as the day. When bills are not received on the first of the month, customers frequently set them aside until the next month and from the viewpoint of the proprietor it is essential that payment should be made as promptly as possible. A "billing ledger" with the aid of which the handling of charge accounts is greatly simplified

FIG. 480

CREDIT MEMORANDUM

Name_____

Address_____

How long in Neighborhood_____

Where Employed_____

Approximate Income (indicate in code)_____

Real Estate Owned_____

Maximum Credit to allow (indicate in code)_____

Credit Approved by other Merchants_____

Parties Authorized to Purchase on Account_____

Remarks_____

is illustrated and explained on page 1403. The use of this form of ledger eliminates the necessity of keeping any other form of ledger for credit customers.

When an account is opened with a new customer, it is essential that evidence should be in the hands of the owner of the store, indicating the financial standing of the person applying for credit. When the organization is large, the establishing of credit is placed in the hands of an individual or department, having facilities for determining financial rating.

In a small business it is also of importance that the proprietor or whoever may have charge of the accounts, have evidence of the financial responsibility of the customer. Frequently this is known through personal acquaintanceship. In many communities, the retail merchants conduct a credit association and willingly supply information concerning the financial reliability of all persons living in the neighborhood.

It is of great help to use a printed form, as it impresses the customer with the business-like methods under which the store is conducted and furthermore commits the customer to a definite agreement. Such a form is printed above (Fig. 480). It will be noticed that the form specifies those who may be permitted to charge on the account. This is desirable information.

If the bill is not paid within the month, it is customary to send a *"statement"* which simply gives the total due on a previous date, this oftentimes being added to the bill of the current month.

Accounts Necessary for an Intelligent Control of Business

As already explained, a business without proper financial records is like a ship without a rudder. It flounders helplessly and guesses its course of action and only too often ends as a wreck. But for the proper understanding of accounting there should be actual experience in the handling of various business transactions, entering these in the appropriate books of record and subsequently drawing conclusions concerning the business, to determine whether it has been conducted at a loss or with a profit. These records should show many other facts, such as the cause of a loss, if such occurs, and the place to apply the remedy, the amount of income tax to pay, and many other guiding facts in the success of the enterprise. These facts properly come from the actual conduct of business and such figures are offered here for illustration and practice.

An Outline of a Month of Business

Preliminary Statements—On the following pages will be found a brief outline covering typical transactions in a drug store. These have been especially selected for instruction in bookkeeping. The business under consideration was started almost two years prior to the date of the detailed transactions but all essential factors, including such items as capital invested, inventories, etc., are given in a preliminary statement.

The business transactions are presented in this manner that they may be used in bookkeeping classes or in a study of accounting. The arrangement requires the closing of the books at the end of a second year of business. This makes necessary the preparation of all closing records and their analysis in the interest of efficient business control.

Following the statement of preliminary facts concerning the business and a skeleton outline of the routine transactions of a month of business (December), there will be found on pages 1402 to 1410 a brief review of *single entry* and of *double entry bookkeeping*, in which these transactions are entered in the several books which are illustrated. The necessary analysis statements are also given.

Following this, on pages 1411 to 1421, these same transactions have been entered upon columnar sheets, with appropriate explanations, for the purpose of calling attention to a system of bookkeeping which is much more practicable for the retail drug store and which offers a valuable business guide for the retailer with a minimum amount of labor.

In working out this bookkeeping problem, the name of the one doing the bookkeeping, or a fictitious name, if that is preferred, should be entered as the proprietor. If your own name is used, it gives a suggestion of reality and adds a personal interest to the work.

All transactions are numbered for ready reference in teaching.

Details of the Business—

1. Use your own name throughout these accounts, and at the beginning adopt a signature which will be uniform for all business papers.

2. That these transactions may seem more personal and real, you are asked to assume that you have been in business at 63rd and Clinton Streets, for almost two years, December 31 next, closing the second year.

3. When you began business you had saved $1630.00, and $1500.00 of this was used as a part of the first cash payment on this store which was bought from C. L. Martin. The balance, $130.00, remains on deposit in the Western Savings Fund Society.

4. You also arranged a loan of $5000.00 from your father, and secured this by means of promissory notes of $500.00 each, made payable to your father with interest in advance, at 5 per cent. The notes are for one year, two years, three years, and up to ten years, respectively.

5. In purchasing the drug store at 63rd and Clinton Streets, almost two years ago, from C. L. Martin, the value was estimated at $15,700.00, divided as follows:

Stock of general drugs and sundry merchandise	$7,163.70
Soda supplies	108.20
Candy stock	82.50
Cigar stock	145.60
General fixtures	4,400.00
Soda fountain	1,800.00
Transfer of lease and goodwill	2,000.00
	$15,700.00

6. The terms of sale at that time were as follows: A cash payment of $5000.00, and the balance, $10,700.00, in ten annual payments of $1070.00 each. Ten judgment notes, with interest in advance at six per cent, each for $1070.00, were given Mr. Martin as security. One of these notes falls due each year until the tenth is paid.

7. At the beginning of the first year, the following payments were made:

Interest in advance on the notes given your father ($5000.00 at 5 per cent)	$250.00
Interest in advance on Martin's notes ($10,700.00 at 6 per cent)	642.00

8. At the close of the first year the following payments were made:

First payment on principal (your father's note)	$500.00
First payment on principal (Martin's note)	1070.00

9. At the beginning of the second, or current year, the following was paid:

Interest on your father's note ($4500 at 5 per cent)	$225.00
Interest on Martin's notes ($9630 at 6 per cent)	577.80
	$802.80

10. *A Bank Account*—A bank account is opened with the Training National Bank, an introduction to the cashier being secured through Mr. Martin. Your signature was registered and the necessary books, *viz.*, bank book and check book procured.

11. *The Lease*—The building in which the store is located is owned by H. H. Wood, of ———. The lease was originally drawn for ten years and had run for two years when you took over the business. It is transferred to you through the consent of Mr. Wood, and a new lease drawn for the

unexpired term. This lease sets forth the following facts concerning your position as tenant:

That C. L. Martin, being tenant under lease given by H. H. Wood, of ———, hereinafter called the lessor, doth hereby underlet unto (————) of the City of ———, hereinafter called the lessee, the first floor storeroom, rear yard, cellar and third floor front bedroom situated on the premises known as 6300 Clinton Street, in the City of ———, for the term of eight years from the first day of January A. D. 19—, at a yearly rate of fourteen hundred and forty and $\frac{x}{100}$ dollars, lawful money, payable in monthly installments on the first day of each and every month. The first payment to be made on the first day of January A. D. 19—.

The lessor hereby agrees to keep and maintain the leased premises in good condition and repair, and at all reasonable times to paper and paint said rooms in a manner satisfactory to the lessee.

The lessor further agrees to pay all taxes and water rent assessed on the premises or any part thereof, and to maintain a perpetual policy of fire insurance to the value of $20,000 $\frac{x}{100}$ upon the same.

The lessee hereby agrees to occupy the storeroom contained in the premises only as a drug store; the rear yard and the cellar only for the receiving and storing of goods necessary and proper to the drug business, and the third floor room only as a private living apartment, and agrees not to underlet the same or any part thereof, or assign this lease, without the previous written consent of the lessor.

Your father agrees to be responsible for your faithful fulfillment of these contracts.

The usual agreements, covering the interests of the landlord, are also included in the lease.

12. *Fire Insurance*—You are carrying the following insurances at this time:

Fire insurance $13,000.00. The policy was paid for at the rate of forty cents for each $100.00 of insurance. The policy, No. 1,662,490, was taken out January 1, of the current year, in the Druggists' Mutual Fire Insurance Company, for one year.

The details of this policy are as follows:

On merchandise generally and bottles and packages containing the same, chiefly drugs, medicines, druggists' sundries, chemicals, cigars, tobacco, syrups and extracts, ice cream, stationery for sale, fancy and toilet articles and supplies, their own, held in trust or on consignment, or for which the assured may be legally liable in the event of loss or damage by fire, or sold but not removed. ($6000.00.)

On all other contents appertaining to the business not mentioned above, chiefly store and office fixtures and furnishings either useful or ornamental, decorations, counters, safes, partitions, cases, shelvings, racks, scales, and weights, machinery, machines, fuel, tools, implements, apparatus, utensils, bottles, jars, labels, inside and outside signs and awnings, floor coverings and mosaic flooring, electric fans, lighting apparatus, stoves, clocks, pictures, mirrors, stationery supplies for use, advertising matter, typewriting machines, cash register, soda water fountains and their appurtenances.

All while contained in or attached to the brick building, situated at 6300 Clinton Street, ———, occupied as a retail store and dwelling.

Privilege: of other insurance without notice until required; to make additions, alterations and repairs; and to keep for sale not more than five (5) gallons (in all) of gasoline, benzine or naphtha.

Lightning, Exclusion and Electric Current Clauses.

Lightning Clause—(Excluding Damage to Electric Apparatus.) This policy shall cover any direct loss or damage caused by lightning meaning thereby the commonly accepted use of the term "lightning" and in no case to include loss or damage by cyclone, tornado or windstorm, not exceeding the sum insured, nor the interest of the insured in the property, and subject in all other respects to the terms and conditions of this policy. *Provided*, however, that if there shall be any other insurance on said property, this company shall be liable only pro rata whether such other insurance be against direct loss by lightning or not, and provided further that if dynamos, wiring, lamps, motors, switches, or other electrical appliances or devices are insured by this policy, this company shall not be liable for any loss or damage to such property resulting from any electrical injury or disturbance, whether from artificial or natural causes, unless fire ensues, and then for the loss by fire only.

It is understood and agreed, that this insurance does not cover and will not be liable for loss to accounts, bills, currency, deeds, evidences of debt, money, notes or securities.

ELECTRIC CURRENT CLAUSE

Permission is granted under this policy for the use of Electric Current after certificate of approval has been issued by the ——— Fire Underwriters Association and while it remains unrevoked by said Association.

Attached to Policy No. 1,662,490 of the Druggists' Mutual Fire Insurance Company of New York.

Workman's Compensation Insurance for which you pay an annual premium of $19.00. This is the minimum premium for this form of insurance, and, with the rate of 19 cents per $100.00 assigned to drug stores by the ——— Insurance Commission, covers about an annual pay roll of $10,000.00, and protects you against any compensation awarded under the law to your employees in case of accident.

Liability Insurance—You also carry liability insurance for which you have paid $13.00 on January 1 of the current year. This protects you and your registered clerks against mistakes in prescription compounding or in the dispensing of poisons, and also provides legal counsel and awarded damages, if any, from suits at law for injuries, either actual or supposed, up to an amount not exceeding $2500.00.

13. *Credit Customers*—The following customers have been allowed credit after suitable investigation of their financial standing, and accounts were opened:

1. John L. Scott, 6125 Market Street. Balance due December 1, $13.50.
2. B. C. Hastings, 6331 Chestnut St.
3. J. P. Milkins, 415 South 63rd Street.
4. Mrs. S. R. Palmer, 5840 Clinton Street. Balance due December 1, $4.80.
5. Dr. F. T. Brown, 840 South 64th St. Balance due December 1, $10.32.
6. William C. Campbell, 6360 Chestnut Street.
7. Mrs. B. C. Hall, 234 North 62nd Street.
8. Miss Mary L. Adams, 6360 Arch Street. Balance due December 1, $8.60.
9. Frank F. Mason, 6536 Market Street.
10. L. C. Beaver, 6163 Clinton Street. Balance due December 1, $6.10.
11. A. S. Wilson, 6537 Arch Street.
12. J. S. Hayes, 6620 Market Street. Balance due December 1, $10.12.

14. *Inventory*—The inventory at the beginning of the current year was as follows:

Fixtures (all but soda fountain) ($4400.00 less 5 per cent depreciation)	$4,180.00
Soda fountain ($1800.00 less 10 per cent depreciation)	1,620.00
Goodwill ($2000.00 less 20 per cent charged off)	1,600.00
General drugs and sundries	8,133.30
Soda supplies	124.50
Candy stock	151.20
Cigar stock	91.00
Coal	30.00
Office supplies	24.80
	$15,954.80

15. *Miscellaneous Business Facts*—The total sales of the previous year were $34,048.60.

16. Credit sales amounting to $87.50 remain unpaid at the beginning of the current year. (Note—Only a few credit customers are listed to lessen the amount of work required. The same principles apply to any number of customers.)

17. The cash on hand at the beginning of the current year was $2371.68.

18. The capital invested in the business by the proprietor at the beginning of the current year was found to be $3211.78.

19. On the beginning of the current year, January 1, invoices for supplies purchased remained unpaid as follows:

Prescriptions, mdse	$890.72
Soda	8.46
Candy	140.75
Cigars	32.27
	$1,072.20

20. Unpaid invoices as of December 1 Current year

		Less 2 per cent discount
Smith Baker and Co., mdse	$960.35	$941.14
Whitney Chemical Co., Chemicals	122.60	120.15
Boyd Whitney Co., Candy	152.70	149.65
Knight Cigar Co., Cigars	80.60	78.99
		$1,289.93

21. **Brief Outline of Detailed Business Transactions**

Monday, December 1, 19—

1. Cash on hand:

In store, for change	$50.00
In bank, subject to check	$3,238.60

2. Pay H. H. Wood, by check, for the December rent, $120.00.

3. Sold John L. Scott, on account, 6125 Market St., 1 lb. sugar of milk, 65 cts., 1 pt. olive oil, $1.25.

4. Cash sales for the day: mdse., $84.40; soda, $18.25; candy, $11.50; cigars, $7.30.

5. Pay Mary Wright for cleaning, $3.50; charge to miscellaneous expenses.

Wednesday, December 3

6. Sold B. C. Hastings, on account, 6331 Chestnut St.
℞ 38362, $1.25 1 pt. Lime Water and bottle, 25 cts.
1 pt. Ext. Witch Hazel, 35 cts.

7. Pay $2.00 for advertising in a programme of St. John's Church, charge to advertising.

8. Cash sales, Dec. 2 and 3: mdse., $153.84; soda, $35.15; candy, $15.30; cigars, $12.40.

(NOTE—The sales of several days are combined to lessen the number of entries. If desired the amounts may be proportionally divided to show daily sales and be recorded as such.)

Saturday, December 6

9. Sold Mrs. S. R. Palmer, on account, 5840 Clinton St. (Balance now due on her account, $4.80):
6 (1 gal.) bottles Crystal Spring Water at 50 cents a bottle (refund 25 cts. per bottle when returned); 1 bottle extract of vanilla, 25 cts.

10. Paid from cash $5.00 for stamps for sending circulars to customers and deposited in the bank all cash in the store except $50.00 for change.

11. Pay the following salaries for the week:

Your own salary, by check	$45.00
James T. Harris, registered clerk by check	45.00
Miss Thompson, by check	15.00
William Smith, cash	15.00

12. Cash sales, Dec. 4, 5, 6: mdse., $243.13; soda, $72.20; candy, $38.15; cigars, $28.50.

Wednesday, December 10

13. Bought a broom for 85 cts., miscellaneous expenses; paid cash.

14. Bought 100 lbs. sugar for soda fountain at 8 cts.; paid cash.

15. Dr. F. T. Brown paid his bill due Dec. 1.

16. Bought 5 tons of stove coal, at $16.25 a ton; paid by check.

17. Paid gas bill, by check, $3.75.

18. Paid electric light bill, by check, $14.65.

19. Cash sales, Dec. 7, 8, 9, 10: mdse., $198.15; soda, $51.90; candy, $21.80; cigars, $17.60.

20. Paid Smith Baker Company, bill of Dec. 1, $960.35, for general mdse., deducting 2 per cent.

21. Paid bill of Whitney Chemical Company, $122.60, for chemical supplies, less 2 per cent.

22. Mrs. S. R. Palmer paid her bill of last month.

23. Paid bill of Boyd, Whitney Company, for candy, $152.70; less 2 per cent.

24. Paid bill of Knight Cigar Company, bill $80.60. less 2 per cent.

Saturday, December 13

25. Sold John L. Scott, on account, ¼ lb. absorbent cotton, 25 cts.
Hot-water bottle, $2.25.
He paid his bill of last month.

26. Cash sales, Dec. 11, 12, 13: mdse., $272.12; soda, $79.15; candy, $35.70; cigars, $31.10. Deposited in the bank all cash except $50.00 for change.

27. Paid the following salaries for the week:

Your own salary, by check	$45.00
James T. Harris, by check	45.00
Miss Thompson, by check	15.00
William Smith, cash,	15.00

Thursday, December 18

28. Sold B. C. Hastings, on account, R 38715, 75 cts.; R 38716, $1.35; 1 perfume lamp, $3.75.

29. Bought decorative material, $5.20.

30. Bought lemons and oranges for soda fountain, cash, $3.60.

Saturday, December 20

31. Bought of Smith Baker and Company, mdse., payable before January 10. Net $412.24.

32. Cash sales for week, Dec. 14 to 20: mdse., $721.41; soda, $127.50; candy, $92.30; cigars, $143.05. Deposited in the bank all cash except $50.00 for change

33. Bought of Knight Cigar Company, cigars, payable before January 10. Net $118.21.

34. Paid the following salaries for the week:

Your own salary	$45.00
James T. Harris	45.00
Miss Thompson	15.00
William Smith	15.00
Extra help, 6 days, at $4.00	24.00

35. Miscellaneous expenses: Carfare, $1.20; messenger service, 75 cts.; special circulars, $10.30; price cards and window cards $16.00.

Saturday, December 27

36. Paid the following salaries for the week:

Your own salary	$45.00
James T. Harris	45.00
Miss Thompson	15.00
William Smith	15.00
Extra help, 6 days, at $4.00	24.00

Deposited in the bank all cash except $50.00 for change.

Wednesday, December 31

37. Cash sales, Dec. 21 to 31: mdse., $1546.75; soda, $127.80; candy, $170.70; cigars, $101.25.

22. *Miscellaneous Items*:

Paid by check second payment on principal (your father's note)	$ 500.00
Paid by check second payment on principal (Martin's note)	$1,070.00

Unpaid account of J. S. Hayes, 6620 Market Street, amounting to $10.12, charged off to bad debts. It was found he left the city and could not be located.

23. *Inventory*, December 31, is as follows:

Fixtures (all but soda fountain)	
$4180 less $220 Dep., *i.e.*, 5% of orig. invest.	$3,960.00
Soda fountain	
$1620 less $180 Dep., *i.e.*, 10% of orig. invest.	1,440.00
Goodwill	
$1600 less $400 Dep., *i.e.*, 20% of orig. invest.	1,200.00
General drugs and sundries.	9,220.10
Soda supplies.	132.50
Candy stock.	141.60
Cigar stock.	105.00
Coal.	30.00
Office supplies.	24.80
	$16,254.00

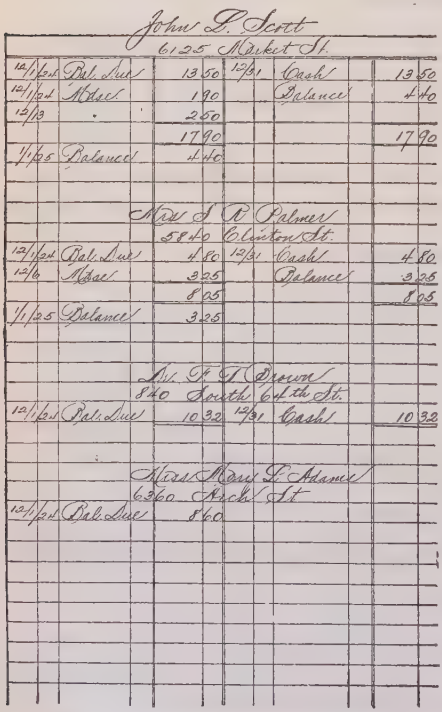
Single Entry Accounting—

The Daybook—The usual form of daybook, as found in a retail drug store, consists of a book ruled as shown in Fig. 477. Into this are entered the records of credit sales. Here will be placed, under the date, the name of the customer and the itemized sale. Frequently this book is used for recording the initial payment "on account" by a credit customer. In many stores the original entry of a credit sale is made upon a small pad of paper, suitably ruled, and the individual record rung up in the cash register under the "charge" key. In some cash registers the amount is also recorded in the register on a tape, thus providing a check against the possible loss of the "charge" slip.

If "double entry" books are not employed these "original entries" of charges and also credits, when entered on the "daybook", are now "posted" in a personal ledger.

The Personal Ledger—(Single Entry). If regular double entry accounts are not being maintained, the charge accounts may be handled by "single entry". This means, of course, that when an item is debited it is posted but once in the ledger, that entry being under the name of the customer who has made the purchase. When a customer pays on the account, he in turn is credited in the ledger. This gives to the proprietor a summary in the ledger, under the name of each customer, of all purchases and sales on account, by the individual or firm involved. The monthly bills and statements are made up from this ledger record. This ledger must be properly indexed, or, if a

FIG. 481


John L. Scott
6125 Market St.
12/1/24 Bal. Due 13 50 12/31 Cash 13 50
12/14/24 Mdse 1 90 Balance 4 40
12/13 " 2 50
17 90 17 90
1/1/25 Balance 4 40
Mrs. A. R. Palmer
5840 Clinton St.
12/1/24 Bal. Due 4 80 12/31 Cash 4 80
12/9 Mdse 3 25 Balance 3 25
8 05 8 05
1/1/25 Balance 3 25
Mr. F. T. Brown
840 South 64th St.
12/1/24 Bal. Due 10 32 12/31 Cash 10 32
Miss Mary L. Adams
6360 Arch St.
12/1/24 Bal. Due 8 60

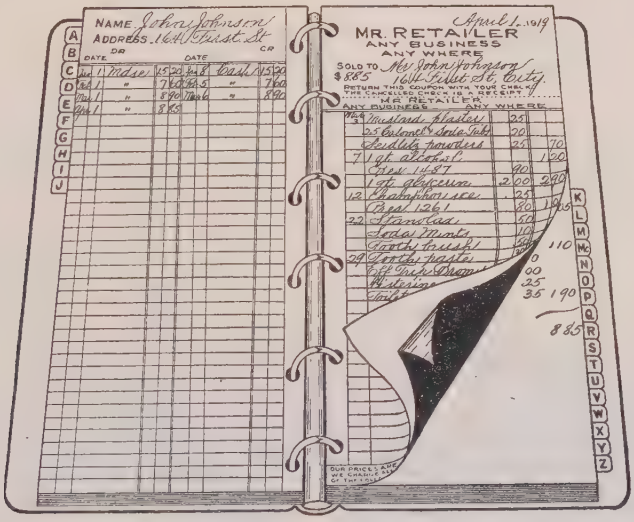
Personal ledger (single or double entry)

"loose-leaf ledger", it must be arranged in alphabetical order. Every entry in the ledger should also carry a memorandum of the page number, or the "charge" slip number, from which the original entry was taken.

The Billing Ledger—In modern systems of accounting it has become almost universally the custom to use the principle of the billing ledger for personal accounts. A typical ledger of this character, suitable for use in a retail drug store, is shown in Fig. 482. It is sold by the LaWall Systems, of Philadelphia. The many advantageous features are clearly indicated. The ledger entry is always before the proprietor, although the record need be but the total of the month's debits and credits, a single entry.

The necessity of transferring details to the ledger is made unnecessary through the use of a carbon copy duplicate, thus avoiding one complete writing of the credit sales of the month. The billhead itself carries a stub

FIG. 482



Billing ledger

at the top which, when used in a window envelope, serves as the address. This may also be torn off and returned by the customer with his check and avoids the necessity of a receipt as it states distinctly that no receipt will be returned except upon request, the canceled check being considered sufficient. At the bottom of the bill there is a polite reminder that credit is a favor and that prompt payment is expected.

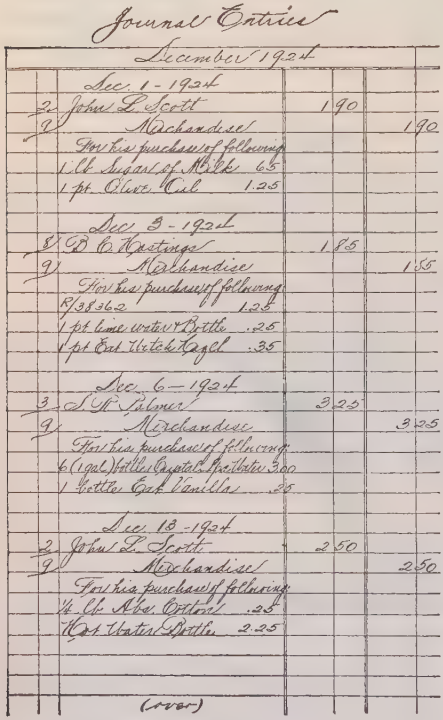
For those who grant credit accounts, the adoption of such a system is invaluable. One very important advantage is the fact that, if posting has been done regularly, by simply adding each account, the bills are ready at the close of the month for mailing to the customer, thus enabling the proprietor to issue bills without delay and without special effort.

Double Entry Accounting—If the proprietor is using a double entry system of accounts throughout, the "personal accounts", that is, the record of the sale to the retail customer and the payment on these sales, may be handled as already described under the daybook, page 1392, but in posting them they must first be "journalized". This consists of determining the two parties to the transaction, the one to be debited and the other credited. In determining

this entry the bookkeeper may advantageously ask the question with reference to every transaction, "Who is in debt"? The person or account "in debt" is of course debited, the other party to the transaction is credited. If this question is asked for every transaction, it will always give the clue to proper journalizing.

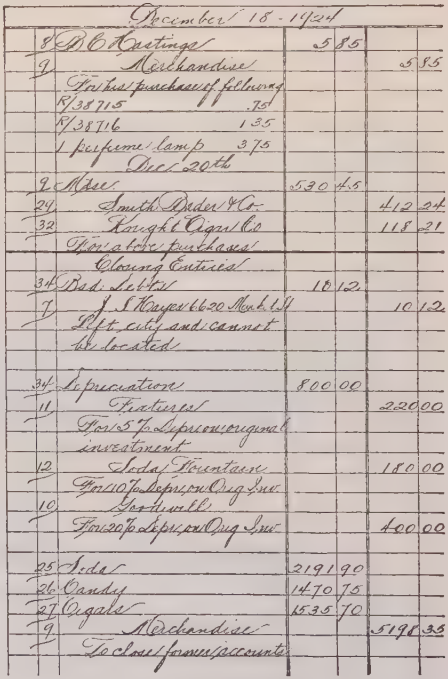
Journalizing—For the beginner it is desirable to write out this journalizing step, as illustrated in Figs. 483 to 485. When properly journalized, the transactions are then posted in the ledger. It can be seen that the account of a customer making a purchase is marked with the abbreviation, "Dr."

FIG. 483


Journal Entries
December 1924
Dec. 1 - 1924
2 John L. Scott 1 90
9 Merchandise 1 90
For his purchase of following
1 lb Sugar of Milk .65
1 pt Olive Oil 1.25
Dec 3 - 1924
8 B C Hastings 1 85
9 Merchandise 1 85
For his purchase of following
R/38362 1.25
1 pt lime water Bottle .25
1 pt Eat Witch Hazel .35
Dec. 6 - 1924
3 L R Palmer 3 25
9 Merchandise 3 25
For this purchase of following
6 (1 gal) Bottles Capital Sparkling Water 3.00
1 Bottle Oak Vanilla .25
Dec 18 - 1924
2 John L. Scott 2 50
9 Merchandise 2 50
For his purchase of following
1/4 Cs Abs. Cotton .25
Hot Water Bottle 2.25
(over)

The journal

FIG. 484


December 18 - 1924
8 B C Hastings 5 85
9 Merchandise 5 85
For his purchase of following
R/38715 .75
R/38716 1.35
1 perfume lamp 3.75
Dec 20th
9 Mdse 5 30 4 5
24 Smith Drug Co 4 12 24
32 Knight Cigar Co 1 18 21
Personal Use purchases
Closing Entries
31 Bad Debts 10 12
7 J. S Rayen 6620 Mark Ln 10 12
Left city and cannot be located
31 Depreciation 800 00
11 Fixtures 2200 00
For 5% Depreciation original investment
12 Soda Fountains 1800 00
For 10% Depreciation Orig Inv
10 Good will 4000 00
For 20% Depreciation Orig Inv
25 Sales 219190
26 Candy 14707 5
27 Cigars 15357 0
9 Merchandise 51906 35
To close former accounts

The journal

indicating the debit side of the ledger and the credit side with the abbreviation "Cr."

The account supplying the goods for the sale is primarily known as the "merchandise" account, and this account is accordingly credited whenever a sale is made. This merchandise account may be subdivided into as many classifications as are desirable. For instance, it may be represented by various departments as drugs, soda, cigars, candy, etc. In this case, the credit when a sale is made in any one department, would be entered to the credit of the department involved.

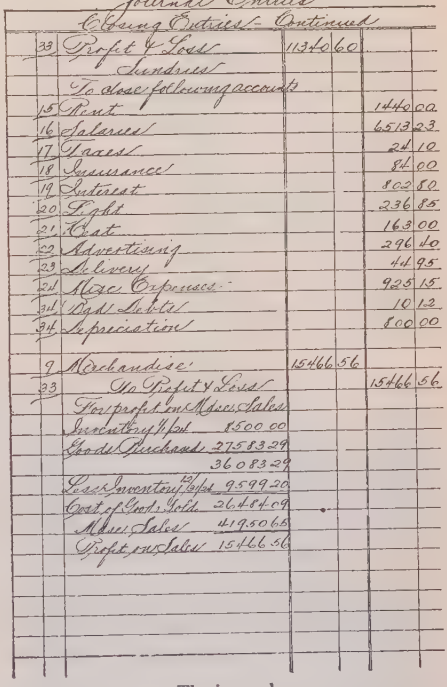
When a bookkeeper becomes skilled, the actual writing out of the journal becomes unnecessary. Then the original entry may be journalized mentally and posted at once in the correct ledger accounts.

The Cashbook—The only kind of cashbook which any retail pharmacist should use should be double entry in character. In other words, the cash

account should always have a debit and a credit side. The cash account should be comprehensive. It may be that a petty cash account may be carried on the side, in which are entered small expenditures and even receipts, but the combined "cashbooks", should record every transaction in which cash is involved and its balance should show "total cash". (See Figs. 450 to 453.)

Journalizing in the cashbook is sometimes confusing to the amateur but, if the "cash account" is considered as occupying the position of an official, say a treasurer, who is responsible for the money of the firm and who must be prepared at any time to report the balance on hand, it will then be seen that this account or individual is in debt or is debited whenever money is received. Likewise this account, or this individual representing the business, must be credited whenever money is paid out. If a complete record of every cent received by the business from whatever source is kept on the debit side, and if, on the credit side, is a complete record of every expenditure, no matter how small, the "balance", that is, the difference between the debit and credit side, will always indicate the cash on hand. This cash, of course, may be in various forms. Some of it may be in the cash register of the store, another portion may be in the store safe, and the remainder may be in bank or even invested, but the cashbook, when closed or balanced, should indicate accurately the total cash available.

FIG. 485


Journal Entries
Closing Entries Continued

31		Profit & Loss			11340	60	
		Sundries					
		To close following accounts					
	15	Rent					1440 00
	16	Salaries					6513 23
	17	Taxes					24 10
	18	Insurance					84 00
	19	Interest					802 50
	20	Light					236 85
	21	Coal					163 00
	22	Advertising					296 40
	23	Delivery					41 95
	24	Misc. Expenses					925 15
	31	Bad Debts					10 12
	31	Depreciation					800 00
	9	Merchandise			15466	56	
	31	To Profit & Loss					15466 56
		For profit on Merc. Sales					
		Inventory Feb. 1st		8500 00			
		Goods Purchased		27583 29			
				36083 29			
		Less Inventory Feb. 28th		9599 20			
		Cost of Goods Sold		26484 09			
		Merc. Sales		41950 65			
		Profit on Sales		15466 56			

The journal

The entries in this form of cashbook are usually chronological and constitute the "original entry". It may be, of course, that money received on account may be entered upon appropriate slips and rung up on the cash register during the day and subsequently entered in the cashbook. In such cases, the original slip becomes the "original entry". This cashbook must ultimately be posted to the ledger. The debit side is posted first and every transaction involves at least two parties.

If the money received in the business has come from the sale of merchandise, the two ledger accounts involved are cash and merchandise. Cash is debited as having received the value and merchandise is credited as the account supplying the goods sold. If a customer has paid money on account, the accounts involved are: first, the cash account, which is debited as having received the value, and second, the personal account of the customer who is given credit for the payment. In a transaction representing the payment of a bill for supplies, the personal account of the firm supplying the goods will be debited and the cash account, representing the cash paid out, will be credited.

If rent has been paid, the rent account, perhaps under the name of the

FIG. 486

Dr. Cash

19					
Dec 1	To Balance			3288	60
	" Cash	Mdse		84	40
	" "	Soda		18	25
	" "	Candy		11	50
	" "	Cigars		7	30
3	" "	Mdse		153	84
	" "	Soda		35	15
	" "	Candy		15	30
	" "	Cigars		12	40
6	" "	Mdse		243	13
	" "	Soda		72	20
	" "	Candy		38	15
	" "	Cigars		28	50
10	" "	Mdse		198	15
	" "	Soda		51	90
	" "	Candy		21	80
	" "	Cigars		17	60
	" "	Dr. F. T. Brown		10	32
	" "	Mrs. A. R. Palmer		4	80
13	" "	John L. Scott		13	50
	" "	Mdse		272	12
	" "	Soda		79	15
	" "	Candy		35	70
	" "	Cigars		31	10
20	" "	Mdse		721	41
	" "	Soda		127	50
	" "	Candy		92	30
	" "	Cigars		143	05
31	" "	Mdse		1546	75
	" "	Soda		127	80
		Forward		7503	67

Cashbook

FIG. 487

Cr. Cash

19					
Dec 1	By Cash H. H. Wood	Rent		120	00
	" " Mary Dwight	Misc.		3	50
	" " St. John Church	Adv.		2	00
	" " Stamps	"		5	00
	" " Salaries	Salary		120	00
	" " Brooms	Misc. Exp.			85
	" " 100 lbs Sugar	Mdse		8	00
	" " 3 Tons Coal	Heat		48	75
	" " Gas	Light		3	75
	" " Electric Light	"		14	65
	" "	Smith Bakers Co		941	14
	" "	Whitney Chem. Co		120	15
	" "	Boyd Whitney Co		149	65
	" "	Knight Cigar Co		78	99
	" " Salaries	Salary		120	00
	" " Decorations	Adv.		5	20
	" " Lemons & Oranges	Mdse		3	60
	" " Salaries	Salary		120	00
	" " Cotton Rolls	"		24	00
	" " Special Circulars	Adv.		10	30
	" " Carfare	Misc. Exp.		1	95
	" " Show Cards	Adv.		16	00
	" " Salaries	Salary		120	00
	" " Cotton Rolls	"		24	00
	" " Southern Note	Notes Payable		500	00
	" " Martins Note	" "		1070	00
		Forward		3631	48

Cashbook

FIG. 488

Dr. Cash

19					
Dec 31	Forward			7503	67
	To Cash	Candy		170	70
	" "	Cigars		101	25
				7775	62
	Summary				
2	John L. Scott			13	50
3	Mrs. A. R. Palmer			4	80
4	Dr. F. T. Brown			10	32
9	Mdse			3219	80
25	Soda			511	95
26	Candy			385	45
27	Cigars			341	20
				4487	02
1	Cash				

Cashbook

FIG. 489

Cr. Cash

19					
Dec 31	Forward			3631	48
	By Balance			4144	14
				7775	62
	Summary				
9	Mdse			11	60
15	Rent			120	00
16	Salaries			528	00
20	Light			18	40
21	Heat			48	75
22	Advertising			38	50
24	Misc. Expenses			6	30
28	Notes Payable			1570	00
29	Smith Bakers Co			941	14
30	Whitney Chemical Co			120	15
31	Boyd Whitney Co			149	65
32	Knight Cigar Co			78	99
				3631	48
1	Cash				

Cashbook

owner of the property, will be debited, and cash will be credited. If a salary has been paid, the salary account, perhaps divided into an account for each employee, will be debited and the cash account again credited. Thus every entry in the cashbook will be appropriately journalized and entered on the debit or credit side of the proper account in the ledger.

The Ledger—The ledger consists of a systematic summary of every transaction. When records are transferred from the books of original entry to the appropriate account in the ledger, the act is spoken of as "posting" and the account is said to have been "posted". When the records have been properly posted, there will be found in every account, all transactions involving that account, the entries being divided into debits and credits. Ledger entries are illustrated in Figs. 490 to 497.

The Trial Balance—When properly posted, at the end of a stated period, it is customary for the bookkeeper to take off what is known as a "trial balance". This consists of tentatively closing every account with a pencil addition of both Dr. and Cr. sides and a subtraction, so that the balance in every account may be determined. All debit balances are then added, and also all credit balances and the totals of both should be identical. This is simply a mechanical check upon the fact that "for every debit there has been a credit". It does not conclusively prove that the books have been properly posted. There is always the possibility that a debit and credit may have been reversed, but it is a valuable first check upon the correctness of entries.

Closing the Ledger—In obtaining more valuable information from the ledger concerning the status of the business, the accounts are now divided into two groups. These are usually spoken of as "personal" accounts and "speculative" accounts.

"Personal" Accounts are those which are mere records of transactions. One type is when goods have been purchased by a credit customer and then paid for; the account closes without a balance. Others are simply records of money received and money paid out and the balance is a simple statement of cash on hand. Personal accounts are supposed to involve no profit or loss. They are simply a record, though an important one, of various transactions of the business.

On the other hand, *speculative accounts* are those which involve the possibility of a loss (in many instances an expense), or a gain. Many of these accounts are simply the expense accounts necessitated by the conduct of business, such as rent, salaries, light, heat, etc. Other speculative accounts are of a different character.

The *merchandise account*, for instance, whether standing for all merchandise sold, or divided into departments, is an account which should show the gross profit or gain, in fact, this account is the true speculative account. In a properly organized business it should show sufficient profit to cover all expenses, and in addition, should leave a balance of net profit for the proprietor.

The next step in closing the ledger must be the entry, in all accounts involving an investment, of the correct inventory. For instance, the merchandise account must be credited with the goods on hand before a true statement of profit or loss can be determined. The heating account will usually carry an inventory for fuel on hand. The fixture account would, of course, be credited with an inventory of the present value of fixtures and there will doubtless be other accounts with an inventory.

Wherever value is found in accounts it must be credited before the closing of the books. This entry is usually made in red ink on the credit side.

FIG. 490

T. C. Beaver
6165 Clinton St

12/1/24	Bal Due		6 10				

J. A. Mayer
6620 Market Street

12/1/24	Bal Due		10 12	12/9/24	Paid Dollar		10 12

O. B. Hastings

12/9/24	Mdse		1 85		Balance		7 70
12/18	"		5 85				
			7 70				7 70
1/1/25	Balance		7 70				

The ledger

FIG. 491

Smith Baker Co.

12/6/24	Cash		9 41 14	12/1/24	Bal Due		9 41 14
	Balance		4 12 24	12/9/24	Mdse		4 12 24
			13 53 38				10 53 38
				1/1/25	Balance		4 12 24

Whitney Chemical Co

12/9/24	Cash		1 20 15	12/1/24	Bal Due		1 20 15

Boyd Whitney Co

12/9/24	Cash		1 49 65	12/1/24	Balance		1 49 65

Knight Cigar Co

12/9/24	Cash		78 99	12/1/24	Bal Due		78 99
	Balance		118 21	12/9/24	Mdse		118 21
			197 20				197 20
				1/1/25	Balance		118 21

The ledger

FIG. 492

Cash

12/1/24	Balance		3288 60	12/9/24	Cash		3631 48
12/31	Cash		4487 03		Balance		4144 14
			7775 63				7775 63
1/1/25	Balance		4144 14				

Merchandise

1/1/24	Inventory		8500 00	12/1/24	Sales		33517 15
12/	Purchases		27041 24	"	J. L. Scott		190
12/9/24	Sundries		530 45	12/9	O. B. Hastings		185
12/31	Cash		11 60	12/6	A. R. Palmer		325
	Profit & Loss		15466 56	12/9	J. L. Scott		250
				12/18	O. B. Hastings		585
				12/31	Cash		32190
				"	Sundries		5195 35
				"	Inventory		9599 20
			51549 85				51549 85
1/1/25	Inventory		9599 20				

Goodwill

12/1/24	Balance		1600 00	12/9/24	Depreciation		220 00
					Inventory		3960 00
			1600 00				4180 00
1/1/25	Inventory		1200 00				

The ledger

FIG. 493

Fixtures

12/1/24	Balance		4180 00	12/9/24	Depreciation		220 00
					Inventory		3960 00
			4180 00				4180 00
1/1/25	Inventory		3960 00				

Soda Fountain

12/1/24	Balance		1620 00	12/9/24	Depreciation		180 00
							1440 00
			1620 00				1620 00
1/1/25	Inventory		1440 00				

Coal

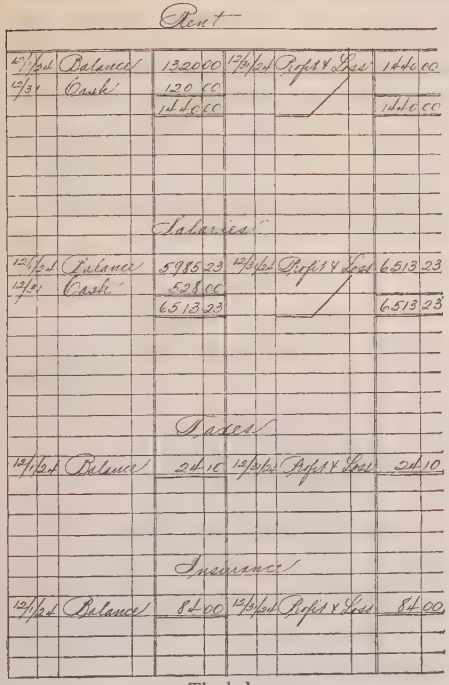
12/1/24	Balance		30 00	12/9/24	Inventory		30 00
1/1/25	Inventory		30 00				

Office Supplies

12/1/24	Balance		24 80	12/9/25	Inventory		24 80
1/1/25	Inventory		24 80				

The ledger

FIG. 494



Rent

12/1	p1	Balance	1320 00	12/31	p1	Profit & Loss	1440 00
12/31		Cash	120 00				
			1440 00				1440 00

Salaries

12/1	p1	Balance	5985 23	12/31	p1	Profit & Loss	6513 23
12/31		Cash	528 00				
			6513 23				6513 23

Taxes

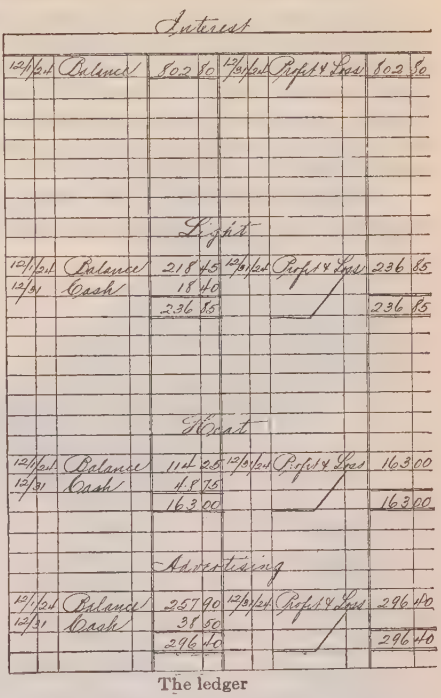
12/1	p1	Balance	24 10	12/31	p1	Profit & Loss	24 10

Insurance

12/1	p1	Balance	84 00	12/31	p1	Profit & Loss	84 00

The ledger

FIG. 495



Interest

12/1	p1	Balance	802 80	12/31	p1	Profit & Loss	802 80

Light

12/1	p1	Balance	218 45	12/31	p1	Profit & Loss	236 85
12/31		Cash	18 40				
			236 85				236 85

Heat

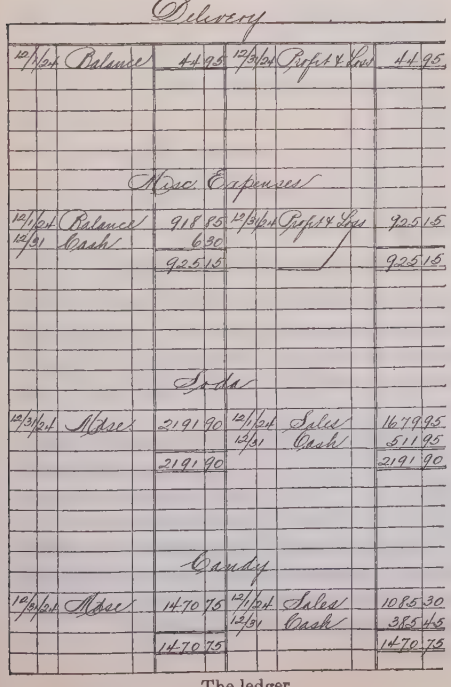
12/1	p1	Balance	114 25	12/31	p1	Profit & Loss	163 00
12/31		Cash	48 75				
			163 00				163 00

Advertising

12/1	p1	Balance	257 90	12/31	p1	Profit & Loss	296 40
12/31		Cash	38 50				
			296 40				296 40

The ledger

FIG. 496



Delivery

12/1	p1	Balance	44 95	12/31	p1	Profit & Loss	44 95

Misc. Expenses

12/1	p1	Balance	918 85	12/31	p1	Profit & Loss	925 15
12/31		Cash	6 30				
			925 15				925 15

Soda

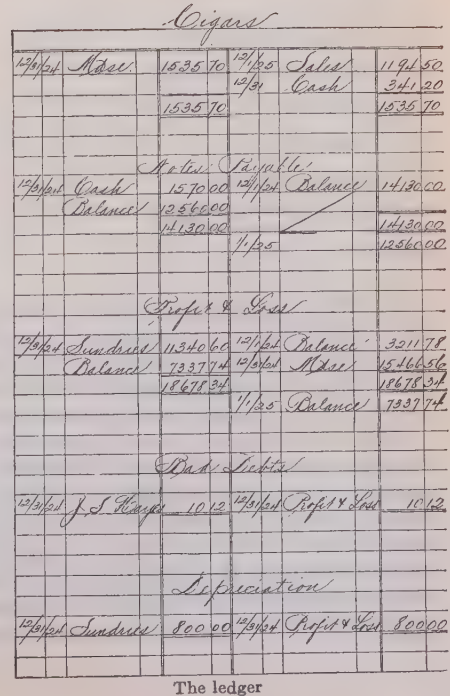
12/3	p1	Misc	2191 90	12/1	p1	Sales	1679 95
				12/31		Cash	511 95
			2191 90				2191 90

Candy

12/3	p1	Misc	1470 75	12/1	p1	Sales	1085 30
				12/31		Cash	385 45
			1470 75				1470 75

The ledger

FIG. 497



Cigars

12/3	p1	Misc	1535 70	12/1	p5	Sales	1194 50
				12/31		Cash	341 20
			1535 70				1535 70

Notes Payable

12/3	p1	Cash	1570 00	12/1	p1	Balance	1413 00
		Balance	1256 00				
			1413 00				1413 00
				1/25			1256 00

Profit & Loss

12/3	p1	Sundries	11340 60	12/1	p1	Balance	3211 78
		Balance	7337 74	12/31	p1	Misc	15466 56
			18678 34				18678 34
				1/25		Balance	7337 74

Bad Debts

12/3	p1	J. S. Hays	10 12	12/31	p1	Profit & Loss	10 12

Depreciation

12/31	p1	Sundries	800 00	12/31	p1	Profit & Loss	800 00

The ledger

A *statement of profit and loss* must now be made (see Fig. 498). This consists of gathering together the gross profits, that is, the difference between the cost of the merchandise and the credits for their sale, plus the inventory. Then the expenses or losses must all be assembled. The difference between the total profits, which is spoken of as *gross profit*, and the expenses and loss, for the same term, will yield the "*net gain*", or perchance, "*net loss*". This net profit (or net gain, if the expenses have exceeded the gross profits) is now entered in the capital account.

If there has been a net profit, the capital account is credited with the amount. If it is a loss, the capital account is of course debited.

FIG. 498

Statement of Operations

Year ended Dec. 31, 19—

Operating Revenue:					
Gross Misc. Mdse. Sales		36752	30		
" Soda "		2191	90		
" Candy "		1470	75		
" Cigar "		1535	70		
Total Operating Revenue				41950	65
Operating Expenses:					
Rent		1440	00		
Salaries		6513	23		
Taxes		24	10		
Insurance		84	00		
Interest		802	80		
Light		236	85		
Heat		163	00		
Advertising		296	40		
Delivery		44	95		
Misc. Expenses		925	15		
Bad Debts		10	12		
Depreciation		800	00		
Cost of Goods Sold:					
Mdse. Inv. 1/1/24	8500.00				
Purchases	27583.29				
	36083.29				
Less Inv. 12/31/24	9599.20	26484	09		
Total Operating Expenses				37824	69
Profit for Year 1924				4125	96
add profit and loss first of year 1/1/24				3211	78
Total Profit & Loss 12/31/24				7337	74

Statement of profit and loss

FIG. 499

Assets and Liabilities

Dec 31— 1924

		Assets		Liabilities	
Cash		4144	14		
Accounts Receivable		30	05		
John L. Scott	440				
Miss L. B. Palmer	325				
Mrs. Mary L. Adams	860				
L. C. Bryant	610				
C. B. Hastings	770				
Merchandise (Inventory)		9599	20		
Goodwill (")		1200	00		
Fixtures (")		3960	00		
Soda Fountain (")		1440	00		
Coal (")		30	00		
Office Supplies (")		24	80		
Notes Payable				12560	00
Accounts Payable:				530	45
Smith Bill & Co.	412.24				
Knight Cigar Co.	118.21				
Profit & Loss				7337	74
Total		20428	19	20428	19

Statement of assets and liabilities

A general statement is now necessary which is termed a *statement of assets and liabilities* (see Fig. 499). All ledger accounts are now closed and the balances brought forward. In the case of accounts involving an inventory, the individual accounts, when closed, are debited to the inventory in opening the account for the next period.

The resources are now all assembled, including such items as cash, merchandise inventory, fixtures, and all other inventories, unpaid credit sales, goodwill, etc. The liabilities are also assembled. These would consist of such items as unpaid invoices, promissory notes, etc. The difference between the resources and liabilities should then be determined and this should equal the total of the capital account, if the previous statement of net loss or gain has been entered thus proving the correctness of the accounts and providing the proprietor with valuable facts concerning his business (see Fig. 498).

The Adding Machine

The adding machine is an extremely useful accessory in any drug store. It makes it possible to obtain accurately, quickly, and conveniently all figures pertinent to the successful operation of a business

Some of the more common uses for an adding machine are as follows:

Making up the bank deposit slip.

The balancing of bank statements.

The checking and proving of incoming invoices.

Analysis of sales by departments, or clerks, or both.

Departmental inventories.

Handling counter sales, both *cash* and *charge*, where several invoices are involved.

The segregation of expense items.

The taking of a trial balance.

The proving and balancing of ledgers.

FIG. 500

Adding machine

The machine illustrated in Fig. 500, made by Burroughs Adding Machine Company, has a carriage, similar to that on a typewriter, for accommodating wide forms. This makes possible the use of any special forms desired.

A Columnar System of Accounting

The individual drug store proprietor, who keeps his own books, is apt to feel that the kind of bookkeeping which would give him results such as those just discussed is too complicated for his own use. It is true that to obtain these results by the usual double entry methods is a task which requires considerable time as well as technical knowledge of bookkeeping.

To meet this condition a simplified accounting plan has been developed for the retail druggist by the LaWall Systems of Philadelphia, Pa. One important advantage of this plan is that no technical knowledge of bookkeeping is necessary to operate it, although results fully as useful as those obtainable from the most complete sets of double entry books are obtained. Moreover, specially designed sheets make it possible for a druggist to obtain these results with a minimum of effort and time. The following pages contain a description of how records should be kept to obtain such results, starting with original entries and tracing them through to resulting profit and loss statements, financial statements, and comparisons. As mentioned, the druggist need have no technical knowledge of bookkeeping to maintain and understand records kept in this manner. The LaWall Systems of Philadelphia, Pa., owners of the patents, have graciously given their consent to the reproduction of many of their specially designed record sheets in connection with this explanation of their modern system of drug store bookkeeping.

Original Entries—*Cash Totals*—A special form (Figs. 501 and 502) is used to provide a convenient and easily compiled record of daily cash totals. A pad of these forms is kept at the cash register and each night when the store is closed the day's figures are entered in the appropriate columns. Space is provided on the form for recording separately (in columns A to F) the business of 1 to 6 different departments.

Cash Paid Out—Another original entry form may be merely a memorandum book in which are recorded the details and amounts of any cash paid out during the day. Such entries are made, of course, at the time the money is paid out. In some stores each item of cash paid out is recorded on an individual slip of the type shown in Fig. 478. A pad of these slips is kept in the cash register. As a safeguard the cash register is used to imprint the amount upon the slip. Thus a check of the cash register record would show any slips missing. In stores having receipt-printing cash registers, a common practice is to ring the amount paid out on the register and then mark on the receipt the purpose for which the money was paid. These paid out receipts are kept in the cash drawer until permanently recorded in a book to be described later.

FIG. 501

DAILY RECORD Dec. 7 1910 1910

TOTAL NET SALES BY DEPARTMENTS
(Enter Figures from "Daily Cash Balance Slip" opposite lines indicated in columns.)

	Department	1 Net Cash Sales (Line 2)	2 Net Charge Sales (Line 2)	3 Total Net Sales (Line 2)
A	Misc.	198 15		198 15
B	Soda	51 90		51 90
C	Candy	21 80		21 80
D	Cigars	17 60		17 60
E				
F		289 45	—	289 45
G	Total Net Sales			
	OTHER CASH RECEIPTS		No. of Customers	
H	Received on Acct. of Charge Sales	10 32	Ave. Sale to Each $	
			REMARKS	
1	Total Cash Receipts for Day	299 77		
1	Cash Balance Beginning of Day		411 98	
2	Cash Receipts for Day (Line 1)		299 77	
3	Total (1+2)			711 75
4	Bank Deposits for Day		361 98	
5	Petty Cash Expenditures (Line J)		8 85	
6	Total (4+5)			370 83
7	Cash Balance End of Day (3-6)			340 92
8	Bank Balance Beginning of Day		3346 24	
9	Deposits for Day		361 98	
10	Total (8+9)			3708 22
11	Total Checks Issued (Line K)			1357 08
12	Bank Balance End of Day (10-11)			2351 14
13	Total Cash on Hand End of Day (7+12)			2692 06

The LaWall Systems, Phila., Pa. (Form A-2 Left)

DISTRIBUTION OF

	Description	4 Total
10¢	Broom	55
	100 lbs sugar @ 8¢ lb Sodas	8 00
J	Total Petty Cash Expenditures	8 85

DISTRIBUTION OF

Check No.	Description	4 Total
	10¢	
125	Blank Co. 3 tons Coal @ 16.25 ton	48 75
126	Gas Co. Gas bill	3 75
127	Electric Co. Electric bill	14 65
128	Smith Jobber & Co. 960.35 less 2%	941 14
129	Dodge Williams Co. 152 10 " 2%	149 65
130	Whitney Chemical Co. 122 60 " 2%	120 15
131	Knight Cigar Co. 80 60 " 2%	78 99
K	Total Checks Issued	1357 08
L	Total Amount Paid Out for Day (J+K)	1365 93

Copyright 1922

Sales Charged—When a sale is made for which cash is not received immediately, a record of the sale must be kept, at least until the goods are paid for. Serious losses result from a disregard of this simple fact. (See page 1392.)

Money Received On Account—When the charge sales just described are paid for, the cash received is recorded as money received on account. It is a payment for sales previously made. A slip such as shown in Fig. 479 may be used for recording each payment on account. The name of the customer and the amount paid are written in in the space shown and, as a safeguard, the slip is imprinted with that amount on the cash register. In the stores which use the memorandum book for cash paid out and charge sales, money received on account may also be recorded in this book. If the store is using a monthly billhead with a detachable coupon (see Fig. 446), this coupon (which already has written on it the name and address of the customer and the amount of

the bill) is mailed or brought to the store by the customer with his remittance and serves as the store's record of the payment of the account. As a safeguard, it likewise should be imprinted on the cash register with the amount paid.

Bank Book—The bank book is a receipt book in which the receiving teller at the bank records all money (cash and checks) deposited to the credit of the store.

Checks Issued—A simple method of recording and classifying checks issued is shown on the LaWall plan Daily Record Sheet (see Figs. 501 and 502). This method is explained in the description which follows of the Daily Record Sheet.

Daily Record Sheet—As previously explained, the Daily Cash Balance Sheet (Fig. 503) provides a convenient form on which to record the daily cash totals of the business. Once these figures are recorded the next step is

FIG. 502—*Continued*

DAILY RECORD

Dec 7 & 10 1924

PETTY CASH EXPENDITURES FOR DAY

	5 Mdse.	6 Freight Express & Hauling	7 Rent	8 Salaries and Wages	9 Taxes	10 Insurance	11 Interest	12 Repairs	13 Light	14 Heat	15 Advertising	16 Delivery	17 General and Miscell.	18 Personal Withdrawals	19 Other Payments
Soda	8 40												85		
	8 40												85		

CHECKS ISSUED FOR DAY

	5 Mdse.	6 Freight Express & Hauling	7 Rent	8 Salaries and Wages	9 Taxes	10 Insurance	11 Interest	12 Repairs	13 Light	14 Heat	15 Advertising	16 Delivery	17 General and Miscell	18 Personal Withdrawals	19 Other Payments
										41 75					
									3 75						
									14 65						
Misc	941 14														
Candy	14 96 5														
Misc	120 15														
Cigars	7 19 9														
	1289 93								18 40	41 75					
	1297 93								18 40	41 75			85		

The LaWall Systems, Phila., Pa. (Form A-2 Right) Copyright 1922

to classify them so that they can be interpreted and compared. The use of a "Daily Record Sheet" (Figs. 501 and 502) accomplishes this. The numerous columns provide a ready means of classification.

One of these Daily Record Sheets provides space for a complete record of a day's business: money taken in and what it was taken in for; checks and cash paid out and what they were paid out for. The figures for this record are posted from the original entries just listed.

The left hand side of the sheet provides the following record of receipts:

Cash sales, charge sales, and total sales by departments.
Cash received on account of charge sales.
Other cash received (as from upstairs rooms rented).
Cash on hand in the store from the previous day.
Cash in the bank.
Bank deposits made during the day.

The right hand side of the Daily Record Sheet is a record of payments:

Cash paid out and the purpose for which it was paid. The original entries are posted item by item and the amount entered in the proper expense column. For instance, in posting an item of 75 cents for oranges, the word oranges would be entered under the column headed "Description" and the amount, 75 cents, in the column "Total Paid Out". While entering the amount in this column it is the work of a second to enter it also in the column "Merchandise", this indicating the purpose for which the money was spent. Similarly an item of $1.24 paid the express company would first be recorded in the columns "Description" and "Total Paid Out" and then the amount $1.24 also entered in the column "Freight, express, and hauling".

Checks paid out and the purpose for which they were paid. Payments by check are entered and distributed in exactly the same way as cash paid out. As a matter of fact, this part of the Daily Record Sheet may serve as an original entry for checks issued, the record corresponding to that which usually would be made upon the check stub.

FIG. 503

DAILY CASH BALANCE SLIP Dec. 7-10 1924

	DEPARTMENT	A	B	C	D	E	F
	CASH SALES:						
a	Cash in Drawer {Less Cash kept in Drawer for Change}	199 62	51 90	21 80	17 60		
b	Cash Paid Out for Petty Expenditures	8 85	—	—	—		
c	Cash Paid Out for Mdse Returned	—	—	—	—		
d	Total (a+b+c)	208 47	51 90	21 80	17 60		
e	Less Cash Rec'd on Acct of Chg. Sales	10 32	—	—	—		
f	Gross Cash Sales for Day (d−e)	198 15	51 90	21 80	17 60		
g	Less Cash Paid Out for Mdse Returned (c)	—	—	—	—		
h	Net Cash Sales for Day (f−g)	198 15	51 90	21 80	17 60		
	CHARGE SALES:						
i	Gross Charge Sales						
j	Less Charge Sales Returned						
k	Net Charge Sales for Day (i−j)						
l	Total Sales for Day (h+k)	+	+	+	+		

The LaWall Systems, Phila., Pa. (Form A-1) Copyright 1922

The bottom line of the Daily Record Sheet summarizes the day's business. In addition to showing the details of receipts and expenditures, this space is provided for totaling and summarizing them. To the proprietor who wants to see at a glance the significant features of a day's business, the importance of this summarizing is apparent.

Customers' Charge Accounts—The Daily Record Sheet provides a record day by day of the total amount of charge business done, but does not show the names of the individuals with whom the business was done or the amounts owed by each. It is possible to obtain with one writing a record for the store of the amount owed by each customer and a bill or statement for the customer showing the same facts (see Fig. 482).

Accounts Payable—Accounts payable is the term applied to bills which the store itself is to pay. They arise of course out of the purchase of merchandise for sale and other items of expense incurred in the conduct of the store. When such items are paid immediately, the record of the transaction is furnished by the cash paid out slip or the statement of checks issued in the Daily Record Sheet.

As in the case of customers' charge accounts, however, the store itself frequently makes purchases which are to be paid at a later date. A special record of these transactions must be kept. The Invoice Record, shown in Fig. 504, is a simple, convenient method of keeping such a record.

Bills are entered as they are received, one on each line of the Invoice Record. Space is provided on this line for entering the gross amount of the bill, its date and the date on which it is to be paid if a cash discount is to be earned. When the bill is paid, the cash discount, other deductions, and the number and date of the check are entered in appropriate columns. Thus this one line on the Invoice Record forms a complete record of the transaction. Moreover a glance at the Invoice Record at any time shows the amount of unpaid bills and also the dates on which they must be paid if various cash discounts allowed are to be earned.

The Invoice Record Sheets are punched at the top to fit a post file, on which the unpaid bills themselves are also placed in alphabetical order. The reason that a store should make its own record of accounts payable, in addition to the record formed by the bills themselves, is that the bills themselves

FIG. 504

INVOICE RECORD

NO. 4

Day to pay for Discount	Name of Firm	Date of Invoice	Gross Amount of Invoice	DEDUCTIONS			Net Amount Paid	Check No	Date Paid
				Freight Express	Mdse. Returned	Discount			
12/10	Smith Bader & Co.	12/1/24	960 35			19 21	941 14	128	12/10/24
"	Whitney Chemical Co.	"	122 60			2 45	120 15	130	12/10/24
"	Boyd Whitney Co.	"	152 70			3 05	149 65	129	12/10/24
"	Knight Cigar Co.	"	80 60			1 61	78 99	131	12/10/24
1/10/25	Smith Bader & Co.	12/20	420 65			8 41			
"	Knight Cigar Co.	12/20	120 62			2 41			

are awkward to handle for quick reference and, more important, if a bill should be lost or misplaced, a sizable cash discount might be lost because the bill to be paid could not be found. Again a vendor might send two bills for the same purchase; if the bills themselves form the only record, there is the possibility that the purchase would be paid for twice.

Monthly Record Sheet—The Daily Record Sheet (Figs. 501 and 502) shows on one double page a detailed record of a day's business. For comparative purposes it is desirable to bring together the totals of the various classes of receipts and expenditures for each day's business. This is accomplished by the use of the monthly record sheet shown in Figs. 505 and 506.

This double page shows day by day the totals of the various classes of receipts and expenditures for an entire month. For instance, the totals for the first day of the month are entered in the appropriate columns on the line marked. To lessen the number of figures presented in this example the total of several days of business have been combined. In ordinary practice, however, the figures would be entered each day.

The second day's figures are entered on line 2. Following line 2 and each of the other lines numbered for the days of the month is a line which provides space for a cumulative record for each of the classes of receipts and expenditures. This cumulative record makes possible on any date comparisons of various classes of receipts and expenditures, not only for the current month

but for corresponding periods of other months. For instance, the proprietor with this cumulative record, can compare at a glance purchases and sales, total expenses or any one of several classes of expenses on the twelfth, the twenty-first or any other day of the month with each other or with the similar figures for corresponding days of other months. It is not necessary to wait until the end of the month or year to make such comparisons. The use of this columnar classification makes possible these comparisons at any time.

Inventories creep up unless carefully watched and are very apt to cripple the ability of the retailer to take advantage of cash discounts. A simple method of watching the inventory is to compare the totals of sales and purchases on the

FIG. 505

MONTHLY RECORD

MONTH OF December 1924

DATE		TOTAL NET SALES BY DEPARTMENTS — From Daily Record—Column 3						Total Net Sales (From Column 3 Line G) Add Line 8	Total Net Charge Sales (From Column 3 Line G)	CASH RECEIPTS						Total Cash Receipts (From Column 1 Line 11) Add Line 14	CASH PAID OUT		
		Mdse. Line A	Soda Line B	Candy Line C	Cigars Line D	Line E	Line F			Total Net Cash Sales (From Column 1 Line G)	Received on Account of Charge Sales (From Column 1 Line G)	Misc. Income (From Column 1)					Mdse. Bought For Sale (From Column 3 Line L)	Freight, Express and Hauling (From Column 4 Line L)	Total Mdse. 16 & 17
Today	1	88 30	18 25	11 50	7 30			125 35	1 90	121 45						121 45			
To date	2																		
Today		86 30	18 25	11 50	7 90			123 95	1 90	121 45						121 45			
To date	3	1566 99	355 15	153 30	124 40			2199 84	18 35	2116 49						2116 49			
To date		241 99	53 40	26 80	19 70			341 89	3 75	338 14						338 14			
Today	4																		
To date		241 99	53 40	26 80	19 70			341 89	3 75	338 14						338 14			
Today	5	241 99	53 40	26 80	19 70			341 89	3 75	338 14						338 14			
Today	6	241 98	72 00	38 10	21 00			385 23	2 25	381 98						381 98			
To date		483 97	125 40	64 90	41 20			727 12	7 00	720 12						720 12			
Today	7																		
To date		483 97	125 40	64 90	41 20			727 12	7 00	720 12						720 12			
Today	8																		
To date		483 97	125 40	64 90	41 20			727 12	7 00	720 12						720 12			
Today	9																		
To date		483 97	125 40	64 90	41 20			727 12	7 00	720 12						720 12			
Today	10	198 15	41 90	21 40	17 00			278 45	—	278 45	10 32					289 77	1297 93		1297 93
To date		682 62	177 30	86 30	58 20			1005 57	7 00	1009 67	10 32					1009 89	1297 93		1297 93
Today	11																		
To date		682 62	177 30	86 30	58 20			1005 57	7 00	1009 67	10 32					1009 89	1297 93		1297 93
Today	12																		
To date		682 62	177 30	86 30	65 10			1016 67	7 00	1009 67	10 32					1019 89	1297 93		1297 93
Today	13	271 62	79 15	35 70	31 70			420 57	2 50	418 07	13 60					431 67			
To date		954 24	256 45	122 45	96 90			1437 14	9 50	1427 64	23 92					1451 46	1297 93		1297 93
Today	14																		
To date		954 24	256 45	122 45	96 90			1437 14	9 50	1427 64	23 92					1451 46	1297 93		1297 93
Today	15																		
To date		954 24	256 45	122 45	96 90			1437 14	9 50	1427 64	23 92					1451 46	1297 93		1297 93
Today	16																		
To date		954 24	256 45	122 45	96 90			1437 14	9 50	1427 64	23 92					1451 46	1297 93		1297 93
Today	17																		
To date		954 24	256 45	122 45	96 90			1437 14	9 50	1427 64	23 92					1451 46	1297 93		1297 93
Today	18																		
To date		954 24	256 45	122 45	96 90			1437 14	9 50	1427 64	23 92					1451 46	1297 93		1297 93
Today	19																		
To date		954 24	256 45	122 45	96 90			1437 14	9 50	1427 64	23 92					1451 46	1297 93		1297 93
Today	20	214 76	57 80	27 60	14 05			314 21	3 45	310 76	9 60					320 36			
To date		1168 90	314 25	150 05	110 95			1751 35	12 95	1738 40	33 52					1771 82	1297 93		1297 93
Today	21																		
To date		1168 90	314 25	150 05	110 95			1751 35	12 95	1738 40	33 52					1771 82	1297 93		1297 93
Today	22	218 25	70	36 70	25			325 70	5 40	320 30						320 30			
To date		1387 15	314 95	186 75	111 20			2077 05	18 35	2058 70	33 52					2092 12	1297 93		1297 93
Today	23																		
To date		1387 15	314 95	186 75	111 20			2077 05	18 35	2058 70	33 52					2092 12	1297 93		1297 93
Today	24	218 25	70	36 70	25			325 70	5 40	320 30						320 30			
To date		1605 40	384 15	223 45	111 45			2402 75	23 75	2379 00	33 52					2412 42	1297 93		1297 93
Today	25																		
To date		1605 40	384 15	223 45	111 45			2402 75	23 75	2379 00	33 52					2412 42	1297 93		1297 93
Today	26	218 25	70	36 70	25			325 70	5 40	320 30						320 30			
To date		1823 65	384 85	260 15	111 70			2728 45	29 15	2699 30	33 52					2732 82	1297 93		1297 93
Today	27																		
To date		1823 65	384 85	260 15	111 70			2728 45	29 15	2699 30	33 52					2732 82	1297 93		1297 93
Today	28																		
To date		1823 65	384 85	260 15	111 70			2728 45	29 15	2699 30	33 52					2732 82	1297 93		1297 93
Today	29																		
To date		1823 65	384 85	260 15	111 70			2728 45	29 15	2699 30	33 52					2732 82	1297 93		1297 93
Today	30																		
To date		1823 65	384 85	260 15	111 70			2728 45	29 15	2699 30	33 52					2732 82	1297 93		1297 93
Today	31	15 60	1 25	1 70	1 00			19 55	—	19 55						19 55			
TOTAL		1839 25	386 10	261 85	112 70			2748 00	29 15	2718 85	33 52					2752 37	1297 93		1297 93

The LuWall Systems, Phila., Pa. (Form A-3 Left) (D.R. is an Abbreviation for Daily Record)

Copyright 1922

monthly Record Sheet (Figs. 505 and 506). Suppose the total purchases up to the twenty-fourth of the month amount to $1600, and the total sales up to that time in the month have been $2000, the gross margin upon which the store has been operating is 33 per cent of sales. Sales of $2000, therefore, show us that purchases should have been $1333, consequently the proprietor has over-bought $267. From that day until the end of the month he must try to confine his purchases to little or nothing in order that the month may wind up properly.

Sales Totals—Sales of each day should be compared with the same day of the previous year. A comparison of weekly totals and also of monthly totals with the previous year should be made. These sales totals when taken together with the cash register record showing the actual number of transactions are very valuable.

The important thing in a business of any kind, after all, is to know the best points and to create more of them, and also to know the weak spots so as to eliminate or avoid them. Figures by themselves will not always show this, but a comparison of figures will often point them out.

Yearly Record Sheet—The Yearly Record Sheet (Figs. 507 and 508) is the logical development of the Monthly Record Sheet. Column headings correspond to those on it. The figures on the last line of the Monthly Record Sheet form the monthly totals, which when transferred to the Yearly Record Book Sheet give a month by month record of receipts and expenditures for the year's business.

FIG. 506

MONTHLY RECORD

MONTH OF December 1924

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
CASH PAID OUT																		
EXPENSES																		
Rent (From D.R. Column 7 Line L)	Salaries and Wages (From D.R. Column 9 Line L)	Taxes (From D.R. Column 13 Line L)	Insurance (From D.R. Column 10 Line L)	Interest (From D.R. Column 12 Line L)	Repairs (From D.R. Column 15 Line L)	Light (From D.R. Column 16 Line L)	Heat (From D.R. Column 18 Line L)	Advertising (From D.R. Column 19 Line L)	Delivery (From D.R. Column 16 Line L)	General and Misc. (From D.R. Column 17 Line L)			Total Expenses Additions	Personal With Grants (From D.R. Column 18 Line L)	Other Payments (From D.R. Column 17)	(From D.R. Column 17)	Total Cash Paid Out (From D.R. Column 4 Line L) + (B+32+33+34+35)	DATE
120 00										3 50			123 50				123 50	1 Today
																		To date
120 00								2 00		3 50			123 50				2 00	2 Today
													2 00				125 50	To date
120 00								2 00		3 50			125 50				125 50	3 Today
																		To date
120 00								2 00		3 50			125 50				125 50	4 Today
																		To date
120 00								2 00		3 50			125 50				125 50	5 Today
																		To date
120 00								2 00		3 50			125 50				125 50	6 Today
								4 00					125 00				125 00	To date
120 00	120 00							7 00		3 50			250 50				250 50	7 Today
																		To date
120 00	120 00							7 00		3 50			250 50				250 50	8 Today
																		To date
120 00	120 00							7 00		3 50			250 50				250 50	9 Today
																		To date
120 00	120 00							7 00		3 50			250 50				250 50	10 Today
						18 40	42 75			66 00			68 00				136 93	To date
120 00	120 00					18 40	42 75	7 00		4 35			318 50				161 68	11 Today
																		To date
120 00	120 00					18 40	42 75	7 00		4 35			318 50				161 68	12 Today
																		To date
120 00	120 00					18 40	42 75	7 00		4 35			318 50				161 68	13 Today
	120 00												120 00				120 00	To date
120 00	240 00					18 40	42 75	7 00		4 35			438 50				172 68	14 Today
																		To date
120 00	240 00					18 40	42 75	7 00		4 35			438 50				173 68	15 Today
																		To date
120 00	240 00					18 40	42 75	7 00		4 35			438 50				173 68	16 Today
																		To date
120 00	240 00					18 40	42 75	7 00		4 35			438 50				173 68	17 Today
																		To date
120 00	240 00					18 40	42 75	7 00		4 35			438 50				173 68	18 Today
																		To date
120 00	240 00					18 40	42 75	7 00		4 35			438 50				173 68	19 Today
																		To date
120 00	240 00					18 40	42 75	7 00		4 35			438 50				173 68	20 Today
	144 00							31 50		1 95			177 45				181 05	To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	21 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	22 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	23 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	24 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	25 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	26 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	27 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	28 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	29 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	30 Today
																		To date
120 00	384 00					18 40	42 75	38 50		6 30			615 95				191 48	31 Today
	144 00												144 00		1870 00		1870 00	TOTAL
1200 00	5281 00												1594 95		1870 00		3631 43	

The La Wall Systems, Phila., Pa. (Form A-3 Right) (D.R.—is an Abbreviation for Daily Record) Copyright 1923

Inventories—In a drug store, a physical inventory is an expensive and time consuming task. In fact many druggists say that an inventory accurate to the last penny is impossible to obtain in a drug store. The amount contained in a partly filled shelf bottle, for example, is difficult to determine unless the contents are taken out and measured and if this is done the loss in measuring valuable drugs, may very well be the profit on several dollars worth of sales. However, in almost any store it is possible to determine within the limits of a few hundred dollars the amount of goods on hand. The following example illustrates why such a measurement is necessary.

Druggist Black's annual sales are	$100,000
The goods he purchased during the year	50,000
His expenses amounted to	30,000
Apparently his profit is	20,000

On the face of this report, druggist Black appears to have been extraordinarily successful. But consider this: suppose an inventory of the goods in his store at the beginning of the year for which the figures above are given totaled approximately $20,000, whereas another inventory at the end of the year showed a total of only $10,000. Actually, therefore, Druggist Black had sold during the year not only the $50,000 worth of goods which he had purchased but also an additional $10,000 represented by the decrease in the stock of goods on hand. His real profit is not $20,000 but $10,000.

Correspondingly, a showing of profit less than that actually earned would result if an extraordinary increase in the amount of goods on hand occurred

FIG. 507

YEARLY SUMMARY 19—

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	TOTAL NET SALES BY DEPARTMENTS							CASH RECEIPTS								CASH PAID OUT		
	Mdse A	Soda B	Candy C	Cigars D	E	F	Total Net Sales Add 1 to 6	Total Net Charge Sales	Total Net Cash Sales	Received on Account of Charge Sales	Misc. Income				Total Cash Receipts Add 9 to 14	Mdse Bought for Sale	Freight Express and Hauling	Total Mdse 16+17
January	3016.50	152.40	62.30	131.90			3363.10	16.70	3346.40	20.00					3366.40	1867.10	3.50	1870.60
February	2765.05	168.10	80.70	63.70			2904.65	203.30	2701.35	36.00					3101.35	2046.40	+	2046.40
2 Mos	5781.55	458.50	143.00	195.60			6267.75	220.00	6047.75	56.00					6467.75	3913.50	3.50	3917.00
March	2753.35	127.80	100.50	75.90			3057.55	37.00	6304.65	66.00					6370.65	3947.50	3.50	3951.00
3 Mos	5534.90	376.30	243.50	270.60			9325.30	257.00	12352.35	122.00					12837.65	7861.00	7.00	7868.00
April	4152.05	146.70	76.70	90.20			4465.65	49.10	9446.06	71.15					9566.31	6057.30	6.00	6063.30
4 Mos	4687.95	523.00	320.20	360.80			13791.05	306.10	21798.41	193.15					22403.96	13918.30	13.00	13931.30
May	2404.20	121.00	102.70	102.60			2730.50	67.35	10379.80	91.75					10538.90	7196.60	7.60	7204.20
5 Mos	4969.55	644.00	423.30	463.40			16521.55	373.45	32178.21	284.90					32942.86	21114.90	20.60	21135.50
June	3600.35	166.70	122.40	102.20			3991.65	82.55	15812.16	112.15					16006.91	10879.75	18.00	10897.75
6 Mos.	8569.90	810.70	545.70	565.60			20513.20	456.00	47990.37	397.05					48949.77	31994.65	38.60	32033.25
July	3691.10	177.00	107.60	97.20			4072.90	76.00	14065.90	140.85					14282.75	9500.50	20.00	9520.50
7 Mos.	12261.00	987.70	653.30	662.80			24586.10	532.00	62056.27	537.90					63232.52	41495.15	58.60	41553.75
August	3216.10	164.70	101.60	142.10			3624.50	82.55	13952.90	140.85					14176.30	9643.50	21.40	9664.90
8 Mos.	15477.10	1151.40	754.90	804.90			28210.60	614.55	76009.17	678.75					77408.82	51138.65	80.00	51218.65
September	3200.39	170.75	110.75	125.70			3607.59	77.10	14076.89	170.00					14323.98	9300.50	23.00	9323.50
9 Mos	18677.49	1322.15	865.65	930.60			31818.19	691.65	90086.06	848.75					91732.80	60439.15	103.00	60542.15
October	3804.70	162.70	103.65	140.60			4211.65	82.55	15898.49	190.10					16171.79	10927.50	24.50	10952.00
10 Mos	22482.19	1484.85	969.30	1071.20			36029.84	774.20	105984.55	1038.85					107904.59	71366.65	127.50	71494.15
November	3358.11	178.90	120.60	125.80			3783.41	82.55	15898.49	190.10					16171.79	10927.50	24.50	10952.00
11 Mos	25840.30	1663.75	1089.90	1197.00			39813.25	856.75	121882.04	1228.95					124076.38	82293.15	152.00	82445.15
December	3233.25	211.35	152.40	241.20			3838.20	82.55	15898.49	190.10					16171.79	10927.50	24.50	10952.00
TOTAL	29073.55	1875.10	1242.30	1439.20			43651.45	939.30	137780.53	1419.05					140138.88	93220.65	176.50	93397.15

MONTHLY SUMMARY OF ACCOUNTS RECEIVABLE

		JAN.	FEB	MAR	APR	MAY	JUN.	JUL	AUG.	SEP	OCT	NOV.	DEC.
A	Customers' Unpaid Accounts First of Month	57.80	124.20	61.60	65.45	63.10	57.10	64.00	57.20	58.55	52.64	56.84	53.74
B	Charge Sales (Col 8)	76.10	56.10	13.10	15.15	16.15	39.00	8.10	2.10	13.10	14.55	12.60	12.45
C	Total = A+B	133.90	180.30	74.70	80.60	79.25	96.10	72.10	59.30	71.65	67.19	69.44	66.19
D	Less Received on Account (Col. 10)	9.70	118.70	9.25	17.50	14.15	24.10	14.90	3.00	13.01	10.35	13.45	13.15
E	Customer's Unpaid Accounts End of Month (C-D)	124.20	61.60	65.45	63.10	65.10	72.00	57.20	56.30	58.64	56.84	55.99	53.04

(B) Includes $ of Hopes & charged off in 19—

MONTHLY COMPARISONS

MONTH	TOTAL SALES (Col 7) Previous Year	Current Year	% INCREASE	AVERAGE SALES PER DAY Previous Year	Current Year
January	2710.60	3351.10	19.4	90.66	108.09
February	2370.75	2904.65	26.3	81.75	103.76
March	2700.00	3137.65	23.3	87.09	101.21
April	2520.90	3187.05	23.4	84.03	106.24
May	2702.30	3235.10	19.7	87.17	104.36
June	2702.90	3383.40	25.0	90.20	112.78
July	2710.40	3467.90	19.6	87.43	111.87
August	3000.65	3623.60	20.8	96.79	116.89
September	3000.50	3607.59	20.2	100.02	120.25
October	3001.10	3780.55	25.3	96.81	120.31
November	3102.95	3752.71	21.6	103.41	125.09
December	3333.25	3441.75	3.2	107.52	111.31
TOTAL	34068.60	41920.65	23.1	93.28	114.85

SUMMARY OF CASH

FOR YEAR ENDED 19——

A	Cash Balance First of Year	2371.69
B	Total Receipts for Year (Col. 15)	41997.98
C	Total = A+B	44369.66
D	Total Cash Paid Out (Col. 36)	40225.52
E	Cash Balance End of Year = C-D	4144.14

The LaWall Systems, Phila., Pa. (Form A-4 Left)

Copyright 1922

during the year. It is thus apparent that when marked changes occur during any year in the amount of goods on hand a new inventory is necessary in order to get a correct idea of the profit earned.

Once a store is well established, however, such violent fluctuations in inventory should not occur. Milk of magnesia, for example, may be bought in half dozen lots from the local wholesaler. When four bottles have been sold, another half dozen is ordered. This process is repeated indefinitely and occurs not only in the case of milk of magnesia but also in the case of all the other thousands of items stocked by the retail drug stores. When the stock of goods is reduced to this relatively stable basis, the stock of goods on hand at any time can be calculated in the following way:

		Per cent
Suppose sales last year were	$50,000	100
Cost of goods sold	30,000	60
Expenses	15,000	30
Net profit	5,000	10

An inventory at the beginning of this year totals	$25,000
Purchases this year total	31,000
Total	$56,000
Sales this year were $52,000 and on the average these goods cost 60 per cent of their selling price or	$31,200
Therefore, stock on hand at the end of this year is	$25,800

FIG. 508

YEARLY SUMMARY 1924

CASH PAID OUT

EXPENSES

19 Rent	20 Salaries and Wages	21 Taxes	22 Insurance	23 Interest	24 Repairs	25 Light	26 Heat	27 Advertising	28 Delivery	29 General and Miscell	30	31	32 Total Expenses Add (1 to 31)	33 Personal Withdrawals	34 Other Payments (Notes Payable)	35	36 Total Cash Paid Out (18+32+33+34+35)	Month
120 00	560 00			102 50		22 10		20 00	8 10	66 60			1879 10				1879 10	January
120 00	591 75		5 60			18 50	41 50	11 25	6 80	41 25			1944 90				2777 10	February
240 00	108 75		52 50	102 50		24 50	41 50	25 00	22 50	78 60			2294 75				2294 75	March
120 00	550 25	24 10	19 20			20 50		5 00	2 60	73 60			3241 65				3260 25	3 Mos
240 00	1469 00	24 10	71 70	102 50		62 50	41 50	41 00	12 90	116 65			3241 65				3241 50	April
120 00	540 00		13 00			24 10		2 50	6 10	6 20			4008 45				4008 45	4 Mos
480 00	2158 00	24 10	84 90	102 50		28 00	41 50	20 00	22 50	78 60			4008 45				4008 45	May
120 00	550 25					26 10		20 00	2 30	76 20			4783 65				4783 65	5 Mos
600 00	2710 25	24 10	84 90	102 50		163 60	41 50	7 50	22 30	365 25			4783 65				4783 65	June
120 00	531 00					9 00		60 00	7 10	120 00			5679 00				5799 10	6 Mos
720 00	3241 25	24 10	84 90	102 50		172 60	41 00	129 00	29 60	485 25			5679 00				5799 10	July
120 00	531 00					18 00		14 50	6 10	104 60			6448 10				6448 10	7 Mos
840 00	3527 25	24 10	84 90	102 50		146 90	41 00	148 10	35 50	429 85			6448 10				6448 10	August
120 00	564 00					17 00		14 00	2 50	99 60			7239 00				7239 00	8 Mos
960 00	4232 25	24 10	84 90	102 50		164 00	41 00	162 00	37 00	534 85			7239 00				7239 00	September
120 00	548 00					16 90	41 00	9 00	3 10	62 70			7787 90				7787 90	9 Mos
1080 00	4920 25	24 10	84 90	102 50		180 90	41 00	171 00	40 10	597 60			7787 90				7787 90	October
120 00	540 70					17 90		20 00	3 25	71 20			8357 65				8357 65	10 Mos
1200 00	5461 25	24 10	84 90	102 50		198 80	41 00	191 00	43 35	781 15			8357 65				8357 65	November
120 00	521 60					19 90		15 00	1 60	120 00			9476 60				9476 60	11 Mos
1320 00	5982 85	24 10	84 90	102 50		218 45	41 00	206 00	44 95	901 15			9476 60				9476 60	December
120 00	528 00					18 00	41 00	18 00	2 50	99 60			10549 50		1670 00		10549 50	TOTAL
1440 00	6510 85	24 10	84 90	102 50		236 45	41 00	224 00	47 45	1001 15			10549 50		1670 00		10549 50	

Total Depreciation for Year (Estimated) (A) 820 00
Total Bad Debts Charged off During Year (1/3 HAYES 3%) 1014 60
Total Expenses Plus Depreciation and Bad Debts 11370 60

(A) Fixtures except Soda Fountain $4000 @ 5% = $220
Soda Fountain 1800 " 10% 180
Good Will 2000 " 20% 400
Total $800

PROFIT FOR YEAR

				%
A	Total Sales (Col 7)		52614	100
	COST OF GOODS:			
B	Inventory First of Year	8500 00		
C	Unpaid Bills End of Year (From Invoice Record)	530 45		
D	Total Cash Purchases (Col 18)	28126 04		
E	Total - B+C+D		37156 49	
F	Inventory End of Year	9599 20		
G	Unpaid Bills First of Year (From Invoice Record)	1072 20		
H	Total - F+G		10671 40	
I	Total Cost of Goods Sold - E-H		26485 09	50
J	Gross Profit from Sale of Goods - A-I		16466 56	
K	Total Expenses Plus Depreciation and Bad Debts (Col. 32)		11370 60	
L	NET PROFIT - J-K		5095 96	
M	Miscellaneous Income (Col 11)		1029 00	
N	TOTAL NET PROFIT FOR YEAR (L+M)		6124 96	
O	Less Proprietor's Personal Account (Withdrawals) (Col 33)		1670 00	
P	Balance to Capital Invested - N-O		4454 96	

STATEMENT OF ASSETS & LIABILITIES YEAR ENDED 19....

ASSETS			LIABILITIES	
Cash		4114 54	Accounts Payable	530 45
INVENTORIES				
Stock of Goods 7/1/25	9320 10		Notes Payable	12560 00
~~Exchange~~ SODA	132 50			
~~Sundries~~ CANDY	141 60			
CIGARS	105 00			
TOTAL HAND	9699 20			
COAL	30 00			
OFFICE SUPPLIES	24 50			
Accounts Receivable	30 05			
Notes Receivable				
GOOD WILL	1200 00			
FIXTURES	3960 00		Total Liabilities	13090 45
SODA FOUNTAIN	1440 00		Capital Invested	7333 12
TOTAL	20421 19		TOTAL	20421 19

The LaWall Systems, Phila., Pa. (Form A-6 Right) Copyright 1912

If the stock of goods on hand is known to fluctuate very little, a physical inventory need be made only occasionally to compare the calculated figure with the amount of goods actually on hand (see also Inventories, page 1352).

Profit and Loss Statements—With the inventory determined within reasonable limits, the calculation of profit or loss becomes an easy matter. The use of the form shown on the Yearly Record Sheet greatly simplifies this work. If the proprietor has kept his records in the form described in the preceding pages, he can, with a few minutes' work, determine his profit, not only annually, but also monthly or even daily.

Financial Statements—The profit shown by this Profit and Loss Statement will not be necessarily in the form of cash. This is a point at which considerable confusion and misunderstanding occur. A proprietor may calculate that his business earned a net profit of $3500 and still have only $1000 in the bank and numerous bills yet to be paid. To prove the accuracy of the Profit and Loss Statement, it then becomes necessary for the proprietor to take account of all the resources he has and also every liability standing against him. This he can do conveniently in the Statement of Assets and Liabilities which appears in the lower right hand corner of the Yearly Record Sheet (Fig. 508).

As assets, he first considers the cash on hand or in the bank, then his stock of merchandise, his fixtures, including the soda fountain if he has one, office supplies, coal, and other usable goods. He also includes any paid up insurance policies and securities which he may hold.

Goodwill is sometimes also included as an asset, but because of its intangible and transient nature it is not always considered wise to attempt to place a dollar value on it.

Depreciation—Depreciation is a measure of the loss in value of an asset.

Soda Fountain Depreciation—The life of a soda fountain is not dependent upon its wearing out but is rather dependent upon how soon it may become out-of-date. The average soda fountain becomes obsolete within five years, and to use the older type of fountain after that period very often makes it a liability. Depreciation on the soda fountain should really be at the rate of twenty per cent a year.

Fixture Depreciation—This is rather a difficult subject because as a matter of fact well-made fixtures will practically never wear out. The average life of a drug store, or rather we should say the average period of life for the drug store before it sells out, moves, or the proprietor dies, is seven years. On an average then, there must be a re-adjustment of fixture and fountain valuations every seven years. A specially made fixture is seldom of any use in another room, and, consequently, its value the day it is put in is about 50 per cent less than its face cost. Whereas, with absolutely standard interchangeable unit fixtures, there is a substantial use-value because it cannot only be placed in another drug store, but it can be adapted to fifty different kinds of retail stores with the result that it does not lose its face value, and 5 per cent per year is plenty of depreciation to figure.

Another factor in the use of interchangeable unit fixtures is even more important, namely, that of having the ability to re-arrange departments inside the store. Changes are often required in arrangement in order to make the most economical use of clerks, floor space, and also to get the best sales returns out of the customers. The ability to interchange units or add to them keeps the value of standard units always fresh as they can be moved or changed about with practically no cost and as easily as household furniture may be arranged.

In purchasing a drug store the value of fixtures and soda fountain should be estimated not according to their initial cost but rather according to their use-value. Pharmacists sometimes pay $5000 or $6000 for an equipment that not only is obsolete but also is an actual *liability* to the business, whereas they might have installed a totally new equipment for $2000 or $3000 and have it efficient in every way.

A fixture should be considered simply as a piece of machinery that will enable the proprietor of the store or his assistants to give the best possible service to his trade. When that machinery is so badly designed or arranged in the store that its use-value is negligible, then the price of those fixtures should be

set not according to the marble, wood, and trimmings that are on them, but exactly according to the value that they are going to have when the store is put on an efficient basis.

A factory owner in taking over an old plant will consider an obsolete machine as a liability, and when retailers get to figuring this way, they will reach a better business basis.

Stock Depreciation on Merchandise—The inventory of the store suffers from breakage, leakage, spoilage, or from becoming out of date, and it is considered good business to estimate two per cent depreciation on inventory, or set up a reserve to meet such losses as are bound to occur in the normal store.

In addition to the assets already listed, all customers' unpaid accounts and other money owing to the proprietor should be included. If any of the customers' accounts cannot be collected, they should not be considered as assets any longer but should be deducted and charged as an expense of conducting the business.

The liabilities are listed on the right hand side of this balance sheet. They consist principally of unpaid bills and any other money owed by the proprietor.

It is possible now to prove the accuracy of the Profit and Loss Statement. If the total of the money owed plus the capital invested in the business plus the net profit shown for the year equals the total of the assets, the result is correct.

The financial statement is a measure of the strength of a business.

Naturally if the margin between assets and liabilities is low the proprietor's equity in the business is small and might be wiped out by a few unprofitable months. Such a store would be a poor credit risk.

The store having records which permit the quick and accurate compilation of a financial statement has a great advantage. For example, the opportunity may come suddenly to buy the store building. Few stores would have on hand the cash to finance such a proposition but a financial statement, based upon such accurate records as those described in the preceding pages, would show the financial strength of the store and convince a banker of the credit which could be extended legitimately for the transaction.

The banker is guided almost entirely by a financial statement, and more especially by a comparative statement of years or months because this "*comparative statement*" shows the trend of the business.

It is important to note that if a banker can tell so much more about a store by looking at a *statement*, than he can by making a detailed inspection of its stock, fixtures, location, prospects, etc., then it surely behooves the owner to pay a little more attention to these vital figures. Some day we will see groups of retailers making comparisons of these vital figures and learning from one another what they could never learn from a study of their own figures. An example of an undertaking of this kind is illustrated by Fig. 509. This is a reproduction of a questionnaire sent to its members for this purpose by the Philadelphia Wholesale Drug Company, a coöperative association of retail druggists.

Valuable Information from Accounts

When accounts have been closed and the proprietor has before him the financial facts concerning the business, covering a stated period, he should fully utilize these. Exceedingly important information to determine at once would be the per cent relationship of the cost of merchandise sold, the expense of conducting business, and the net profit, all in relation to the total sales.

Strictly Confidential

FIG. 509

DRUCO

Note: Please answer every question. This is necessary in order to get facts which will be the most practical help to you.

Census of Business Costs—1925 No 2152

Twenty-five to forty cents out of *every* dollar a druggist takes in, he pays out again for operating expenses. Before these expenses can be reduced, present expenses must be known. That is the object of this inquiry. The figures you send in will be used *only* to make an average of operating expenses of drug stores in Philadelphia and vicinity. When it is known what it costs on the average to operate a drug store, an individual proprietor is in a position to compare his own results with the average of all; to see where he is weak and where he is strong in comparison with the average. He can then act intelligently to cut down the expenses which are too high.

Promptness in returning this sheet is vital; the sooner we have your facts the sooner you will have the results. If at all possible sit down now and fill it out immediately or have your bookkeeper do it for you. Then return the white sheet in the inclosed envelope by the next mail. Keep the yellow copy for your records.

Sales
Total sales for 1925. $.....
Can you say what per cent are charge sales?.....
(Per cent)

Salaries
Total amount paid in 1925 to people who work in the store in wages, commissions, and bonuses. Do not include deliverymen's wages as they are shown below under "Delivery".
How many people do you employ in the store?..... $.....
(Number)

Rent
Actual amount paid as rent for the year 1925, including any taxes, assessments or insurance that you pay for the owner. If you own your building, you should put down what the store would rent for to someone else and also include taxes, assessments and insurance that you pay on it, and mortgage interest. $.....

Light and power
Total of your electric (or illuminating gas) bill in 1925. $.....

Heat
What you spent in 1925 for coal (or oil and gas). $.....

Insurance
Insurance on stock, fixtures and equipment; liability insurance; life insurance on members of the firm if paid for out of the business and issued for the business. Do not include fire insurance on the building. $.....

Taxes
City, county, state and government taxes on stock, fixtures, equipment. Do not include income or luxury taxes or taxes on real estate. $.....

Interest
Interest on money borrowed for use in the business. Do not include interest on your investment in the business or interest that you may pay on mortgages on the building. $.....

Losses from bad debts
Total amount of bad debts you charged off during 1925. $.....

Repairs
Expenses for repairs to building and store equipment in 1925. $.....

Depreciation
Depreciation is the *decrease* in the value of fixtures and soda fountain. Suppose, the fountain you bought three years ago you figure will last you just about another three years. Therefore, in each of the six years you have it in your store it loses one sixth of its value. This loss in value each year is a legitimate expense to be charged as part of the cost of running your business. You can estimate similarly the life of your other fixtures. Simply divide the length of time you expect to use them into the price you originally paid for them and you have the amount of depreciation you should charge off each year. Include here the total amount of depreciation you charged off in 1925 for both fixtures and fountain. $.....

Delivery
Wages of messengers and deliverymen, parcel post, express and car fare spent in delivering merchandise you sold; bicycle expenses and costs of operating a delivery automobile, if you use one. $.....

Advertising
Cost of advertising in publications, street cars, billboards, etc. Also circulars and circular letters, calendars, and expenses in decorating windows. $.....

Owners' or managers' salaries
Total amount paid a manager or taken out of the business by owners as salary or payment for services. You are entitled to at least as much salary as you would have to pay a manager to operate the store for you, or as much as you would earn working for someone else. Do not include, however, dividends or withdrawals of capital $.....
How many owners are active in the business?.....
(Number)
Is the amount you list here also included under the heading "Salaries" above?.....
(Yes or No)

Miscellaneous
Includes stationery and office supplies, wrapping paper, brooms, soap, towels, coats and aprons and other store supplies, donations, dues in trade associations, trade paper subscriptions, telephone and telegraph, thefts, lawyer's fees, and any other expenses not previously listed. $.....

Merchandise bought during 1925
Total cost of merchandise bought in 1925. $.....

Merchandise stock December 31, 1925
How much merchandise had you on hand at the end of the year (December 31, 1925)? If you took an inventory about that time use that figure. $.....
Is the value of your stock figured at *cost* or *selling* price?.....
(Which?)

Merchandise stock January 1, 1925
How much merchandise did you have on hand the first of *last* year? Use the inventory figure if you took one about then. $.....

Note: If you have more than one store, please use a separate blank for each store. Let us know if you need more blanks.

Percentage Comparison—The reduction of the Profit and Loss Statement to percentages makes possible many useful comparisons.

The "total sales" must always be considered as 100 per cent. *This is the only basis for satisfactory calculation*, because on this basis it is possible to arrive at percentage relationships from the annual business, which can then be used for comparison from day to day throughout the entire succeeding year. This is because the sales and expenses are always definite figures which may be known daily, while the cost of goods sold is difficult to determine. This basis for calculation for per cent comparisons is almost universally adopted today in the business world.

With the taking of an inventory and the final closing of the bookkeeping record, which in many businesses is only done annually, it is possible to determine the actual "first cost of merchandise sold". This is then compared, on a percentage basis with total sales and total expenses, and the actual profit or loss percentage determined for the period under examination. Figures often given for an average successful business are about 65 per cent for first cost of goods; 25 per cent for expenses, and 10 per cent for net profit, making total sales 100 per cent. If the figures for any one year do not show something like this relationship, the business man may take the necessary steps to bring about a more satisfactory ratio.

If the net profit is greater than indicated here, there is, of course, no need for concern. The proprietor is very fortunate. However, if the expenses are much higher in their per cent relationship to sales, and net profit much lower, the proprietor has the necessary evidence to stimulate his efforts toward readjustment. It may be that he will have to reduce expenses if that is practicable. A study of these may show him where some expense is excessive. On the other hand, he may find that the expenses cannot be reduced. Then he has the alternative of increasing the sales, which would materially reduce the per cent relationship of expenses to sales unless he is compelled, because of the increased sales, to add proportionally to the expense of the business. In almost every business, up to a certain point, more goods could be sold without greatly increasing the expense because most of the fixed costs would remain the same, such as rent, light, heat, etc. There would probably be some increase in advertising and, possibly, in salaries.

The proprietor also may improve the situation by eliminating goods which are showing small profit, or even loss, and replacing these by more profitable merchandise; or perhaps, the cost of regular goods is not being carefully watched, and that by more careful buying, or buying under different conditions, the margin of profit between first cost and the selling price may largely be increased. It is true that the selling price is often fixed by the buying public and trade conditions, and is not easily changed.

The proprietor is also in possession of figures which indicate to him the exact value of every sale. He is awakened to the fact that many articles that he has been selling freely have actually been passing over his counter at a loss. If he is wise, he will endeavor to curtail such sales, only permitting those which are actually necessary to please customers, and will, on the other hand, select merchandise which gives a reasonable profit, and advertise and sell these in preference to the less profitable lines.

He will also recognize the importance of adding an adequate profit to the cost of professional work. In other words, by knowing the figures which represent "cost of goods" and "overhead", the proprietor will gain a control of his business, which had not been possible heretofore, and which may be

utilized to insure definite and dependable profits, so that from month to month it may be known whether the business is profitable or otherwise.

In determining the percentage relationship of sales, total cost of goods, expenses, and net gain in any one department, such as at the soda fountain, the candy counter, or the cigar case, the ordinary retail drug store is somewhat handicapped because of the difficulty of proportioning properly the general expenses. Purchases, of course, can be kept separate, and some expenses will be assigned definitely to a special department, such as laundry, or special clerks, but the division of rent, light, heat, etc., among the several departments calls for good judgment and some study in each store. The floor space required for each department is usually the basis for this division of expenses. The front part of the store must bear the larger percentage. To obtain greater value from the rear and other parts of the store many proprietors introduce in these locations attractive features which are intended to draw customers. The drug and prescription counter, and telephone booths are especially effective.

Sometimes the front of the store, back one-fourth, is expected to bear at least one-half of the general expenses. The second fourth of the sales room would then carry one-fourth of the expenses, while the last half of the sales room would be expected to pay the remaining expenses. Thus if the soda fountain were in the front of the store, it would be expected to pay its share of the expenses in the ratio indicated; if half way back, though occupying no smaller space, it would pay much less. Of course, this ratio must be determined by each proprietor and upon this the actual net profit in any one department determined.

Finally, it has been demonstrated by wide experience, that facts such as these, if available for business, give a satisfaction and control to the proprietor which amply justify the comparatively small amount of labor required, and changes the business from a guess to a definite profit-making machine, the control of which is in the hands of the management to manipulate almost at will.

The following hypothetical example of Druggists Jones and Brown, graphically illustrates the importance of correct accounting records:

	Jones' Drug Store		Brown's Drug Store	
Annual Sales	$50,000	100 per cent	$45,000	100 per cent
Cost of Goods	35,000	70 per cent	35,000	77 per cent
Expenses	12,500	25 per cent	7,500	17 per cent
Profit	2,500	5 per cent	2,500	6 per cent

Both Jones and Brown apparently have made the same profit, although Mr. Brown's records show he did $5,000 less business. As a matter of fact, Brown did just as much business as Jones but failed to keep track of some of his expenses, with the result that apparent sales totaling $45,000 really were $50,000 because, $5000 had been paid out in the course of a year for expenses and no record kept of it. (Incidentally, such an occurrence is not at all unusual.)

But, as the two statements show, both earned the same profit in their business; what is the harm in such a situation? Jones knows that to make his intended 5 per cent profit on an article, his cost of that article must not exceed 70 per cent of the selling price. Goods that he purchases for $8.00 he must sell for at least $11.50. As a matter of fact, the cost of Brown's goods also should not exceed 70 per cent of their selling price, but the wrong notion

of his expenses and profits which he has obtained from his failure to record properly his expenses leads him to believe that his cost of doing business is 23 per cent and not 30 per cent, the same as Jones. This false notion of his cost of doing business leads Brown to believe that the goods he buys for $8.00 he can sell for $10.40 and make his usual profit. Such a sale is an actual loss, as the following example shows:

	Supposed result
Selling price	$10.40
Cost of Goods	8.00
Supposed Expenses	1.77
Supposed Profit	.63

	Actual result
Selling Price	$10.40
Cost of Goods	8.00
True Expenses	2.60
Loss	.20

Very evidently, a repetition of such sales leads inevitably to a depletion of stock and cash and finally to bankruptcy.

The National income tax laws have required that records be kept so that the tax on net income could be determined correctly. Any failure to charge expenses correctly therefore leads not only to a false notion of the cost of doing business and consequent errors in pricing, but also may cause an overpayment of income taxes, through a failure to keep a full record of legitimate expenses.

Constructively, the maintenance of accurate and adequate records and accounts gives the retail druggist many opportunities to increase his profits. The following example illustrates this fact:

Suppose, annual sales are	$50,000
Cost of goods is	35,000
Expenses	12,500
Profit	2,500
Suppose, annual sales remain	$50,000
Cost of goods is still	35,000
But expenses reduced to	12,000
Profit then becomes	3,000

Thus a 4 per cent reduction in expenses results in a 20 per cent increase in net profits.

The retail druggist will agree that in management the problem of diagnosis is much more difficult than that of treatment.

It is easier to cure a known difficulty than it is to find the difficulty. A mechanic may spend hours looking for the cause of an automobile's failure to start and only a few minutes in correcting it once he has found it. Accurate and dependable records enable a druggist to see the strengths and weaknesses of his business. He then is in a position to act quickly and intelligently to control them. He will see when his payroll climbs too high, when he buys too much, when his customers are not paying their bills as they should, and a thousand other facts which he knows are warning of dangers ahead.

ACCOUNTING—A RECORD OF PROGRESS

One of the principal advantages of keeping drug store records under the plan just described is the fact that the proprietor has constantly available the exact conditions of his business. Trial balances and other preliminary calculations are unnecessary.

The value of any accounting records lies in their interpretative use. The following tabulation indicates how the proprietor can readily measure his part progress, and on the basis of these records plan intelligently for the future. With these facts before him, he can see the places at which he is weak and lay plans to strengthen them. He also sees the strengths of his business and therefore can proceed knowingly to intrench himself in these respects.

The following are the facts which should always be available for the proprietor of a pharmacy who desires to intelligently control the finances of his business. He should insist upon obtaining such figures regularly and in comparison with those from previous months or years.

1. *Net Sales*—Compare with previous corresponding periods, by departments and totals. Compare also with total cost of merchandise.

2. *Total Charge Sales*—Compare total outstanding accounts with the amount paid on account to determine how rapidly they are being collected.

3. *Total Cash Receipts*—Compare cash receipts with total cash paid out.

4. *Total Cost of Merchandise*—Compare cost of merchandise with total net sales to determine gross margin. Compare also with previous corresponding periods.

5. *Total Expenses*—Compare total expenses with previous corresponding periods.

6. *Net Gain or Loss*—Add the total for cost of merchandise to the total for expenses and subtract this sum from the total net sales for the same period. The result is the net gain or loss for the period. Compare this result with the result for previous corresponding periods.

7. *Total Cash on Hand*—Compare with cash on previous dates.

8. *Total Unpaid Bills*—Compare with the corresponding figures for previous dates.

9. *Inventory*—Compare with previous inventories. If no inventory has been taken it is possible to make an estimate by the method explained on page 1354.

10. *Comparison with Averaged Results of Other Stores* (see page 1421)—By converting the figures to percentages, the proprietor is in a position to compare his results with the typical results of other stores.

PART IX

THE PHARMACIST AS AN ANALYST

CHAPTER LXXXV

THE QUALIFICATIONS OF A PHARMACIST AS AN ANALYST

THE pharmacist is primarily trained to manufacture, compound, and dispense medicines. This has been his opportunity and responsibility through centuries of service, a service in one of the most important of professional callings—that of aiding in the alleviation of suffering and in the prevention and cure of disease.

Pharmacists have played an important rôle in the development of chemistry and many notable discoveries and investigations have been made by apothecaries, working with meager equipment, in small laboratories, and with little in the way of library facilities, or knowledge of what had been done by others.

During the past few decades the practice of pharmacy has undergone some radical changes in the character of the professional work accomplished.

While still retaining the distinctive privileges and responsibilities of compounding prescriptions and dispensing medicines, the pharmacist has relinquished much of the responsibility of manufacturing to the large scale producer. This condition has been brought about partly for economic reasons and partly because of the increase in the number of chemicals and preparations which are difficult to make and still more difficult to standardize. A survey of the titles of preparations and processes which have been officially recognized during the first century of the existence of the United States Pharmacopœia will reveal this trend very clearly.

Processes were originally included for nearly all chemical salts and plant principles, in addition to galenicals and solutions. At the present time the pharmacist would not be warranted on the score of equipment nor on the grounds of economy in preparing many of the compounds which his predecessor manufactured as a matter of ordinary routine.

There are still, however, many preparations which may be easily and economically made by the pharmacist who wishes to continue in the line of manufacturing, but many pharmacists no longer take the time and trouble to prepare even these.

During this period of development of large scale manufacture, which has curtailed the professional work of the pharmacist in this direction, there has been no diminution of his responsibility for the character and integrity of the products which he employs in the compounding of prescriptions or of the drugs and medicines which he dispenses at retail.

Of all retail merchants the pharmacist is the only one who is scientifically trained in the art of identifying his wares and of detecting evidences of adulteration therein or deterioration thereof, and he may be, and frequently is, held legally responsible for not having exercised that knowledge.

The pharmacist is peculiarly well qualified on the basis of his professional knowledge and scientific education and training to act in the capacity of an

analyst, not only for his own protection, but as an opportunity for service to the medical profession and to the community in which he practices.

The practice of analytical chemistry, if only to a limited extent, keeps the pharmacist up to date in scientific learning and places him in the independent position of one who answers questions regarding quality and purity of the medicines which he sells instead of one who asks them.

The practice of analytical chemistry, also has remunerative possibilities, if carried on conscientiously and carefully, and the analyst is paid for the professional service which he renders just as physicians, dentists, and lawyers are paid.

The graduate of a course in pharmacy possesses the fundamental knowledge and training necessary for success in this line; all that he lacks is experience. If he is so inclined and makes good use of his opportunities, he may obtain this experience while carrying on his regular professional work, and in so doing he increases his scientific knowledge and elevates his professional standing in the community.

Equipment of a very moderate character may be used at the start, and as the need develops and opportunities occur a real laboratory can be built up in which work of the highest class may be performed.

The pharmacist's first duty, of course, is in the direction of the maintenance of quality and purity in such items of his own stock as are likely to vary from the standards, especially those which are apt to change on account of deterioration.

It is assumed that the pharmacist possesses a balance which is sensitive enough to serve for certain analytical procedures, particularly those connected with volumetric determinations of strength of a number of commonly used preparations which should be frequently tested and adjusted in this respect.

In a number of analytical determinations, based on volumetric procedures, no balance at all is required, all calculations being based upon measurements with pipettes and burettes.

Among the simpler operations are the following:

1. The titration of the official diluted acids and adjustment to standard strength.
2. The determination of strength of alkaline solutions, such as lime water, solutions of potassium and of sodium hydroxides and of the ammonia waters.
3. Estimation of strength of tincture of iodine, and Lugol's solution, etc.
4. Estimation of strength of hydrogen dioxide solution.
5. Estimation of strength of Carrel-Dakin solution, Labarraque's solution and Javelle water.

The foregoing list, comprising more than a dozen determinations, will require a very limited supply of apparatus and reagents, the minimum list being as follows:

One burette, graduated to $\frac{1}{10}$ cc.	Normal sodium hydroxide solution.
One 10 cc. delivery pipette graduated to $\frac{1}{10}$ cc.	Normal sulphuric acid.
	Tenth-normal potassium permanganate.
Three delivery pipettes of 5 cc., 10 cc., 25 cc. capacity, respectively.	Tenth-normal sodium thiosulphate.
	Phenolphthalein T.S.
Three beakers of assorted sizes.	Methyl orange T.S.
Three flasks of assorted sizes.	Starch T.S.

This complete outfit will cost less than $10.00 and no guide books or textbooks other than the U. S. P. and N. F. will be needed.

The addition of a few reagents and test solutions will increase the scope of the work to include the testing of most of the official liquors and the determination of purity of many of the official inorganic chemical salts.

If determinations of alcoholic strength are included in this initial list, a distillation flask, a condenser, and glass and rubber tubing will be needed, also an accurate pycnometer equipped with a thermometer. These items will cost more than the entire previous list, but if commercial determinations are made at standard prices for such service, the expenditure will soon be covered.

In order to develop confidence in one's work and at the same time provide for a check against error, particularly when carrying out a test for the first time, it is advisable to carry out two experiments in addition to the one upon the sample being investigated. One of these experiments should be arranged to give negative results and the other as to produce a positive reaction. For example, in testing for the presence of methanol in a specimen of alcohol, if three tests are carried out simultaneously, one upon a specimen known to be free from methanol, one upon a specimen to which methanol has been added, and one upon the unknown specimen, there need be no doubt in the mind of the analyst as to the interpretation of the results and such procedure will establish the correctness of the technic and the authenticity of the reagents beyond any question. The majority of careful analysts, as a matter of routine, follow this procedure every time an important test is made.

The pharmacist is frequently deterred from attempting to do analytical work or to check up official substances in the mistaken belief that every factor and every single test under each monograph must be included in the examination. Except in the rare instances where complete evidence must be presented, as in an examination leading to possible court procedure, this is not necessary. For example, it is rarely necessary to take the specific gravity of diluted acids, alkali solutions, etc., if the strength is found to be up to standard. Then too, many of the tests, such as the tests for heavy metals and for arsenic, which appear rather formidable when the text is first read, will be found to be very simple when actually applied as a matter of routine.

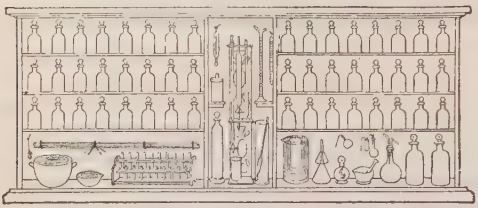
Selective preference may be given to the classes of tests in the following order: First, the identity tests, for it is apparent that if the substance fails to meet the requirements in this respect it is unnecessary to apply additional tests; second, the test for strength, for here again, if the substance is found to be substandard, that is, below standard, the article may be rejected without proceeding further; lastly, the tests for small amounts of impurities which would have no influence upon tests for identity or strength. For a very complete study of the rationale of the U. S. P. and N. F. chemical tests, see page 1449.

Assuming that the pharmacist has undertaken analytical work, along the lines previously outlined, for the examination of his own products, his ambition may next be properly directed to the classes of work for which opportunity exists in nearly every community, in which specialized service may be given to the medical profession, including boards of health, to the legal authorities, to such industries as are not equipped for doing their own laboratory or control work, or to the laity in the examination of water and food samples.

The first of these possibilities is covered in the chapter on Diagnostic and Clinical tests (see page 1568). The others may be developed as need or opportunity arises in the particular community in which the pharmacist happens to be situated. Work for the legal profession comprises a number of possibilities, such as the determination of alcoholic strength of liquors, tests for the identification or detection of narcotic drugs and many others along similar lines.

Industrial work is very broad in its scope, but the pharmacist's technical knowledge of chemicals and of the principles underlying manufacturing operations gives him an advantage which can frequently be utilized in the solution of minor manufacturing problems. Work upon food products includes such determinations as the quality of milk and its freedom from preservatives; the testing of butter for moisture content or its distinction from oleomargarine; the testing of beverages for the presence of saccharin, preservatives, or the presence of forbidden colors; sanitary chemical water analysis, etc.

FIG. 510



Laboratory cabinet

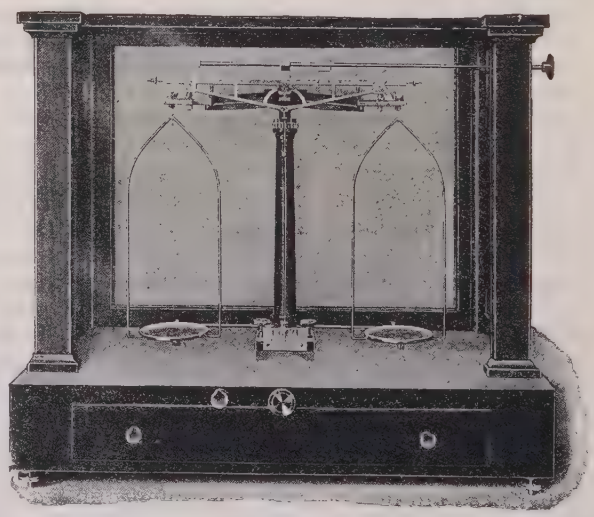
For all such work the pharmacist should charge the standard or prevailing price for conscientious, careful service. Price lists for analytical determinations are obtainable upon application to established laboratories or information may be obtained therefrom concerning charges for specific kinds of work.

If the amount of work increases so as to justify expenditure for additional apparatus and equipment, the first effort should be directed toward the purchase of an analytical balance and the installation of a laboratory work counter (see Fig. 510).

There are many firms supplying laboratory fixtures from whom catalogues and prices may be obtained upon application.

An analytical balance differs from a high class prescription balance in the matter of sensitiveness; a satisfactory analytical balance is sensitive to the tenth of a milligram (approximately 1/600 grain), and should never be used for weighing more than 100 Gm. at one time.

FIG. 511



Troemner analytical balance

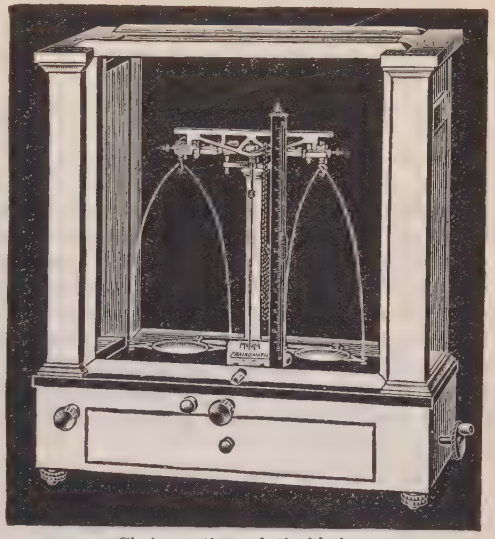
Modern analytical balances are constructed with extraordinary care and accuracy. They are always provided with leveling devices, and with levers for arresting the motion of the balance so as to expedite weighing. The beam of an analytical balance is graduated (sometimes on both sides of the center of gravity) and equipped with a platinum wire rider, which is manipulated by a sliding adjustable lever. The fractions of a milligram are weighed by means of this rider, which may be quickly transferred to any portion of the beam. Henry Troemner and Company, of Philadelphia, list an excellent analytical balance (see Fig. 511).

Another type of analytical balance is the Chainomatic balance (see Fig.

512) in which fractional weights are recorded by means of an adjustable swinging chain, and individual weights under 1 Gm. may thus be dispensed with entirely. It is manufactured by the Christian Becker Company.

A set of accurate high class analytical weights is needed in connection with the use of the analytical balance. These should never be left uncovered when not in use and the individual weights should always be handled with the tweezers accompanying the set (see Fig. 513).

Fig. 512

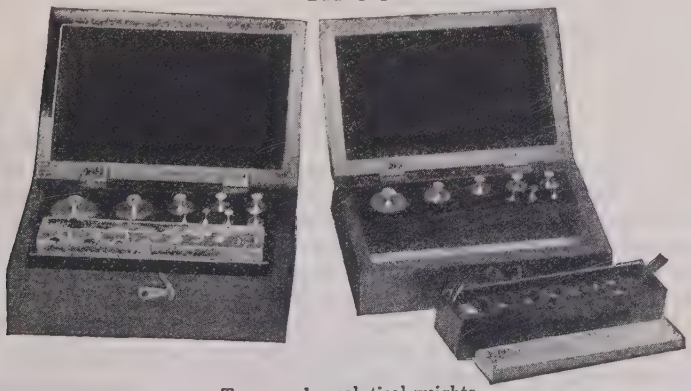


Chainomatic analytical balance

The works of reference needed in an analytical laboratory depend entirely upon the scope of work. For pharmaceutical testing of official substances, the U. S. P. and N. F. of course are given primary consideration. Among the indispensable adjuncts of the analyst's library are the following works:

Official Methods of Analysis of the A. O. A. C.—covering foods, beverages insecticides, fertilizers, drugs, etc.
Standard Methods of Chemical Analysis, Scott.
Food Inspection and Analysis, Leach.
Allen's Commercial Organic Analysis.
Detection of Poisons, Autenrieth translated by Warren.
Standard Methods of Water Analysis, A. P. H. A.
Standard Methods of Milk Analysis, A. P. H. A.
Volumetric Analysis, Sutton.
Chemical Technology of Oils, Fats, and Waxes, Lewkowitsch.
Analysis of Drugs and Medicines, Nelson.
Chemistry and Analysis of Drugs and Medicines, Fuller.
Micro-Chemical Tests for Alkaloids, Stephenson.

Fig. 513



Troemner's analytical weights

Many valuable publications may be obtained from the various departments of the United States Government. The departments whose publications are of particular value to the analyst are those of the U. S. Department of Agriculture, Bureau of Chemistry, and those of the Bureau of Standards.

Upon application to the Superintendent of Documents, Washington, D. C., lists of publications covering particular fields of work may be obtained free of charge, and from these may be selected the publications which are desired, usually for a nominal price ranging from 5 cents to 25 cents per copy, and in this manner a very complete reference library may be acquired at a comparatively small cost.

Among the more valuable of these Government publications from the standpoint of information, are those issued by the U. S. Department of Agriculture, which give the standards of purity to which various food products must conform.

The publications of the American Medical Association are particularly helpful in connection with the examination of non-official pharmaceutical preparations. The laboratory Reports of the Council of Pharmacy and Chemistry of the A. M. A. contain detailed descriptions of many specially devised methods of analysis and the book entitled Nostrums and Quackery contains valuable information concerning the composition of many proprietary remedies.

It is in problems connected with the composition of medicinal preparations more than in any other class of substances that the limitations of chemical analysis are appreciated. There are many drugs which contain no constituents capable of accurate estimation or even of certain identification. In such cases an experienced pharmacist may make use of his training in connection with the physical properties of drugs and their preparations in arriving at a knowledge of the ingredients which contribute the predominant physical characteristics of the preparation.

Important factors in the successful practice of analytical chemistry are the proper selection and adaptation of methods of analysis for substances other than those which are official or for which methods are not available in the works of reference at hand, and also in the intelligent interpretation of results and in the formulation of reports which may be easily understood by the persons for whom they are intended.

An individual may be an excellent analyst in connection with routine work, but if he possesses no resourcefulness in emergencies, or if he cannot intelligently interpret his results to the satisfaction of himself or of his client, or if he cannot write a final report which is intelligible to the recipient, he will fail just as certainly as though his work itself were faulty.

The pharmacist who possesses the ability and the inclination and can find the time to devote a minimum of a few hours a week to the simpler analytical procedures will find himself repaid in many ways. He will acquire a first hand knowledge of the quality, purity, and strength of some of his official preparations and in so doing will gain confidence in himself, his work and in his profession, in the larger sense. He will acquire a facility in manipulative detail that will stimulate his ambition to go further, and the further he goes the more fascinating and profitable he will find the work. It is fascinating in that it unfolds new vistas of professional interest and activity, and profitable not only in insuring him against the possibility of being penalized as a violator of the pharmacy laws in regard to the strength and purity of the medicines dispensed by him, but also profitable in affording time and opportunity to develop a remunerative class of work for which opportunity exists in nearly every community.

CHAPTER LXXXVI

URINALYSIS

THE fact that neighborhood physicians are relying more and more upon the local pharmacist to perform the simpler diagnostic tests, and especially urinalysis, prompts the compilation of this special chapter. Moreover, it is quite apparent that there is a desire among pharmacists to develop professionally along lines of service, such as are presented in association with the physician in the performance of these special tests and examinations. With the specialized chemical training which is now a part of the pharmacist's professional education, he is well fitted to perform this type of service. His technical information, his skill in manipulation, and his experience in accurate weighing and measuring are all contributory to his special fitness to conduct these important diagnostic tests.

One who can be trusted to weigh with exquisite accuracy the tiny particle of aconitine, that may mean life or death to the person for whom it is intended, is expected to be equally careful and as conscientious in performing even the most insignificant test of physiologic function.

Medical information has awakened the laity to the need for watchfulness over the body even in times when health may seem dominant. The insurance companies and health agencies are continually preaching preventive medicine. The individual has been taught the value of the blood and the urine test, and no longer will the cursory test of the old family doctor suffice. It must be performed by a specialist, and the physician frequently turns over to the patient the results of the analysis.

FIG. 514

(PRINT HERE THE NAME AND ADDRESS OF THE CHEMIST)

DATE RECEIVED
PATIENT
DOCTOR
DATE REPORTED

URINALYSIS

PHYSICAL

COLOR Light amber
ODOR Normal
SPECIFIC GRAVITY 1.038
REACTION Acid. plus
TURBIDITY A
SEDIMENT P

MICROSCOPIC

CASTS P
EPITHELIA P
PUS P
BLOOD A
MUCUS P
CYLINDROIDS P
SPERMATOZOA
BACTERIA
OXALATES
PHOSPHATES
URATES
URIC ACID P

CHEMICAL

(QUALITATIVE AND QUANTITATIVE)

REDUCING SUGAR (FEHLING'S / BENEDICT'S) P
ACETONE P
DIACETIC ACID P
ALBUMIN (HELLER'S CONTACT / COAGULATION (HEAT)) P
INDICAN A
UREA (GM PER LITER) 16
BILE A

P INDICATES PRESENCE OF SUBSTANCE
A INDICATES ITS ABSENCE.

GENERAL REMARKS

Sugar --- 4.9 percent.
Albumin - a slight trace
Pronounced trace of acetone and diacetic acid.
An occasional fine granular cast.
Few clumps of leukocytes (pus cells).

A. Brown.

EXAMINED BY

Model urinalysis report

Thus has the scope and the work of the clinical laboratory been broadened and enlarged. Thus has an opportunity to serve come to the pharmacist. These facts fully justify the introduction of a special chapter on urinalysis into this work.

In reporting the results of clinical examinations, in justice to both the physician and the patient, it is always necessary to render reports directly to the physician. Only when definitely instructed to do so by the physician, should the analyst report his findings verbally or otherwise to the patient. He should never attempt a diagnosis or discuss the clinical findings with the patient.

A printed or mimeographed report blank may be compiled to suit the needs of the analyst, but a better plan is to formulate it to suit the wishes of

the physician who reads it. Such a report, filled in for a typical analysis, is submitted herewith, and will serve as a pattern (see Fig. 514).

To facilitate the collection of specimens, mailing bottles, bearing a label (see Fig. 515), should be supplied to physicians of the neighborhood. In the clean bottle should be placed a few drops of saturated boric acid solution as a preservative. This policy is an aid to the development of this type of professional work.

The instruments and apparatus required to conduct a small clinical laboratory need be neither elaborate nor expensive. However, in addition to ordinary glassware, and the regular equipment of the pharmacy, the following equipment will be found necessary for a full examination.

Fig. 515

Patient's Name

_____

Address

_____

Doctor's Name

_____

Address

_____

This specimen when delivered to

(Print here the name and address of chemist)

will insure a prompt report.

The Report is always Mailed Directly to the Physician.

Label for urine sample

A well-equipped microscope provided with high and low power, and oil-immersion lenses such as the Spencer microscope (see Fig. 516).

A centrifuge (hand, water, or electrically driven).

The extra glassware consists of a burette, pipettes, urinometers, ureometer, albuminometer, etc.

The following textbooks are suggested as authoritative and practical, giving not only a broader treatment of urinalysis, than is possible here, but also containing chapters on gastric analysis, blood analysis, sputum examination, and many other subjects which may be readily added to the general work of a pharmaceutical clinical laboratory. The first is the more generally useful: *Clinical Diagnosis*, Todd; *Practical Physiological Chemistry*, Hawk; *U. S. Army Laboratory Manual, No. 6*, and *Blood and Urine Chemistry*, Gradwohl and Blaivas.

It is obvious that beyond the conduct of certain of the ordinary tests, such as blood counting, urinalysis, gastric content analysis, etc., special training is required, as for instance, in conducting the Wassermann test, or other complement fixation tests. But with a keen interest in this work, and the training already attained, no one is better fitted to perform even the more complicated tests than the graduate in pharmacy. Certainly the physician can better trust his work to the well-trained pharmacist than to a technician whose only scientific training is that acquired in a hasty three or six months' intensive course, where fundamentals are brushed aside and only the technical operations perfected.

Composition of Urine

The composition of urine is very complex, as indicated in the following table. It is to be noted that there may be, even in a normal urine, great variances from the figures given in this table. It may be accepted, however, that the average healthy person, under average conditions, will secrete urine of about this composition. The normal twenty-four hour excretion of urine measures from 1000 cc. to 1500 cc. consisting of:

NORMAL CONSTITUENTS

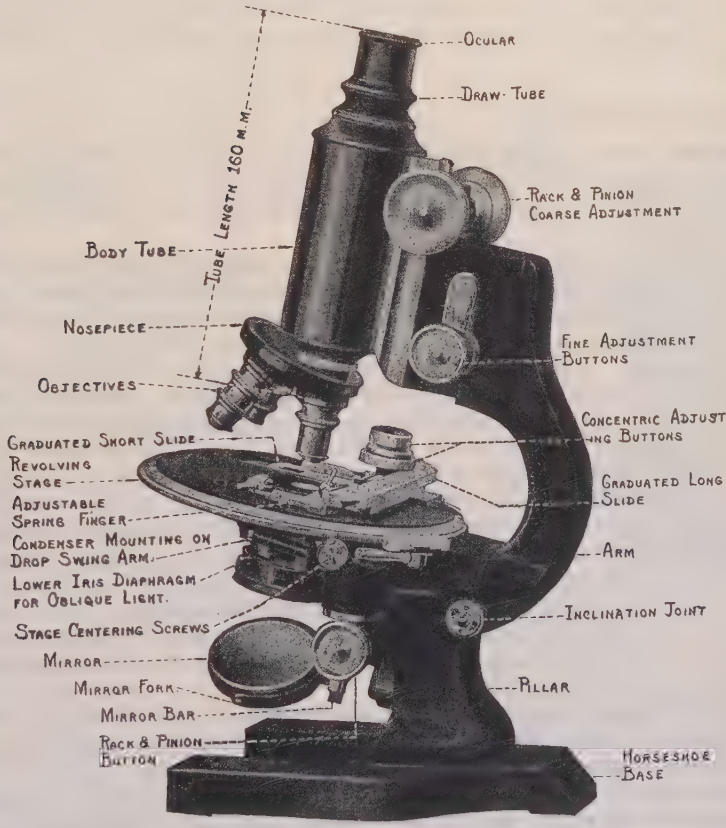
Water	1000 to 1500 cc.
Dissolved Solids	50 to 60 Gm.

The dissolved solids consist of the following:

Urea	30 to 40 Gm.
Chlorides	15 Gm.
Sulphates	2.5 Gm.
Phosphates	2.5 Gm.
Ammonia	0.7 Gm.
Uric Acid	0.7 Gm.

Other substances such as pigment, creatinin, hippuric acid, etc.

FIG. 516



Spencer microscope

The following list comprises those substances which are considered abnormal when found in urine in appreciable amounts.

ABNORMAL CONSTITUENTS

Proteins: Serum albumin, serum globulin, albumoses, mucin, Bence-Jones protein.
Carbohydrates: Glucose, lactose, pentose, levulose and other sugars.
Acetone bodies: Acetone, aceto-acetic acid (diacetic acid) and oxy-butyric acid.
Bile.
Indican.

The abnormal microscopic factors are considered elsewhere in the text.

Examination of Urine

A twenty-four hour specimen is usually desirable, because the total excretion of both solids and water can be learned in this way. A single specimen is sometimes useful, as sugar or albumin may be present in the urine at one time of the day and not at other times.

Generally no preservative is needed. When, however, the urine must be carried a long distance or kept more than a day or two a preservative is required. Solution of formaldehyde (formalin) may reduce copper solutions used in sugar tests, and should not be added. Thymol vitiates certain tests and so does salicylic acid. This prohibits their use as urine preservatives. Boric acid, in very small amount (about 0.5 Gm. per sample), is the most effective preservative.

PHYSICAL PROPERTIES

Amount—The normal quantity for an adult is from 1000 to 1500 cc. in twenty-four hours. Children pass more in proportion to body weight than adults. A new-born infant passes from 150 to 200 cc., a child of five years about 700 cc.

In health more urine is passed during the day than during the night. This may be reversed in disease, notably in chronic interstitial nephritis.

The amount varies physiologically according to the quantity of fluids and watery foods taken and the activity of other organs of elimination.

Appearance—Normal urine is transparent, though a slight cloud of mucus may appear on standing. Cloudiness is generally due to pus, blood, bacteria, urates, or phosphates. Albumin itself, in pathologic amounts, causes no change in the appearance of the urine, except that it may, in unusual amount, increase the viscosity to a perceptible degree. The consistency of normal urine is watery; pathologically it may be frothy from the presence of albumin, syrupy from the presence of sugar, or ropy from mucus or pus in alkaline urine.

Odor—Normal urine has a faint aromatic odor. On standing a long time all urines are decomposed (undergo alkaline fermentation) and have a very unpleasant odor. Certain drugs (cubeb, copaiba, tolu, saffron, and turpentine) impart specific odors to urine. Asparagus promptly imparts a very characteristic odor to urine. A pus-containing specimen often develops a putrid odor on standing, due to bacteria.

Color—Normal urine is amber or straw colored. It may vary a great deal within normal limits. With the ingestion of certain drugs and in some diseases, the color may be any of the following:

Blue or green. The administration of methylene blue usually accounts for a blue or greenish color. On rare occasions a bluish urine appears from putrefactive changes in the intestines in cholera.

Dark yellow or greenish-brown. This color is usually due to bile. A vivid yellow often appears in the urine of persons habituated to phenolphthalein. This is indicated by its turning red when rendered alkaline.

Black. Melanin from a melanotic sarcoma may color the urine black. In salol, phenol, or iodoform poisoning, the urine may turn black on standing. Silver compounds (such as argyrol, protargol, etc.), used for irrigating, frequently color the urine a deep brown, especially the sediment formed on standing.

Red, brown, or smoky color. This may be due to blood.

Red. In an alkaline urine this may be due to phenolphthalein, rhubarb, senna, or cascara (or any emodin-bearing drug).

White. A milky appearance is found when there is an admixture of chyle.

Reaction—Normal urine is usually acid in reaction, but may be temporarily neutral or alkaline. An amphoteric reaction, the urine turning red litmus paper blue and blue litmus paper red, is not unusual and has no pathological significance. Alkaline urine may be due to decomposition in the bladder as in cystitis with retention of the urine, or to administration of alkaline drugs. A meat diet has the tendency to increase the acidity, and a fruit and vegetable diets to diminish acidity. Thus a change in reaction may be from a pronounced acid to a pronounced alkaline, in a normal person, during the course of a day.

The reaction is determined by the use of litmus paper, acid urine turning blue litmus paper red, and an alkaline urine turning red litmus paper blue.

Total Acidity—The total acidity of urine varies considerably. In estimating the total acidity, the specimen of urine should be a mixture of the twenty-four hour excretion, and should be as fresh as possible.

It may be quantitatively determined in the following manner:

Folin's Method of Estimating Acidity—Measure 10 cc. of urine into a 100 cc. flask, add about 25 cc. of distilled water, 3 drops of a 1 per cent alcoholic solution of phenolphthalein and about 2 Gm. of potassium oxalate. Add slowly N/10 NaOH until a permanent faint pink color appears. The flask should be shaken after each addition of alkali, and the alkali added drop by drop after adding the first one or two cc. The number of cc. of N/10 NaOH required to neutralize 1 cc. of urine, multiplied by the number of cc. of urine passed in twenty-four hours, gives the degree of total acidity.

Fig. 517

Urinometer

Specific Gravity—The normal specific gravity of a twenty-four hour specimen of urine is between 1.012 and 1.020. Normally a great variation occurs in separate passages of urine, the night urine having a higher specific gravity. It also varies normally according to the amount of fluid ingested, and the quantity of skin excretion.

Physiologically, the specific gravity varies inversely as to the quantity. It is increased by nitrogenous diet. Pathologically, the specific gravity is high in the following diseases: diabetes mellitus, acute nephritis, acute fevers. The specific gravity is low in diabetes insipidus, and in chronic interstitial nephritis the specific gravity is markedly fixed and low, due to inability of the kidney to excrete a concentrated urine.

The specific gravity is estimated by means of the urinometer (See Fig. 517, and page 63). This is sufficiently accurate for general clinical purposes. The instrument is generally calibrated for use at 15° C. If the specific gravity is taken at any other temperature, correction as given below must be made. In making this correction, one unit in the third decimal place is added for every three degrees above 15° C., and subtracted for every three degrees below 15° C.

Example: The urinometer is calibrated for 15° C.
The specific gravity of the urine when taken at 18° C. is 1.020.
The true specific gravity at 15° C. would be 1.020 plus 0.001 = 1.021.

In using the urinometer always read the meniscus at the lowest point.

Total Solids—By the total solids is meant the solids excreted in twenty-four hours. The chief value of the estimation of the specific gravity is to give an idea of the amount of solids excreted. The normal total solids of an adult on ordinary diet is about 60 Gm. About 4 per cent of the weight of the urine is that of the solids and of this, urea forms a little less than half.

The total solids may be estimated by the use of Haeser's coefficient. The two last figures of the specific gravity multiplied by 2.33 (Haeser's coefficient) equals the Gm. per 1000 cc. This multiplied by the number of liters (1000 cc.) passed in twenty-four hours gives the total solids. Example: 1400 cc. of urine is the twenty-four hour amount. The specific gravity is 1.016. 16 x 2.33 x 1.4 = 52.19. The total solids are 52.19 Gm.

Long's coefficient (2.6) is used in much the same way, and is considered more accurate by many authorities.

CHEMICAL CONSTITUENTS

Albumin—In the classification of organic substances albumin is in the group of proteids, hence is often referred to as such. The presence of albumin in the urine is spoken of as albuminuria, and when present in appreciable amount is considered an indication of an abnormal condition. True albuminuria is the presence in the urine of albumin which has escaped through the cortex of the kidney. There is, however, an albuminuria without definite kidney lesions (usually small amounts of albumin). This may be functional, as after severe exercises, or after prolonged cold baths. Contaminating bacteria in a stale urine will afford a false albumin test.

A wrong impression is prevalent in some quarters that when albumin is found by chemical test in urine, there will *always* be found microscopically such findings as casts, blood, or pus cells. The converse is more nearly true, *i.e.*, albumin will be found always when casts, blood or pus cells are present —but albumin may be found in the absence of these.

Serum albumin and serum globulin are usually both present in albuminuria, sometimes also nucleo-albumin and albumoses. Most ordinary tests respond to all these substances. The appearance of proteoses or globulin, except in association with serum albumin, is rare. The Bence-Jones proteid appears in the urine in multiple myeloma. When present, there is usually a large amount. This proteid coagulates on heating at about 60° C., clears up on further heating, and reappears on cooling.

For all albumin tests the urine must be clear. If cloudy, filter. If still cloudy, mix the urine with light magnesia or purified siliceous earth (kieselguhr), and filter.

Qualitative Tests for Albumin: Heller's Test—Take an inch of urine in a test tube. Carefully underlay this with half an inch of strong nitric acid. Should the urine be alkaline, it is best to acidulate it with a few drops of acetic acid before conducting the test.

Interpretation of the test:

Precipitates.

Albumin shows a white ring at the junction of the acid and urine.

Nucleo-albumin or *mucin* shows a white ring above the contact with a clear zone between.

Urates show a cloud above the contact line which disappears on heating or on using diluted urine.

Colors.

Normal—varies from a faint pink to a brownish ring at the point of contact.

Biliary pigment—dark green or blue.

Indican—violet or bluish when great excess is present.

Iodides—intense brownish red.

Aniline-compounds—red to purple.

Robert's Modification of Heller's Test—Use in place of the nitric acid a reagent consisting of 100 cc. of a saturated aqueous solution of magnesium sulphate mixed with 20 cc. of nitric acid.

The interpretation is the same as that of Heller's test so far as the precipitates are concerned, and the test is more delicate, particularly in that the colored rings are not so much in evidence.

Coagulation Test—Heat about 15 cc. of urine in a test tube, boiling it near the surface of the fluid. The addition of a few drops of acetic acid to the liquid will show a persistent cloudiness if albumin is present. Phosphates will be precipitated by the simple heating, but this precipitate will promptly dissolve in the acid. Often in an intense albuminuria, as in eclampsia, the urine "boils solid" (*i.e.*, coagulates). This is an indication of the presence of between two and four per cent of albumin. Many authorities prefer this method, as it is simpler than the other tests.

Quantitative Estimation of Albumin: Purdy's Method—Into a 15 cc. graduated, conical centrifuge tube place 10 cc. of clear urine, 3 cc. of a 10 per cent potassium ferrocyanide solution, and 2 cc. of 50 per cent acetic acid. Shake the tube, set it aside for ten minutes to allow for the precipitation of the albumin, centrifuge for exactly three minutes at 1500 revolutions per minute, in an instrument with a radius, including the tubes, of exactly 6¾ inches. Then remove the tube from the centrifuge and determine the number of Gm. of albumin per liter by the following table. If the amount of albumin is very large, the urine should be accurately diluted.

Relation of Precipitate to Albumin per 1000 cc.

Volume of precipitate in centrifuge tube	Weight of dry albumin per 1000 cc.	Volume of precipitate in centrifuge tube	Weight of dry albumin per 1000 cc.
0.25	0.5	2.75	5.7
0.5	1.0	3.0	6.3
0.75	1.6	3.25	6.8
1.0	2.1	3.50	7.3
1.25	2.6	3.75	7.8
1.5	3.1	4.0	8.3
1.75	3.6	4.25	8.9
2.0	4.2	4.50	9.4
2.25	4.7	4.75	9.9
2.5	5.2	5.0	10.4

Example: The centrifuged precipitate is 1.5 cc. before testing, which, by the use of the table, is found to equal 3.1 Gm. of albumin per 1000 cc. The twenty-four hour specimen contained 1500 cc.; multiplying 3.1 by 1.5, the result equals 4.65 Gm. of albumin in 1500 cc.

Tsuchyia's Method—(For use where no centrifuge is available).[1]

[1] Descriptions and formulas of the reagents and test solutions specified in this chapter will be found in the chapter on Reagents.

To conduct the test, fill an albuminometer (see Fig. 518) to the letter U with clear, filtered urine. Add the reagent, filling the tube to the mark R. Insert a rubber stopper and invert several times until the contents are thoroughly mixed. Carefully remove the stopper to allow the escape of generated vapors, again stopper the tube and set it aside for twenty-four hours.

Fig. 518

Albuminometer

In from twelve to eighteen hours examine the liquid in the tube, and if the precipitate tends to adhere to the sides of the albuminometer, rotate once very gently between the palms of the hands. If done properly, this will loosen the flocculi and cause them to fall to the bottom of the tube.

This procedure must be done very gently, otherwise the sediment already formed will be disturbed. At the end of twenty-four hours, read the height of the precipitate in the albuminometer and calculate the parts of albumin, by weight, from the following table, bearing in mind that the parts must be multiplied by the dilution, if it has been found necessary to dilute the urine with water. The final result will be the Gm. of dry albumin per 1000 cc. of the sample.

Example: If the precipitate is level with the 2 cc. mark, Pfeiffer's table shows that there are 3.2 parts per thousand or 0.32 per cent. of albumin.

Relation of Precipitate to Albumin per 1000 cc.

0.5 cc.	= 1.00 parts per 1000
1.0 cc.	= 1.50 parts per 1000
1.2 cc.	= 1.75 parts per 1000
1.4 cc.	= 2.00 parts per 1000
1.6 cc.	= 2.40 parts per 1000
1.8 cc.	= 2.80 parts per 1000
2.0 cc.	= 3.20 parts per 1000
2.2 cc.	= 3.60 parts per 1000
2.4 cc.	= 4.00 parts per 1000

Glucose (Dextrose)—Glucose or dextrose (grape sugar) ($C_6H_{12}O_6$) is the only important carbohydrate found in urine. The presence of glucose in the urine temporarily does not mean the existence of diabetes any more than does the presence of albumin always indicate nephritis. After a diet rich in carbohydrates glucose may appear in the urine temporarily and such a condition is spoken of as physiological or alimentary glycosuria.

However, when glucose is persistently present in appreciable quantity, *diabetes mellitus* is indicated. Large amounts of glucose have been found in this disease, from 150 to 250 Gm. (5 to 8 oz.), per diem being the average; a urine containing more than 10 per cent of glucose is seldom excreted. The sugar in urine is not identical with table sugar (sucrose). It is different in chemical composition and in chemical behavior. For instance, table sugar does not directly reduce Fehling's solution.

Qualitative Test for Glucose—Benedict's solution is now considered more accurate than either Fehling's or Haines' solution, and it has the additional advantage of permanence. For qualitative work there are many, however, who consider Fehling's solution superior to any other. Under no circumstances should the Benedict's qualitative reagent be confused with the Benedict's quantitative reagent.

Place about 5 cc. of Benedict's qualitative solution in a test tube, add from 8 to 10 drops (not more) of the urine under examination, and boil the mixture

vigorously for a minute and a half and allow it to cool spontaneously. In the presence of sugar (glucose), the entire solution will be filled with a precipitate, which may be red, yellow, or green, depending upon the amount of sugar present.

If the amount of glucose is small (under 0.3 per cent), the precipitate forms only on cooling. If the urine contains no sugar (glucose), the solution either remains perfectly clear, or shows a faint blue turbidity consisting of precipitated urates, which should cause no confusion. Even very small quantities of glucose (0.1 per cent) yield precipitates of surprising bulk with Benedict's reagent.

Lactose (milk sugar) is occasionally found in the urine of expectant or nursing mothers. It is a reducing sugar, *i. e.*, it will behave chemically like glucose. There are special tests which may be used to distinguish it from glucose. Unlike glucose it is not readily fermentable.

Benedict's Quantitative Estimation of Glucose—The titration method of Benedict is now conceded to be far superior to the older titration methods of Fehling and Purdy. This method gives excellent results and no special or expensive apparatus is required. It is superior to the Lohnstein fermentation test, because the results may be obtained at once (in about five minutes). It is also superior to the polariscope method in those instances when lævorotatory substances (as β-hydroxybutyric acid) are present, thus necessitating a determination both before and after fermentation.

Place the urine in a graduated burette, pipette 25 cc. of Benedict's volumetric solution into a non-soluble glass flask of about 150 cc. capacity and add from 5 to 10 Gm. of anhydrous sodium carbonate and a small amount of powdered pumice.

Heat the mixture to boiling on a piece of wire gauze, with an asbestos center and run the urine in rapidly from the burette until a chalky-white precipitate begins to form. Then run the urine in more slowly, with continuous boiling, until the last trace of blue color disappears, indicating the end point. Chloroform or formaldehyde, if present, should first be removed by boiling, as they interfere with the reaction. Benedict found that 0.050 Gm. of glucose or 0.052 Gm. of levulose reduced 25 cc. of Benedict's volumetric solution. Myers and Fine found that 0.054 Gm. of galactose or 0.067 Gm. of lactose reduced 25 cc. of this volumetric solution. If a large amount of glucose is present, the urine should be accurately diluted and the test carried out on the diluted specimen, the final results being multiplied by the proper factor.

Example: A twenty-four hour specimen of urine contained 2500 cc. The quantity of urine required to reduce the 25 cc. of Benedict's (equivalent to 0.050 Gm. of Glucose) was 12.5 cc.

Therefore—12.5 cc. of urine contains 0.050 Gm. of glucose;
1 cc. of urine contains 0.004 Gm. of glucose;
2500 cc. of urine contains 10 Gm. of glucose;
2500 cc. contains 10 Gm. (24 hour output)
100 cc. contains $\frac{10}{25}$ or 0.4 per cent of glucose.

Urea—Urea is the chief organic constituent and the most important nitrogenous end product in urine. Half of the protein nitrogen taken into the system as food is excreted by the kidneys as urea. Thus the detection of urea may be utilized as a means of identifying an unknown liquid suspected of containing urine.

The percentage of urea in normal urine varies largely with diet and with urine concentration. The average normal quantity is between 2 and 2.5 per cent. In disease the amount retained in the blood varies greatly. A test conducted on a single sample of urine is of no value. It should be conducted only on an aliquot portion of a twenty-four hour specimen. Obviously the test is always quantitative. It is conducted with solution of sodium hypobromite and the instrument illustrated in Fig. 519 known as the Doremus-Hinds' ureometer. This instrument on the indicating arm reads to a total of 0.03 Gm. of urea per cc. in 0.001 Gm. graduations. The small urine arm reads to a total of 2 cc. of urine in 0.1 cc. graduations.

Conduct of the Test—Take 5 cc. each of solutions *one* and *two* (see Solution of Sodium Hypobromite, page 1570) in a large test tube, mix, and dilute with 10 cc. of distilled water. Before pouring this solution into the ureometer close the stopcock. Fill the bulb with the reagent just prepared and incline the tube until the long arm is completely filled and sufficient liquid remains in the open tube to prevent any bubbles of air forming at the top of the closed arm. Should 20 cc. be insufficient, a few cc. of distilled water may be added. The small arm is filled exactly to the zero mark with urine to be tested.

FIG. 519

Ureometer

Carefully turn the stopcock, allowing 1 cc. of urine to enter the tube containing the reagent. This should be done very slowly. As soon as the evolution of gases (chiefly nitrogen) has ceased, usually in from ten to twenty minutes, read off the number of cc. of gas in the long arm, and multiply this figure by 1000 to obtain the amount of urea, which is expressed in Gm. per 1000 cc. of urine.

Theoretically, in using the ureometer the urine should be free from both albumin and sugar. Practically, however, these substances need not be removed. For all clinical purposes this method is entirely sufficient and no other is required, although the Urease Method is considered more accurate.

Indican—Indican (indoxyl-potassium-sulphonate) is formed from indoxyl, an oxidation product of the intestinal putrefaction of albuminous substances.

Indican in a small amount is a constituent of normal urine. Constipation generally is considered a frequent cause of indicanuria.

This substance is tested for by a method whereby the indican is oxidized to indigo blue, which color is soluble in chloroform. The reagent used to oxidize is Obermeyer's solution, which is a solution of 0.4 per cent of ferric chloride in hydrochloric acid (4 parts per 1000). This reagent keeps indefinitely.

Fill a test tube one-quarter full of the reagent, and add an equal amount of the urine to be tested, followed by a small quantity of chloroform. Cover the tube with the thumb and invert it several times slowly without shaking. The chloroform becomes blue in proportion to the indican present, the color increasing on standing. An accurate reading can usually be made in from five to ten minutes. With normal urine a faint blue color will result, while an increase of indican gives a deep blue color.

If the urine is originally highly colored, decolorize with a small amount of lead acetate solution, and filter, as its pigments may interfere with the recognition of the blue color. Color observations should be made only after a lapse of a definite time and for purposes of comparison this time should not vary as the color darkens on standing.

Patients taking iodine will show a false reaction with the chloroform, which,

in the presence of iodine, is colored violet and not blue as with the indican. A confirmatory test may be made, identifying the iodine by its characteristic reaction with starch.

Bile—Bile in the urine is always pathological. It appears whenever bile is present in the blood, that is, in jaundice from any cause. Bile may appear in the urine before the jaundice is apparent in the skin. Bile salts and bile pigments usually appear together and tests for bile pigments usually suffice for both. A greenish-yellow urine, which when shaken shows a persistent yellow froth, is typical of bile.

Tests—*Gmelin's Test*—Superimpose the urine upon nitric acid in a test tube. If bile is present, a dark green color will appear at the point of contact.

Smith-Rosen Test—Superimpose 2 cc. of Smith's reagent, which is a 1 per cent alcoholic solution of iodine, upon about 10 cc. of urine in a test tube: an emerald green ring appearing at the point of contact indicates bile.

β-Oxybutyric Acid, and Acetone, and Diacetic Acid—These so-called ketone bodies are mostly found in acid urines and are indications of simple or complicated acidosis. Frequently they are present in diabetic urines, and when so found are considered gravely significant. They represent the failure of the diabetic patient to completely oxidize the fats. These ketone bodies, end products of incompletely consumed fats, appear in excess in the blood, and are transferred to the kidneys for excretion. Fasting, anesthesia, etc., produce a temporary acidosis, with its acetonuric signs.

Diacetic Acid—*Gerhardt's Test*—To about 5 cc. of urine add solution of ferric chloride, drop by drop, until no more precipitate forms. If diacetic acid is present, a violet-red or Bordeaux-red is produced. A variety of drugs or their derivatives, notably the salicylates, give a positive reaction when present in urine, so that a positive result only indicates the possible presence of diacetic acid. If confusion due to drugs is suspected, boil the red solution from two to three minutes; if the color is due to diacetic acid, it should disappear during boiling, and not reappear on cooling. Still better, as a confirmatory test for the presence of interfering substances, boil the urine and cool before the reagent is added: the diacetic acid will be driven off, but salicylates are fixed, and when the reagent is added, the color will be apparent.

Acetone—As with diacetic acid, this test must not be applied to heated urine, because of its volatility.

Lange's Test—To 5 cc. of urine, add a few drops of a freshly prepared saturated solution of sodium nitroprusside and then 5 cc. of a 20 per cent solution of sodium hydroxide. At this state, acetone will indicate its presence by a permanent crimson color. However, to confirm its presence, add a few cc. of glacial acetic acid to the well-shaken mixture: a purple color indicates acetone.

A test using more easily available reagents is the following:

Half fill a test tube with urine and add 1 cc. each of an aqueous solution of iodine and ammonia water: a black precipitate of nitrogen iodide forms and gradually disappears. If acetone is present, iodoform is formed, and is recognized by its odor, yellow color, and the microscopic appearance of its crystals, which are hexagonal plates. It should be noted, however, that ethanol (ethyl alcohol) in urine will produce the same reaction.

Chlorides—Occasionally a request is made for a quantitative determination of the chlorides in urine. Normally the chloride excretion is about 15 Gm. per day.

Modified Volhard Method—Pipette 5 cc. of urine into a small dish and add about 20 cc. of distilled water. Precipitate the chlorides by the addition of exactly 10 cc. of the standard silver nitrate solution (indicated below) and

add 2 cc. of ferric ammonium sulphate T.S. Add from a burette standard ammonium thiocyanate solution (indicated below) until the first trace of yellow shows throughout the mixture on stirring. By subtracting the number of cc. of ammonium thiocyanate solution required to exactly precipitate the chloride from ten (the amount of silver nitrate solution added), and multiplying by 0.01, the number of Gm. of sodium chloride in 5 cc. of urine will be obtained. From this the total chloride excretion for the twenty-four hour specimen may be computed.

Example: Suppose a twenty-four hour urine specimen measured 1500 cc. It required 6.2 cc. of the ammonium thiocyanate solution and this, subtracted from ten, the amount of silver nitrate solution taken, indicates 3.8 cc. of the silver nitrate solution to precipitate the chlorides present. Multiply this by 0.01 Gm. (1 cc. of the standard silver nitrate equals 0.01 Gm. of sodium chloride); the result shows 0.038 Gm. of sodium chloride in 5 cc. of the urine. In 1500 cc. of urine there will then be 300 times 0.038 Gm. of sodium chloride, or 11.4 Gm. of sodium chloride in the 1500 cc. of urine.

The standard test solutions required for the above test are as follows:

Standard Silver Nitrate Solution—Dissolve 29.06 Gm. of silver nitrate in distilled water and make up to 1000 cc. with distilled water. Each cc. of such a solution is equivalent to 0.01 Gm. of sodium chloride.

Indicator—Dissolve 100 Gm. of crystalline ferric ammonium sulphate in 100 cc. of 25 per cent nitric acid.

Standard Ammonium Thiocyanate Solution—Dissolve about 13 Gm. of ammonium thiocyanate in 800 cc. of distilled water. Titrate this solution against the standard silver nitrate solution, and adjust its volume by adding distilled water, so that it is exactly equivalent to the silver nitrate solution.

MICROSCOPIC EXAMINATION

The microscopic examination of urinary sediments requires considerable practice and a keen sense of visual appreciation. The novice and the careless frequently report the presence of urinary sediments of blood, when blunted calcium oxalate crystals or small white cells are really present; or he may report casts simulated by odd shaped epithelia or all manner of odd foreign matter which may be accidentally present. The novice in urinalysis frequently insists on finding pathologic factors when none are present. In the search for significant criteria in the clinical laboratory, the technician must be ever on guard against pre-formed judgments, and against bias and undue imaginings. The safe dictum in the laboratory always is:

"Report exactly what is found—not a whit more—not a whit less."

The value of the microscopic examination of the urine is of exceeding importance from a diagnostic point of view, often more so than the chemical examination. To determine the nature of the insoluble constituents of the urine it is necessary to find a way of collecting these into a sediment which can then be examined microscopically. This can be accomplished by allowing the urine to settle in a conical glass or, much more expeditiously, by centrifuging. This is done by pouring the urine into a conical tube and whirling in the centrifuge (see page 229) at a fair speed for a few minutes. At the end of this time, take the tube out of the centrifuge and introduce a pipette into the bottom of the tube, a finger being placed over the upper opening of the pipette so as not to allow any urine to enter the pipette while it is being lowered to the bottom of the tube. When the pipette touches the bottom, remove the finger and the deposit will flow into the pipette. Again close the upper end of the pipette,

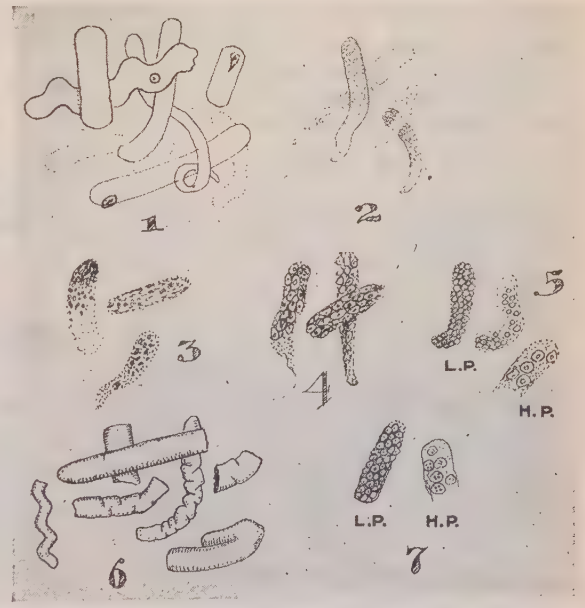
withdraw it, place a drop of the sediment on a clean microscopic slide and place a cover glass over the sediment. It is well to examine the sediment first under the low power of the microscope, care being taken that much of the light is shut off. Casts are not easily seen in the presence of much illumination. Then examine the sediment under the high power, using a dry lens. In this way any suspicious elements noted under the low power may be clearly seen under the high power. When the urine is to be examined for bacteria, etc., these sediments are dried, stained, and examined under an oil-immersion lens. For a discussion of staining methods any standard textbook on bacteriology may be consulted.

Sediments are generally considered in two groups, the organized and the unorganized sediments.

Organized Sediments—These may be roughly classed as follows:

Casts (see Fig. 520) are molds of the uriniferous tubules. Their presence in numbers indicates a diseased kidney, particularly when the albumin content is pronounced. Often a slight toxic condition of the body will cause a few casts to appear for a time in the urine. It may be generally accepted, however, that normal urine contains no casts.

Fig. 520



Casts

1. Hyaline casts.
2. Fine granular casts.
3. Coarse granular casts.
4. Epithelial casts.
5. Blood cell casts (low and high power).
6. Waxy casts.
7. Pus cell casts (low and high power).

Casts are cylindrical, finger-shaped bodies, of varying length. They appear in the urine when the kidney is affected by nephritis, circulatory changes, or toxic irritants. The same causes which produce albuminuria are responsible for casts. They are usually found together, though either may be found without the other.

Hyaline Casts—These are homogeneous and so transparent that the illumination must be considerably cut down in order to see them. They vary much in size, some being very small. They appear with less provocation than other varieties of casts, being found in temporary irritation of the kidneys, after anesthesia, etc. They appear also in connection with other varieties in all forms of nephritis, and may be the only form of cast found in advanced interstitial nephritis.

Granular Casts—The substance of this cast appears finely or coarsely granular and more or less dark looking. Sometimes the base of the cast seems to be hyaline with granules partly filling the clear substance. Granular casts indicate a definite lesion of the kidney and seldom appear except in nephritis. The coarsely granular cast has a more serious significance than the finely granular.

Waxy Casts—These casts are opaque and homogeneous and have a tendency to break off square at the end. They are sometimes twisted or bent and often show transverse cracks. They appear in advanced nephritis and are of serious significance. In acute nephritis, a cast called by many writers "fibrinous" is occasionally found which is difficult to distinguish from "waxy". It is apt to be yellowish or brownish in color.

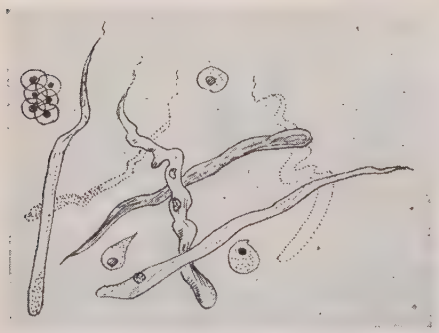
Epithelial Casts—The cells of the tubules or other epithelia compose or cover these casts. Sometimes a hyaline or granular base appears. Sometimes the cast seems entirely formed of epithelial cells.

Blood-cell Casts—These casts are covered by or formed of red blood cells. They appear whenever there is exudation of blood into the kidney tubules, as in acute nephritis.

Pus Casts—A few leukocytes may be attached to casts of any variety, but true pus casts are formed entirely of pus cells. They are found in pyelonephritis, and are always of grave significance.

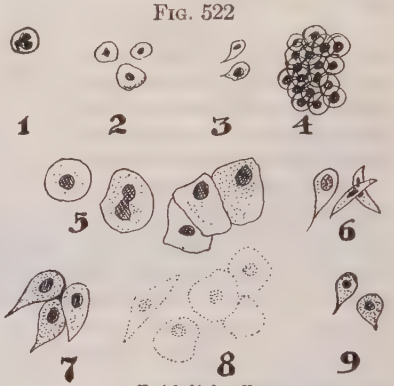
Fatty Casts—These consist of masses of fat globules. They are the product of fatty degeneration of epithelial cells

FIG. 521



Cylindroids
(Few epithelial cells in field)

FIG. 522



Epithelial cells

1. Leukocyte (pus cells) for comparison.
2. Renal cells.
3. Superficial renal pelvic cells.
4. Cells from calices of kidneys.
5. Bladder cells (squamous).
6. Cells from ureter.
7. Bladder cells.
8. Scaly bladder epithelium.
9. Epithelia from prostatic urethra.

composing epithelial casts. If the degeneration is only partial and the cells can still be made out, they usually are called epithelial. They appear in both acute and chronic parenchymatous nephritis.

Pus, blood, and epithelial cells may be found in the same cast. It will take its name from the predominating cells or be called a mixed-cell cast.

CYLINDROIDS (see Fig. 521) are bodies of the apparent composition of hyaline casts, only less solid. One end appears to be molded and the other end stringy and fine. They are considered as being of little significance.

EPITHELIAL CELLS (see Fig. 522)—Some of these are always present. The portion of the urinary tract from which the cells come cannot be definitely located even by those unusually expert in tissue diagnosis. They are of three general types:

Squamous—Large, thin, flat, leaf-like cells, often in sheets; rather small, round nucleus. They come from the bladder, urethra, or vagina.

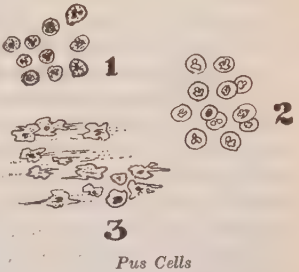
Irregular Cells—Caudate, pyramidal, cylindrical; may come from deep layers of epithelium anywhere in the tract.

Round Cells—Small round cells with comparatively large nuclei, often

slightly granular. These include the renal cells, but cells similar in appearance may come from other portions of the tract. Such cells are not common in normal urine. It is well to report the presence of undue numbers of epithelial cells but not to attempt a description of their origin.

Leukocytes or Pus Cells (see Fig. 523)—These are about twice as large as red blood cells, round granular, with irregular nuclei indistinct or invisible. They may be much or little degenerated. The addition of acetic acid to the slide will clear up the nuclei and make their characteristics more distinct. An occasional leukocyte may be found in normal urine.

Fig. 523



Pus Cells

1. Usual appearance.
2. After addition of acetic acid.
3. Disintegrated pus cells, as in the residual urine of cystitis.

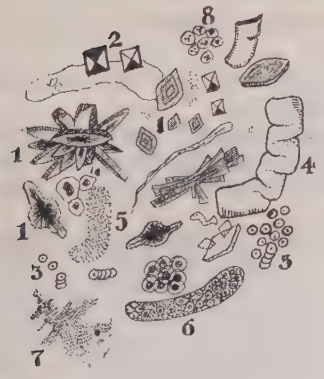
Sources of pus: Urethritis, cystitis, pyelitis, from various bacterial causes, including gonococci and tubercle bacilli. In nephritis a few pus cells may be present.

Erythrocytes or Red Blood Cells—These appear in the urine as the normal biconcave or crenated erythrocyte.

The pathological conditions in which erythrocytes are found in the urinary sediment are as follows:

Hemorrhage of the kidney, of the urinary tract, and from congestion.

Fig. 524



Sediments from acid urine (pathologic)

1. Uric acid crystals.
2. Calcium oxalate crystals.
3. Red blood cells (erythrocytes).
4. Waxy cast.
5. Fine granular cast.
6. Epithelial cast.
7. Amorphous urates.
8. Pus cells.

Fig. 525

Sediments from alkaline urine (pathologic)

1. Thorn apple crystals of ammonium urate.
2. Triple phosphate crystals.
3. Pus cells.
4. Fine granular cast.
5. Coarse granular cast.
6. Hyaline cast.
7. Bacteria.
8. Cylindroid.
9. Cells from calices of kidney.
10. Calcium phosphate crystals.

In the female their presence is not of diagnostic importance as with the male, where they are most frequently indicative of calculus (kidney stone).

Chemical Test for Blood—This is sometimes requested. Either of these two methods may be used for its detection.

Benzidine Test—To about 3 cc. of a saturated solution of benzidine in glacial acetic acid, add an equal volume of solution of hydrogen dioxide and 1

or 2 cc. of the urine to be examined. Shake the tube; in the presence of blood, a blue or green color develops. A control should always be made, using distilled water instead of urine. This is a very sensitive test.

Guaiac Test—Place about 5 cc. of urine in a test tube and add a freshly prepared alcoholic solution of guaiac (1 to 60) until the whole becomes turbid. Then add solution of hydrogen dioxide or old oil of turpentine; a blue color will appear if blood is present.

Unorganized Sediments—These are generally regarded as having but little significance. However, their presence in urine is reported by the analyst, and to the physician such a report may be of diagnostic assistance. A rather complete list of the unorganized sediments (see Figs. 524 and 525), includes the following: *magnesium ammonium phosphate, calcium oxalate, calcium phosphate, calcium sulphate, calcium carbonate, uric acid, urates, cystine, cholesterol, hippuric acid, leucine, and tyrosine.*

The following notes represent rather fully what little there is of diagnostic value in the recognition of the unorganized sediment.

The commonest crystal sediments are the phosphates, urates, oxalates, and uric acid. The phosphates and urates may appear as amorphous sediments, the latter readily dissolving when heated, and the former promptly dissolving upon the addition of acetic acid. Calcium oxalate crystals are generally found in acid urine and are frequently the result of eating rhubarb, asparagus, etc. They are encountered in a variety of forms, as are most of the crystals in urine.

Urates may appear as ammonium, calcium, magnesium, potassium, and sodium urate. The calcium, magnesium, potassium, and sodium urates appear in acid urines, while the sediment of ammonium urate appears in neutral, alkaline, or acid urines.

Sodium urate may be amorphous or crystalline. When crystalline, it appears in sheaves or clusters of colorless needles.

Ammonium urate generally appears in the burr-like form of the "thorn apple", which appears to be balls with spicules attached.

Uric acid crystals, found only in acid urine, are generally amber or brown in color, are found clumped or in single crystals, of an oval tablet shape. They are not readily mistaken for any other crystal formation because of their characteristic pigmentation.

All the crystal forms are illustrated and should be well studied so that identification will be readily made.

CHAPTER LXXXVII

CHEMICAL ASSAY METHODS

EVEN a brief survey of the chemical assay methods of the U. S. P. X reveals the fact that the pharmacist of today is required to possess a rather wide range of chemical knowledge. In the following pages will be found a classified study of the chemical assay processes that the pharmacist is called upon to understand if he is to become a competent analyst.

The assay processes of similar type are considered together, since by associating them in this manner the user will more easily grasp the principles underlying each class of assays. Complex and involved calculations have been omitted so that attention may be concentrated upon the chemical and physical facts involved. A fair knowledge of elemental chemistry and physics is necessary and it is assumed that the student has previously learned what is meant by molecular weights, and their quantitative application to chemical reactions, and it must be remembered that molecular weights represent the proportions in which chemicals react, as it is from these weights that the factors and equivalents given in the texts of the assays have been calculated (see pages 527 to 543).

With this basic knowledge of chemistry and a careful study of the explanations which follow, the pharmacist should be able to understand the various official chemical assay methods and be able to successfully carry out the processes. In every case the official assay method must be strictly followed.

It has been found convenient to arrange the assay processes in four main divisions as follows:

1. Volumetric Assay Methods.
2. Gravimetric Assay Methods.
3. Gasometric Assay Methods.
4. Special Assay Methods.

VOLUMETRIC ASSAY METHODS

This is the most frequent type of assay encountered by the pharmacist in pharmacopœial standardization. Every volumetric determination is based upon the volume of a solution of known strength which is required to complete a chemical reaction with the substance under examination. Such a solution is called a *standard solution* or a *volumetric solution* and is often referred to by means of the abbreviation "V.S.", or in terms of what is called *normality*.

Indicators—It is important to guard against the use of an insufficient amount of a volumetric solution, thus failing to complete a reaction and it is equally necessary to guard against over-stepping a reaction by adding too much of the volumetric solution. To meet this situation an interesting group of chemicals called *indicators* is used. An indicator is a substance that shows the end-point of the reaction, either by a change in the color or by the formation of a precipitate.

Each indicator test solution used in acidimetric or alkalimetric tests must be examined for its sensitiveness. The indicator test solution, unless otherwise directed, should be so adjusted that when 0.15 cc. of the indicator is added to 25 cc. of distilled water, 0.5 cc. of hundredth-normal acid or alkali, respectively, will distinctly develop the characteristic color changes.

Indicator test solutions are injured by exposure to light and should be preserved in dark amber-colored vials. Test papers should be kept in dark bottles. A typical indicator bottle with dropping stopper is shown in Fig. 526.

The indicators most commonly used and recognized by the U. S. P. are as follows:

Brom Cresol Purple (*Dibromo-orthocresol-sulphonphthalein*)—$(OH.C_6H_2Br CH_3)_2CO.C_6H_4SO_2$—Light pink to yellowish crystals (melting point from 241° to 242° C. uncorrected), soluble in alcohol, water, and in solutions of alkali hydroxides and carbonates. Alkaline solutions of brom cresol purple are colored deep purple and exhibit dichromatism, *i.e.*, predominance of red in thick layers and of blue in thin layers. The color is changed to yellow on the addition of acids.

Fig. 526

Indicator bottle

Brom Cresol Purple Test Solution—In an agate mortar, grind 0.1 Gm. of the dry powder with 9.5 cc. of fiftieth-normal sodium hydroxide. When solution is complete, dilute to 250 cc. with boiled-out and cooled distilled water.

This test solution should be deep orange to wine-red in color. If it is purple, the addition of not more than 0.5 cc. of fiftieth-normal acid (to the 250 cc.) should make it wine-red; and if it is yellow, the addition of not more than 0.5 cc. of fiftieth-normal alkali should produce the wine-red coloration. The pH range is from yellow, 5.2 to 6.8, purple. Preserve in glass-stoppered bottles.

Cochineal Test Solution—Macerate 1 Gm. of unbroken cochineal (page 842) during four days with 20 cc. of alcohol and 60 cc. of distilled water, then filter. The color of this test solution is turned violet by alkalies, and yellowish-red by acids. Cochineal T.S. is used in titrating alkaloids.

Litmus—A blue pigment prepared from various species of *Roccella* De Candolle. In blue cubes, masses, fragments, or granules, partly soluble in water and in alcohol.

Litmus Paper—For blue litmus paper, impregnate sheets of white filter paper with litmus T.S. and dry by suspending them on clean cord in a neutral atmosphere.

For red litmus paper, add to litmus T.S. just sufficient of a highly diluted solution of hydrochloric acid to impart to it a faint red tint, impregnate, and dry sheets of filter paper as directed above. The impregnated sheets after drying may be cut into strips as desired. Litmus test papers should respond quickly to one drop of two-hundred-and-fiftieth-normal acid or alkali, respectively. Preserve in well-stoppered bottles.

Litmus Test Solution—Exhaust 25 Gm. of powdered litmus with three successive portions of 100 cc. each of boiling alcohol, continuing each extraction for about one hour. Filter, wash with alcohol and discard the alcoholic filtrate. Digest the residue with about 25 cc. of cold distilled water and filter. Discard this filtrate also. Finally extract the residue with 125 cc. of boiling distilled water and, after thoroughly cooling, filter. Litmus turns red with acids and blue with alkalies. The pH range is from red, 4.5 to 8.3, blue. Litmus is unsuitable for determining alkaloids, carbonates, or bicarbonates. Preserve the filtrate in wide-mouthed bottles, stoppered with loose plugs of purified cotton.

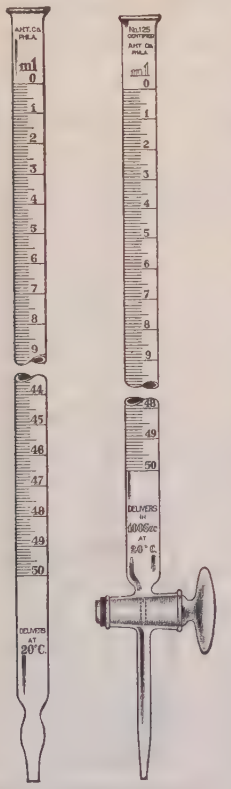
Methyl Orange (*Tropæolin D., Dimethylaniline Orange*)—The sodium salt of paradimethylaminoazobenzene sulphonic acid, $(CH_3)_2$–N–C_6H_4–N = N–C_6H_4. SO_3Na. An orange-yellow powder, slightly soluble in cold water, insoluble in alcohol.

Methyl Orange Test Solution—Dissolve 0.1 Gm. of methyl orange in 100 cc. of distilled water. Methyl orange turns from orange to rose-red with acids, and to yellow with alkalies. This indicator is not suitable for determining organic acids or alkaloids, nor should it be used in alcoholic or in very hot solutions. The pH range is from orange-red, 3.1 to 4.4, yellow.

Methyl Red (*Paradimethylaminoazobenzeneorthocarboxylic Acid*) $(CH_3)_2$–N–C_6H_4–N = N–C_6H_4.COOH—Violet crystals sparingly soluble in cold water, soluble in alcohol.

Methyl Red Test Solution—Dissolve 0.2 Gm. of methyl red in 100 cc. of alcohol. Methyl red turns from red with acids to yellow with alkalies. This solution is unsatisfactory for the determination of carbonates or bicarbonates. It is very satisfactory for many alkaloids. The pH range is from red, 4.2 to 6.3, yellow.

FIG. 527 FIG. 528

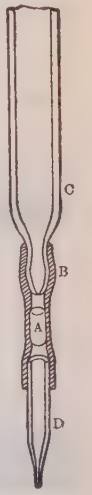


Ordinary burette Glass-valved burette

Phenol Red (*Phenolsulphonphthalein*)—Use *Phenolsulphonphthaleinum*, page 846.

Phenol Red Test Solution—In an agate mortar, grind 0.1 Gm. of the dry powder with 14.5 cc. of fiftieth-normal sodium hydroxide. When solution is complete, dilute to 250 cc. with boiled-out and cooled distilled water. Filter off the insoluble residue. The zone of color transformation of this indicator is from yellow, pH 6.8 to 8.4, red. Preserve in a glass-stoppered bottle.

FIG. 529



Dropping device for burette

Phenolphthalein—Use *Phenolphthaleinum*, page 821.

Phenolphthalein Test Solution—Dissolve 1 Gm. of phenolphthalein in 100 cc. of alcohol. Phenolphthalein is colorless with acids and turns red with alkalies. This test solution is not satisfactory for determining alkaloids, ammonia, carbonates, or bicarbonates in cold solutions. The pH range is from colorless, 8.3 to 10.0, red.

Phenolphthalein Test Paper—Impregnate sheets of white unsized paper with phenolphthalein T.S., dry, and cut into strips of a suitable size. Preserve as directed under litmus paper.

Titration—To *titrate* means to pass a measured volume of a standard solution out of a measuring apparatus called a *burette* into another solution containing the substance, the purity of which is being determined. The performance of this act is spoken of as "carrying out a titration".

Figs. 527 and 528 illustrate two types of burettes. The style shown in Fig. 527 is usually fitted with the dropping device illustrated in Fig. 529. A tightly fitting piece of glass rod (A) is slipped into a section of rubber tube and this connects the burette and glass dropping point. By pinching the tube about "A" the flow of the solution may be accurately controlled.

Figs. 530 and 531 illustrate the usual form of burette stand. Fig. 532 combines the container of the volumetric solution and the stand and is very convenient when large amounts of a solution are to be used.

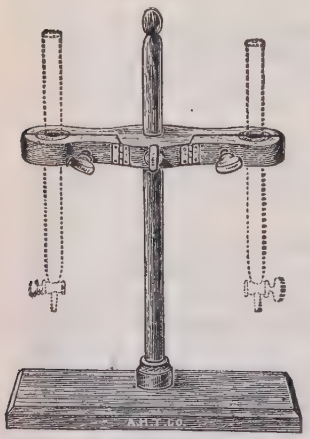
The standard or volumetric solutions used in these titrations contain, in

a given volume, a weight of a dissolved substance which bears a direct relation to its molecular or reacting weight. All normal solutions are equal to each other, volume for volume, in reacting strength, yet rarely, if ever, do any two normal solutions agree in percentage strength, by weight. In one liter of a normal volumetric salt solution there is dissolved the molecular weight of that substance, expressed in grams, divided by its hydrogen equivalent. The application of this statement in preparing volumetric solutions is explained by a consideration of the following equations:

$$\underset{\text{sodium hydroxide}}{NaOH} + \underset{\text{hydrochloric acid}}{HCl} = \underset{\text{sodium chloride}}{NaCl} + \underset{\text{water}}{H_2O}$$

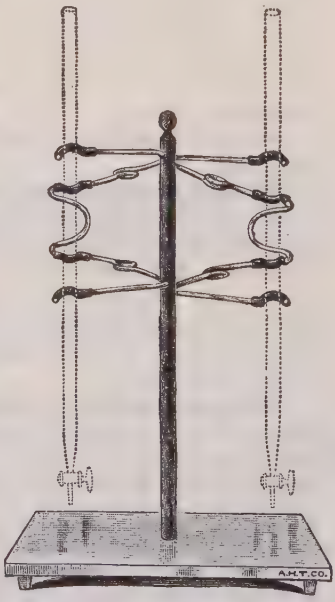
The hydrogen equivalent of both sodium hydroxide and hydrochloric acid is observed to be one. The molecular weight of sodium hydroxide is about forty, and of hydrochloric acid about thirty-six. Therefore, 40 Gm. of 100 per cent sodium hydroxide are required to be dissolved in sufficient distilled water to form one liter of a normal volumetric solution of sodium hydroxide. In one liter of a normal hydrochloric acid solution 36 Gm. of 100 per cent hydrochloric acid

Fig. 530



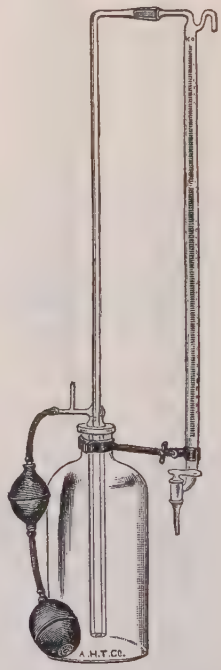
Burette stand

Fig. 531



Burette stand

Fig. 532



Burette stand with stock of V. S. and filler

are required. It follows then that just as forty parts of sodium hydroxide react with thirty-six parts of hydrochloric acid so will one liter of normal sodium hydroxide volumetric solution react with one liter of normal hydrochloric acid volumetric solution.

$$\underset{\text{sodium hydroxide}}{2NaOH} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{sodium sulphate}}{Na_2SO_4} + \underset{\text{water}}{2H_2O}$$

Since one molecule of sulphuric acid contains two atoms of replaceable hydrogen and reacts with two molecules of sodium hydroxide, its hydrogen

equivalent is clearly two instead of one. It follows then that a liter of normal solution of sulphuric acid should contain not 98 Gm. of the 100 per cent acid, corresponding to its molecular weight, but one-half of that amount, or 49 Gm. Such a solution will react with all other normal solutions, volume for volume.

There are times when the hydrogen equivalent is determined only from a knowledge of the work that a chemical substance is required to perform. Potassium dichromate, for example, is invariably used as an oxidizing agent and as such each molecule is capable of liberating six atoms of iodine from potassium iodide, as follows:

$$\underset{\text{potassium dichromate}}{K_2Cr_2O_7} + 6KI + \underset{\text{sulphuric acid}}{7H_2SO_4} = \underset{\text{potassium sulphate}}{4K_2SO_4} + \underset{\text{chromic sulphate}}{Cr_2(SO_4)_3} + \underset{\text{iodine}}{3I_2} + \underset{\text{water}}{7H_2O}$$

The hydrogen equivalent of iodine is one, since each atom combines with an atom of hydrogen to form a molecule of hydriodic acid. It will be observed from the above equation that the hydrogen equivalent of potassium dichromate is six, since each molecule of the dichromate displaces six atoms of iodine from an iodide. Thus, the amount of potassium dichromate dissolved in a liter to form a normal solution corresponds to one-sixth of its molecular weight as expressed in grams.

A *tenth-normal solution* is only one-tenth as concentrated as a normal solution of that particular substance and is generally indicated by means of the expression "$\frac{N}{10}$"; the *fiftieth-normal solutions* are one-fiftieth the normal concentration and are indicated by "$\frac{N}{50}$"; a *two-hundredth normal* solution is referred to as "$\frac{N}{200}$"; while *double-normal solutions* are of twice the normal concentration and are designated by the expression "$\frac{2}{N}$".

With this understanding the volumetric assays will be considered in their appropriate groupings.

Assay Methods Based Upon the Principle of Neutralization.

The following official substances are required to be assayed by direct titration with normal sodium hydroxide:

Using phenolphthalein as the indicator—*Acetic Acid, Diluted Acetic Acid, Glacial Acetic Acid, Boric Acid, Citric Acid, Tartaric Acid, Trichloracetic Acid, Potassium Bitartrate and Sodium Biphosphate.*

Using methyl orange as the indicator—*Hydrochloric Acid, Diluted Hydrochloric Acid, Hypophosphorous Acid, Nitric Acid, Sulphuric Acid, and Diluted Sulphuric Acid.*

Each of the above substances is titrated in aqueous solution, with the exception of boric acid which is dissolved in a mixture of equal parts of water and glycerin.

The following are dissolved in neutral alcohol and titrated with tenth-normal sodium hydroxide, phenolphthalein being used as indicator:

Cinchophen, Eucaine Hydrochloride.

To an accurately weighed portion of the substance, in solution, the indicator is added and the mixture titrated with the standard alkali until the indicator shows by a change in color that the end of the reaction has been

reached. The following equation will serve as an illustration of all of the above acid substances to which this type of assay process is applied:

$$\underset{\text{nitric acid}}{HNO_3} + \underset{\substack{\text{sodium}\\\text{hydroxide}}}{NaOH} = \underset{\substack{\text{sodium}\\\text{nitrate}}}{NaNO_3} + \underset{\text{water}}{H_2O}$$

Cinchophen and eucaine hydrochloride are dissolved in neutral alcohol because of their sparing solubility in water. Sodium chloride is added to the solution of sodium biphosphate in order to prevent ionization and thereby secure a sharper and more reliable end-point. The results are easily calculated by making use of the equivalents given in the official text.

The following acid is assayed by direct titration with normal potassium hydroxide in the presence of phenolphthalein as the indicator:

Formic Acid—The formic acid is neutralized in the titration with the formation of potassium formate according to the following equation:

$$\underset{\text{formic acid}}{HCOOH} + \underset{\substack{\text{potassium}\\\text{hydroxide}}}{KOH} = \underset{\substack{\text{potassium}\\\text{formate}}}{HCOOK} + \underset{\text{water}}{H_2O}$$

The number of cc. of normal potassium hydroxide used is then converted into the weight of formic acid found, by means of the factor given in the N. F. text.

Residual Titrations with Excess of Alkali.

Residual titrations of this group, are those in which the substance being assayed is treated with an excess of standard sodium hydroxide solution, the amount of excess being estimated by subsequent titration with standard acid solution of the same degree of normality.

Acetylsalicylic Acid—This substance, being both an ester and an acid, is completely neutralized and saponified by gently boiling for ten minutes with an excess of half-normal sodium hydroxide. Phenolphthalein is added as the indicator, and the excess of alkali estimated by titration with half normal sulphuric acid. A blank test is carried out, omitting the acetylsalicylic acid and the amount of half-normal alkali consumed by the sample is determined by difference.

Lactic Acid—A carefully weighed portion of the lactic acid is boiled for twenty minutes with an excess of normal sodium hydroxide in order to convert the lactones and inner anhydrides into lactate. The excess of alkali is then estimated by titration with normal sulphuric acid while the solution is still hot, using phenolphthalein as the indicator. A blank test is made, omitting the lactic acid, and, by comparison, the amount of normal alkali consumed by the lactic acid is determined.

Aromatic Sulphuric Acid—This acid is first treated with an excess of normal sodium hydroxide and the mixture evaporated to dryness to remove the interfering volatile organic matter. The residue is dissolved in distilled water, methyl orange added as the indicator, and the solution titrated with normal sulphuric acid.

Solution of Formaldehyde and Paraformaldehyde—Both solution of formaldehyde and of paraformaldehyde are oxidized to formic acid by warming with a solution of H_2O_2, in the presence of an excess of normal sodium hydroxide which immediately converts the formic acid into sodium formate. The mixture is cooled, litmus is added as the indicator, and the excess of alkali estimated by titrating with normal sulphuric acid. The difference between the number of cc. of normal alkali and of normal acid used, represents the number of cc.

of normal sodium hydroxide that are equivalent to the formic acid obtained from the solution of formaldehyde (or from the paraformaldehyde) originally taken. The oxidation of formaldehyde to formic acid is shown by the following equation:

$$\underset{\text{formaldehyde}}{HCHO} + \underset{\substack{\text{hydrogen}\\\text{dioxide}}}{H_2O_2} = \underset{\text{formic acid}}{HCOOH} + \underset{\text{water}}{H_2O}$$

It is difficult to obtain a sharp and dependable end-point by the direct titration of substances like the above with standard alkali. For this reason a completed reaction is assured by adding more than the required amount of standard sodium hydroxide solution. The excess of free alkali is then conveniently estimated by titrating with a standard acid solution of the same volumetric concentration, in the presence of the appropriate indicator.

Calcium Lactophosphate—The conditions in this assay are such as to bring about the precipitation of the phosphate radical as ammonium phosphomolybdate. This precipitate is washed and then dissolved in an excess of half-normal sodium hydroxide. The reaction that takes place is illustrated by the following equation:

$$\underset{\text{ammoniumphosphomolybdate}}{2(NH_4)_3PO_4.12MoO_3} + \underset{\substack{\text{sodium}\\\text{hydroxide}}}{46NaOH} = \underset{\substack{\text{di-ammonium}\\\text{phosphate}}}{2(NH_4)_2HPO_4} + \underset{\substack{\text{ammonium}\\\text{molybdate}}}{(NH_4)_2MoO_4}$$

$$+ \underset{\text{sodium molybdate}}{23Na_2MoO_4} + 22H_2O$$

The excess of alkali is then estimated by titration with half-normal hydrochloric acid, phenolphthalein serving as the indicator. The amount of half-normal sodium hydroxide consumed is then determined by difference and is converted into terms of P_2O_5 by using the factor given in the N. F. text.

Assays by Neutralization with Sulphuric Acid.

The following official substances are assayed by direct titration with sulphuric acid volumetric solution:

Ammonium Carbonate, Ammonia Water, Stronger Ammonia Water, Lime Water, Potassium Carbonate, Potassium Bicarbonate, Sodium Bicarbonate, Monohydrated Sodium Carbonate.

In the estimation of lime water, tenth-normal sulphuric acid is employed, as the standard solution, and the indicator is phenolphthalein. All of the others are titrated with normal sulphuric acid, using methyl orange as the indicator.

The above alkaline substances are easily determined by utilizing their ability to neutralize acids. The standard acid solution neutralizes their alkalinity to form neutral sulphates and water as exemplified by the following equation:

$$\underset{\substack{\text{potassium}\\\text{carbonate}}}{K_2CO_3} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\substack{\text{potassium}\\\text{sulphate}}}{K_2SO_4} + \underset{\substack{\text{carbon}\\\text{dioxide}}}{CO_2} + \underset{\text{water}}{H_2O}$$

Assay of Alkali Salts of Organic Acids.

In this type of assay the organic salts of metals are first converted into carbonates by ignition and then estimated by means of sulphuric acid volumetric solution. The following are assayed by this method:

Solution of Potassium Citrate and Solution of Sodium Citrate—The solvent is first removed from these solutions by evaporation.

Potassium Acetate, Potassium Citrate, and Potassium and Sodium Tartrate, Compound Effervescing Powder—To assay for the potassium bitartrate content. Since this powder also contains sodium bicarbonate, it is necessary to subtract, from the volume of standard acid required to neutralize the ignited residue, the number of cc. of standard acid required to neutralize the sodium bicarbonate also present in the weight of material taken. This is previously determined before the material is ignited.

Sodium Acetate, Sodium Citrate, Lithium Citrate, and Lithium Salicylate—In each of the above determinations the standard acid solution used is half-normal sulphuric acid and the indicator is methyl orange. The following directions from the U. S. P. X apply to all of these determinations:

"Heat about 2 Gm. of the salt, accurately weighed, in a platinum or porcelain crucible, heating at first very gently, then gradually raising the temperature until the salt is thoroughly carbonized. (*Caution—Do not use platinum crucibles for lithium salts.*) The final temperature must not exceed a dull red heat and the flame of the burner must not come into contact with the carbonized mass. After allowing the carbonized mass to cool, moisten with distilled water, ignite again, and repeat the moistening and igniting until a white residue is obtained. Then disintegrate the ignited mass with the aid of a stout glass rod and transfer the mass and crucible to a beaker. Add 50 cc. of distilled water and titrate with half-normal sulphuric acid, using methyl orange T.S. as indicator. The number of cc. of half-normal sulphuric acid used, multiplied by the proper equivalent of the salt, represents the amount of salt present in the quantity taken."

The change that takes place in the ignition of a salt of this type may be shown in a general way, by the following equation:

$$\underset{\text{potassium acetate}}{2KC_2H_3O_2} + \underset{\text{oxygen}}{4O_2} = \underset{\text{potassium carbonate}}{K_2CO_3} + \underset{\text{carbon dioxide}}{3CO_2} + \underset{\text{water}}{3H_2O}$$

The product of the ignition, namely potassium carbonate, is then neutralized by titrating with a standard acid solution according to the following equation:

$$\underset{\text{potassium carbonate}}{K_2CO_3} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

Strontium Salicylate—In this assay the residue of carbonate is dissolved in standard hydrochloric acid, rather than sulphuric acid. The assay is related, in principle, to those explained above.

Assays by Neutralization with Barium Hydroxide.

The following substances are required to be determined by titration with tenth-normal barium hydroxide volumetric solution:

Benzoic Acid—Because of its sparing solubility in water, benzoic acid is dissolved in neutral alcohol. After adding the indicator the solution is ready for titration with the standard barium hydroxide.

Salicylic Acid—The explanation for this assay is similar to that just given for benzoic acid.

Ammonium Benzoate, Caffeine Sodio-Benzoate, Ammonium Salicylate, and Theobromine Sodio-Salicylate—These are first dissolved, then decomposed by sulphuric acid, and the separated organic acid is extracted with successive portions of chloroform. After removing the chloroform by evaporation, the acid is dissolved in neutral alcohol and then titrated by the standard barium hydroxide

solution. This method applies only to the estimation of the organic acids present, the caffeine and the theobromine being first removed and estimated by a gravimetric method explained (see page 1476).

The indicator used in all of the above determinations is phenolphthalein. Standard barium hydroxide solution is more satisfactory than a standard solution of a caustic alkali for titrating benzoic and salicylic acids because a sharper end-point is obtained. The reaction that takes place in a titration of this type is illustrated by the following equation:

$$\underset{\text{benzoic acid}}{2HC_7H_5O_2} + \underset{\substack{\text{barium}\\\text{hydroxide}}}{Ba(OH)_2} = \underset{\substack{\text{barium}\\\text{benzoate}}}{Ba(C_7H_5O_2)_2} + \underset{\text{water}}{2H_2O}$$

Residual Titrations with Excess of Sulphuric Acid.

In assay methods of the residual type, more than sufficient standard acid is added and the excess determined by titration with standard alkali.

Solution of Ammonium Acetate, Solution of Iron and Ammonium Acetate, Ammonium Phosphate, and Sulphonated Bitumen—The ammonia content in each of the foregoing is determined by first liberating the ammonia with sodium hydroxide and distilling in such a way as to receive the ammonia in an excess of standard sulphuric acid. Methyl orange is then added as the indicator and the excess of acid estimated by titrating with standard sodium hydroxide. The results are calculated to ammonium acetate in the solution of ammonium acetate, and to total ammonia in the solution of iron and ammonium acetate and in the sulphonated bitumen.

Milk of Magnesia, Magnesium Carbonate, Magnesium Oxide, and Zinc Oxide—In these four determinations the substance is dissolved in a measured excess of normal sulphuric acid, methyl orange is added as the indicator, and the excess of acid is estimated with normal sodium hydroxide.

Compound Effervescing Powder—To assay for the sodium bicarbonate content, half-normal sulphuric acid is used in excess and, after boiling off the carbon dioxide, the residual acid is estimated with half-normal sodium hydroxide, phenolphthalein serving as the indicator.

Sodium Benzoate and Sodium Salicylate—These salts are estimated in accordance with the principles described under the assay of alkali salts of organic acids, employing the residual instead of the direct method of titration. The official directions for determining these salts as given in the U. S. P. X are as follows:

"Dry about 2 Gm. of the salt to constant weight at from 100° to 110° C., weigh accurately in a platinum or porcelain crucible, and heat at first gently, then gradually raise the temperature until the salt is thoroughly carbonized. The final temperature must not exceed a dull red heat and the flame of the burner must not come in contact with the carbonized mass. Allow the carbonized mass to cool, disintegrate it well with a stout glass rod or powder carefully, and transfer with the crucible to a beaker or casserole. Add 50 cc. of distilled water and 50 cc. of half-normal sulphuric acid, cover the beaker or casserole with a watch-glass and boil for thirty minutes. Filter and wash the residue with hot distilled water until the washings cease to redden blue litmus paper. Dry the residue and filter paper and ignite as described above.

"Transfer the ignited residue to the filtrate and determine the excess of acid in the cooled filtrate by titration with half-normal sodium hydroxide, using methyl orange T.S. as indicator. The volume of half-normal sulphuric acid

consumed, multiplied by the proper equivalent of the salt, represents the amount of salt present in the quantity taken."

Zinc Stearate—A weighed portion of zinc stearate is boiled with an excess of tenth-normal sulphuric acid for ten minutes. This brings about double decomposition, forming soluble zinc sulphate and insoluble stearic acid. The mixture is cooled, then filtered to remove stearic acid, methyl orange is added, and the solution is titrated with tenth-normal sodium hydroxide to estimate the amount of sulphuric acid present in excess. The amount of tenth-normal acid consumed is determined by difference and the results are calculated to zinc oxide.

Codeine Phosphate—The free alkaloid is liberated by adding an excess of sodium hydroxide to an aqueous solution of the salt, extracting with successive portions of chloroform and removing the chloroform by evaporation. The residue of alkaloid is then dissolved in an excess of tenth-normal sulphuric acid, with the aid of a gentle heat, which assists in getting rid of any remaining chloroform. The amount of acid in excess is then estimated by adding methyl red as the indicator and titrating with tenth-normal sodium hydroxide. The amount of tenth-normal acid consumed by the alkaloid is then easily determined and the result is multiplied by the equivalent of codeine, given in the text.

Methenamine—This compound is boiled with an excess of normal sulphuric acid until the odor of formaldehyde is no longer perceptible. The heating brings about a hydrolytic decomposition of the methenamine as follows:

$$\underset{\text{methenamine}}{(CH_2)_6N_4} + \underset{\text{water}}{6H_2O} = \underset{\text{formaldehyde}}{6HCHO} + \underset{\text{ammonia}}{4NH_3}$$

The formaldehyde is expelled but the ammonia immediately combines with a corresponding amount of the normal sulphuric acid to form ammonium sulphate, according to the following equation:

$$\underset{\text{ammonia}}{4NH_3} + \underset{\text{sulphuric acid}}{2H_2SO_4} = \underset{\text{ammonium sulphate}}{2(NH_4)_2SO_4}$$

The excess of normal sulphuric acid is tnen estimated in the usual manner by titrating with normal sodium hydroxide in the presence of methyl orange as the indicator.

Prepared Calamine—The ignited calamine, consisting chiefly of zinc oxide, is warmed with a measured excess of normal sulphuric acid. To the extent that there is oxide in this residue the acid is consumed as follows:

$$\underset{\text{zinc oxide}}{ZnO} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{zinc sulphate}}{ZnSO_4} + \underset{\text{water}}{H_2O}$$

The excess of sulphuric acid is then determined by titrating with normal alkali in the presence of methyl orange as the indicator. The amount of normal sulphuric acid consumed by the calamine can then easily be determined by difference.

Lithium Carbonate—A weighed portion of this salt is dissolved in an excess of normal sulphuric acid. The change that takes place is illustrated by the following equation:

$$\underset{\text{lithium carbonate}}{Li_2CO_3} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{lithium sulphate}}{Li_2SO_4} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

The unused sulphuric acid is then estimated with normal potassium hydroxide, methyl orange being used as the indicator. The difference between the number of cc. of normal acid and normal alkali used represents the figure that is to be multiplied by the factor given in the N. F. text, the result being the weight of lithium carbonate found.

Assays by Neutralization with Hydrochloric Acid.

In the following assays the determinations involve direct titration with normal hydrochloric acid.

Potassium Hydroxide, Solution of Potassium Hydroxide, Sodium Hydroxide, and Solution of Sodium Hydroxide—Each of these four substances absorbs carbon dioxide from the air and contains varying amounts of the alkali carbonate. The presence of carbonate interferes with the accuracy of the titration. For this reason the official procedure requires that the carbonate be first removed as insoluble barium carbonate by agitating a solution of the substance in boiled and cooled distilled water with an excess of barium chloride test solution. Sufficient boiled and cooled distilled water is added to bring the mixture to a definite volume. After filtering the mixture and rejecting the first portion of the filtrate, an aliquot portion is titrated with normal hydrochloric acid, phenolphthalein being used as the indicator.

Sodium Borate and Sodium Cacodylate—Advantage is taken of the hydrolysis and subsequent alkalinity of these salts in aqueous solution. A weighed portion of the salt is dissolved in distilled water and the extent of the alkalinity is determined by direct titration with normal hydrochloric acid, methyl orange being used as the indicator. Sodium cacodylate is sometimes made neutral to phenolphthalein, but this does not affect the accuracy of the titration, since true sodium cacodylate is indifferent to phenolphthalein.

All of the above titrations are based upon the simplest type of equations involving neutralization, as for example:

$$\underset{\text{potassium hydroxide}}{KOH} + \underset{\text{hydrochloric acid}}{HCl} = \underset{\text{potassium chloride}}{KCl} + \underset{\text{water}}{H_2O}$$

Sodium Glycerophosphate—(In this case half-normal instead of normal hydrochloric acid is used.)

Sodium glycerophosphate is alkaline to methyl orange and is converted during the titration into the mono-sodium salt which is neutral to this indicator. The reaction is explained as follows:

$$\underset{\text{di-sodium glycerophosphate}}{C_3H_5(OH)_2Na_2PO_4} + \underset{\text{hydrochloric acid}}{HCl} = \underset{\text{mono-sodium glycerophosphate}}{C_3H_5(OH)_2NaHPO_4} + \underset{\text{sodium chloride}}{NaCl}$$

The factor given in the N. F. text corresponds to this equation and needs only to be multiplied by the number of cc. of half-normal hydrochloric acid used to furnish the weight of sodium glycerophosphate found.

Residual Titrations Using an Excess of Hydrochloric Acid.

These residual titrations involve the use of an excess of standard hydrochloric acid, and the subsequent estimation of this excess by titrating with standard alkali.

Calcium Lactate—This salt is first converted into calcium oxide by incineration. The oxide is then dissolved in an excess of half-normal hydrochloric acid, which is used in preference to sulphuric acid because of the sparing solubility

of calcium sulphate. The amount of acid in excess is then estimated by titrating with half-normal sodium hydroxide, methyl orange being used as the indicator.

Benzaldehyde, and Oil of Bitter Almond (for benzaldehyde content)—Phenylhydrazine reacts with aldehydes and hence is used in estimating the aldehyde content of the two foregoing substances. It is also basic in character, since it combines with acids to form salt-like bodies. In the assay of benzaldehyde, for example, an alcoholic solution of phenylhydrazine is prepared and a definite volume of this is titrated with half-normal hydrochloric acid, methyl orange being used as the indicator. Neutralization takes place as follows:

$$\underset{\text{phenylhydrazine}}{C_6H_5HNNH_2} + \underset{\substack{\text{hydro-}\\\text{chloric acid}}}{HCl} = \underset{\substack{\text{phenylhydrazine}\\\text{hydrochloride}}}{C_6H_5HNNH_2HCl}$$

To an equal volume of the same alcoholic solution of phenylhydrazine a weighed portion of benzaldehyde is added. A condensation product is formed between the phenylhydrazine and the benzaldehyde according to the following equation:

$$\underset{\text{benzaldehyde}}{C_6H_5CHO} + \underset{\text{phenylhydrazine}}{H_2NNHC_6H_5} = \underset{\text{benzal phenylhydrazone}}{C_6H_5CHNNHC_6H_5} + \underset{\text{water}}{H_2O}$$

The unused phenylhydrazine is then neutralized by adding an excess of half-normal hydrochloric acid and filtering the mixture. The amount of acid in excess is determined by titrating the filtrate and washings with half-normal sodium hydroxide, using methyl orange as the indicator. The number of cc. of half-normal hydrochloric acid that corresponds to the original benzaldehyde is then calculated from the above titrations, by difference, and the result is multiplied by the equivalent given in the text.

Oil of Lemon—Here again phenylhydrazine is employed in estimating the aldehyde *citral* which is a normal constituent. The reaction is explained by the following equation:

$$\underset{\text{citral}}{C_9H_{15}CHO} + \underset{\text{phenylhydrazine}}{H_2NNHC_6H_5} = \underset{\text{citral phenylhydrazone}}{C_9H_{15}CHNNHC_6H_5} + \underset{\text{water}}{H_2O}$$

The main features of this assay are similar to those just explained under benzaldehyde.

Residual Titration Using an Excess of Sodium Hydroxide.

These assays require the residual titration of normal sodium hydroxide by means of normal sulphuric acid, following a special reaction on the part of the alkali.

Chloral Hydrate—Normal sodium hydroxide is added in excess to an aqueous solution of the chloral hydrate and the residual alkali is estimated by titration with normal sulphuric acid, phenolphthalein being used as the indicator. When chloral hydrate is treated with caustic alkali, equal molecular proportions of chloroform and an alkali formate are produced. The assay of chloral hydrate is based upon this behavior. The following equation illustrates what takes place:

$$\underset{\text{chloral hydrate}}{CCl_3CHO.H_2O} + \underset{\substack{\text{sodium}\\\text{hydroxide}}}{NaOH} = \underset{\substack{\text{chloro-}\\\text{form}}}{CHCl_3} + \underset{\substack{\text{sodium}\\\text{formate}}}{NaCHO_2} + \underset{\text{water}}{H_2O}$$

Residual Titrations Involving Saponification of Esters.

The following residual titrations involve the saponification of an ester by means of half-normal alcoholic potassium hydroxide and the subsequent titration of the residual alkali with half-normal acid, phenolphthalein being used as the indicator.

Methyl Salicylate and Oil of Dwarf Pine Needles, Oil of Bergamot—All three of these liquids are assayed for their ester content only.

Oil of Lavender and Oil of Santal—These oils are first acetylized in order to convert the alcohols present into esters, the acetates of the corresponding alcohols, which are then determined by saponification in the usual manner.

Oil of Peppermint and Oil of Rosemary—The ester and the alcohol content of both of these oils should be determined, the ester content by the usual saponification method and the aromatic alcohol content by acetylization, followed by saponification.

Alcoholic potassium hydroxide solution is used in all of these determinations because the alcohol serves as a mutual solvent. In the assay for methyl salicylate the residual alkali is determined with half-normal hydrochloric acid, but in all the others it is determined by means of half-normal sulphuric acid.

The determinations in this group are based upon the principle that esters are capable of being saponified or hydrolyzed by the action of caustic alkali. The actual saponification is carried out with the aid of the heat of a water bath and under a reflux condenser.

In the assays requiring acetylization advantage is taken of the fact that alcohols are basic in character, and, under certain conditions, can be made to react with acids or acid anhydrides to form esters. In acetylizing the above oils their alcohols are converted into acetates by the action of acetic anhydride in the presence of anhydrous sodium acetate. When acetylization is complete, the total activity of the oil, now in the form of ester, can be determined by saponification with standard alkali.

The following equation illustrating the saponification of methyl salicylate is given as typical of a reaction of this kind:

$$\underset{\text{methyl salicylate}}{CH_3C_7H_5O_3} + \underset{\substack{\text{potassium}\\\text{hydroxide}}}{KOH} = \underset{\substack{\text{methyl}\\\text{alcohol}}}{CH_3OH} + \underset{\substack{\text{potassium}\\\text{salicylate}}}{KC_7H_5O_3}$$

It will be observed that only to the extent that there is ester present will the alkali be consumed. The excess of alkali is determined by titration with standard acid solution, the difference in the number of cc. is noted, and the calculation is made by applying the equivalent that appears in the text of the assay.

VOLUMETRIC ASSAY METHODS INVOLVING PRECIPITATION

Assays in Which Potassium Thiocyanate is Used.

This method is used for substances which are assayed by direct titration with tenth-normal potassium thiocyanate, ferric-alum being used as the indicator.

Yellow Mercuric Oxide, Red Mercuric Oxide—These are first dissolved in nitric acid which produces mercuric nitrate and water, which is then titrated.

Mercuric Salicylate—This is first digested with a mixture of sulphuric and nitric acids to bring about complete oxidization and to convert the mercury into sulphate.

Mercury—A solution of mercuric nitrate is first formed by dissolving this metal in an excess of nitric acid: This is then titrated.

Mercury with Chalk—This powder is first dissolved in nitric acid to obtain the mercury in the form of the soluble mercuric nitrate. It is then titrated.

Mild Mercurial Ointment and Strong Mercurial Ointment—The mercury in both of these ointments is converted into mercuric nitrate by dissolving in nitric acid. It is then titrated.

Mass of Mercury—After the disintegration of the mass, the mercury is converted into nitrate by dissolving in nitric acid. It is then titrated.

Solution of Arsenous and Mercuric Iodide—The mercuric content of this solution is determined by first reducing the mercuric iodide to metallic mercury by means of formaldehyde. The mercury is then washed, dissolved in nitric acid, and the mercuric nitrate titrated.

It will be noted that the aim in each of the above preliminary treatments is to convert the mercury into a soluble mercuric salt. From this point the assays are practically identical and the actual titration by means of the standard potassium thiocyanate solution may be explained by the following equation:

$$\underset{\text{mercuric nitrate}}{Hg(NO_3)_2} + \underset{\text{potassium thiocyanate}}{2KCNS} = \underset{\text{mercuric thiocyanate}}{Hg(CNS)_2} + \underset{\text{potassium nitrate}}{2KNO_3}$$

The following silver compounds are assayed by this method:

Silver Nitrate and Fused Silver Nitrate—Both of these are in the desired form for solution and titration.

Strong Silver Protein and Mild Silver Protein—These compounds are first converted into silver nitrate by ignition and solution in nitric acid.

The chemistry involved in the titration of the above silver compounds with potassium thiocyanate is explained by the following equation:

$$\underset{\text{silver nitrate}}{AgNO_3} + \underset{\text{potassium thiocyanate}}{KCNS} = \underset{\text{silver thiocyanate}}{AgCNS} + \underset{\text{potassium nitrate}}{KNO_3}$$

Titrations with potassium thiocyanate volumetric solution are carried out in the presence of diluted nitric acid and with ferric alum as the indicator. This standard solution is used in the estimation of the metals yielding thiocyanates which are insoluble in water, particularly those of silver and mercury. The gradual addition of standard potassium thiocyanate reacts with an increasing amount of the nitrate of silver or of mercury until they have been completely precipitated as the insoluble, white, silver or mercury thiocyanate. The ferric-alum indicator then gives warning of the slightest excess of the standard solution, by the formation of the deep red ferric thiocyanate. The presence of even a trace of ferric thiocyanate in a white mixture gives a faint pink color and the appearance of this color is a sign of the completion of the titration.

Residual Titration Using an Excess of Silver Nitrate.

In these assays a precipitate of insoluble silver salt is formed by the addition of an excess of tenth-normal silver nitrate, and the residual silver nitrate is subsequently estimated by titration with tenth-normal potassium thiocyanate, using ferric-alum as the indicator.

Diluted Hydriodic Acid, Ammonium Bromide, Arsenous Iodide, Calcium Bromide, Potassium Bromide, Potassium Iodide, Sodium Bromide, Sodium Iodide, Syrup of Hydriodic Acid, Syrup of Ferrous Iodide, and Lithium Bromide—A weighed portion of each of the above substances is precipitated from aqueous solution as the insoluble silver iodide or bromide, by adding an excess of tenth-normal silver nitrate. Ferric-alum indicator and diluted nitric acid

are then added and the mixture titrated with tenth-normal potassium thiocyanate until a permanent pink color appears in the supernatant liquid. The following is a typical equation to illustrate the reaction that takes place in the original precipitation:

$$\underset{\text{ammonium bromide}}{NH_4Br} + \underset{\text{silver nitrate}}{AgNO_3} = \underset{\text{silver bromide}}{AgBr} + \underset{\text{ammonium nitrate}}{NH_4NO_3}$$

Solution of Potassium Iodide—A measured portion of this solution is assayed according to the method described above for potassium iodide.

Lead Iodide—Sodium hydroxide solution is used in this assay for the purpose of dissolving the lead iodide. The lead iodide is then determined in the usual manner according to the method outlined above.

Ammonium Chloride, Solution of Zinc Chloride, Sodium Chloride, Calcium Chloride, Zinc Chloride, Magnesium Chloride, and Potassium Chloride—The essential difference in the estimation of the foregoing chlorides lies in the fact that the insoluble silver chloride is removed from the precipitating mixture by filtration and the residual silver nitrate is estimated in an aliquot portion of the filtrate. The precipitation of a chloride by means of standard silver nitrate may be illustrated as follows:

$$\underset{\text{silver nitrate}}{2AgNO_3} + \underset{\text{zinc chloride}}{ZnCl_2} = \underset{\text{silver chloride}}{2AgCl} + \underset{\text{zinc nitrate}}{Zn(NO_3)_2}$$

Potassium Nitrate—This salt is converted into potassium chloride by repeatedly evaporating to dryness with hydrochloric acid. It is then estimated as a chloride according to the above description.

Volatile Oil of Mustard—An alcoholic solution of this oil is heated with an excess of tenth-normal silver nitrate, in the presence of ammonia, to completely hydrolyze the allyl-isothiocyanate and form the insoluble silver thiocyanate. The measuring flask containing this mixture is heated on a water bath and is connected with a reflux condenser. The mixture is then cooled, brought to the required volume with distilled water, and filtered and the residual silver nitrate is estimated by titrating an aliquot portion of the filtrate with tenth-normal potassium thiocyanate.

Black Mustard—After macerating with water, alcohol is added and the mixture is distilled, the distillate being received in a mixture of ammonia water and tenth-normal silver nitrate. From there on the procedure is similar to that described above for volatile oil of mustard, since it is this oil which is found in the distillate.

Phosphoric Acid, Diluted Phosphoric Acid, Sodium Biphosphate, Sodium Phosphate, and Exsiccated Sodium Phosphate—All of these are precipitated as silver phosphate in a solution which is, or has been made, neutral to phenolphthalein. Upon the addition of an excess of silver nitrate, nitric acid is formed in every case. Using sodium phosphate as an illustration the equation would be as follows:

$$\underset{\text{sodium phosphate}}{Na_2HPO_4} + \underset{\text{silver nitrate}}{3AgNO_3} = \underset{\text{silver phosphate}}{Ag_3PO_4} + \underset{\text{nitric acid}}{HNO_3} + \underset{\text{sodium nitrate}}{2NaNO_3}$$

The nitric acid is kept neutralized by adding sufficient zinc oxide to render the mixture neutral to litmus, as some of the precipitated silver phosphate would otherwise dissolve. The mixture is filtered and the residual silver

nitrate is determined by titrating an aliquot portion of the filtrate with tenth-normal potassium thiocyanate.

The conditions for titrating are the same as those employed for the preceding group. Diluted nitric acid is the accessory reagent, ferric-alum is the indicator, and tenth-normal silver nitrate is the substance actually being determined in the titration. The excess of standard silver nitrate is employed in each case for the purpose of insuring the complete precipitation of the insoluble silver compound. The difference between the amounts of the two standard solutions used represents the number of cc. of tenth-normal silver nitrate actually consumed in precipitating the substance being assayed.

Calcium Hypophosphite, Potassium Hypophosphite, and Sodium Hypophosphite—The three foregoing hypophosphites are first oxidized to phosphates by repeated evaporation to dryness with nitric acid. The oxidation of a hypophosphite to phosphate by means of nitric acid is explained by the following equation which applies to the oxidation of sodium hypophosphite:

$$\underset{\text{sodium hypophosphite}}{3NaH_2PO_2} + \underset{\text{nitric acid}}{4HNO_3} = \underset{\text{mono-sodium phosphate}}{3NaH_2PO_4} + \underset{\text{nitric acid}}{2N_2O_2} + \underset{\text{water}}{2H_2O}$$

They are then estimated as phosphates according to the description given above.

Ammonium Hypophosphite—The ammonia is first expelled from this salt by boiling with sodium hydroxide, the reaction is explained by the following equation:

$$\underset{\text{ammonium hypophosphite}}{NH_4H_2PO_2} + \underset{\text{sodium hydroxide}}{NaOH} = \underset{\text{sodium hypophosphite}}{NaH_2PO_2} + \underset{\text{ammonia}}{NH_3} + \underset{\text{water}}{H_2O}$$

The hypophosphite is then oxidized with nitric acid, as explained above, and is estimated as phosphate.

Manganese Hypophosphite—The manganese is first removed from this salt by oxidation and precipitation as manganic hydroxide. An aliquot portion of the filtrate is then repeatedly evaporated with nitric acid to convert the hypophosphite radicle into phosphate. This is then estimated as phosphate, as described above.

Direct Titration with Silver Nitrate.

These assays involve precipitation with tenth-normal silver nitrate in the absence of free acid.

Oil of Bitter Almond—(Estimating the hydrocyanic acid content.) A weighed portion of the oil is treated with a mixture of magnesium sulphate, sodium hydroxide, and potassium chromate solutions which has already been titrated with tenth-normal silver nitrate until a permanent pink tint has been produced. The pink is promptly discharged by the oil of bitter almond and the mixture is titrated directly until the permanent reddish tint again appears. This titration is carried out in the presence of sodium hydroxide and magnesium sulphate, the former to fix the hydrocyanic acid as sodium cyanide and the latter to prevent hydrolysis. The potassium chromate serves as the indicator. The following equation explains the chemistry of the titration:

$$\underset{\text{sodium cyanide}}{NaCN} + \underset{\text{silver nitrate}}{AgNO_3} = \underset{\text{silver cyanide}}{AgCN} + \underset{\text{sodium nitrate}}{NaNO_3}$$

The reddish tint indicates the end of the reaction, since the first drop in excess forms a red precipitate of silver chromate when the indicator is present.

Titrations with Sodium Thiosulphate.

These assays require titration with standard sodium thiosulphate solution for the purpose of estimating free iodine.

The titration in all of the determinations of this type is based upon a reaction expressed as follows:

$$\underset{\text{sodium thiosulphate}}{2Na_2S_2O_3} + \underset{\text{iodine}}{I_2} = \underset{\text{sodium iodide}}{2NaI} + \underset{\text{sodium tetrathionate}}{Na_2S_4O_6}$$

The following substances are assayed by this means, some because of the presence of free iodine, others because of their ability under certain conditions to liberate iodine from potassium iodide.

Calcium Iodobehenas, Thymol Iodide, and Thyroxin—The iodine that is organically combined in each of these three materials is converted into potassium iodide by fusion with anhydrous potassium carbonate. This is then completely oxidized to potassium iodate by means of potassium permanganate. Potassium iodide and also free acid are then added to the mixture. Under these conditions all of the iodine is liberated from the iodate and a corresponding amount from the potassium iodide according to the following equation:

$$\underset{\text{potassium iodate}}{KIO_3} + \underset{\text{potassium iodide}}{5KI} + \underset{\text{sulphuric acid}}{3H_2SO_4} = \underset{\text{potassium sulphate}}{3K_2SO_4} + \underset{\text{iodine}}{3I_2} + \underset{\text{water}}{3H_2O}$$

The liberated iodine is then estimated by means of tenth-normal sodium thiosulphate, starch being used as the indicator.

It will be observed from the above equation that only one-sixth of the total iodine liberated comes from the iodate, and, in turn, from the substance being assayed.

Thyroid—The assay for thyroid agrees in principle with those just explained but differs in certain details. First, a mixture of anhydrous sodium and potassium carbonates is used in the fusion; second, Labarraque's solution replaces potassium permanganate in oxidizing the iodides to iodate; third, phosphoric acid is used to liberate the iodine, and fourth, two-hundredth-normal sodium thiosulphate replaces the tenth-normal in estimating the free iodine.

Chlorinated Lime—This assay depends upon the liberation of the available chlorine from a given weight of material by treatment with acetic acid. The reaction that takes place is illustrated by the following equation:

$$\underset{\text{chlorinated lime}}{CaOCl_2} + \underset{\text{acetic acid}}{2HC_2H_3O_2} = \underset{\text{calcium acetate}}{Ca(C_2H_3O_2)_2} + \underset{\text{chlorine}}{Cl_2} + \underset{\text{water}}{H_2O}$$

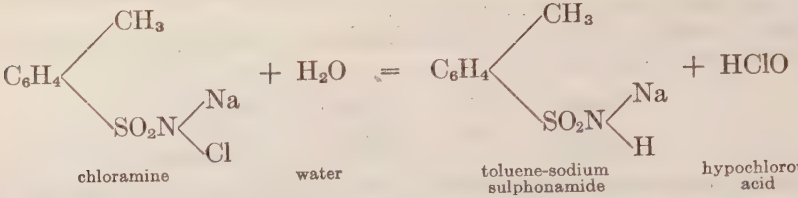
The free chlorine immediately reacts with a corresponding amount of potassium iodide, which was present in the mixture, displacing the iodine, atom for atom, as follows:

$$\underset{\text{chlorine}}{Cl_2} + \underset{\text{potassium iodide}}{2KI} = \underset{\text{potassium chloride}}{2KCl} + \underset{\text{iodine}}{I_2}$$

The free iodine is then estimated by titration with tenth-normal sodium thiosulphate, starch being used as the indicator. The number of cc. of volumetric solution used is calculated to available chlorine in the chlorinated lime by making use of the equivalent given in the official text.

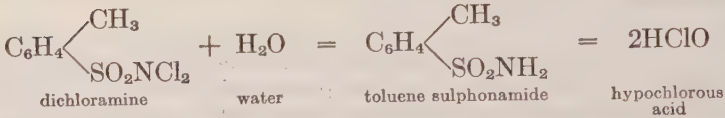
Chloramine and Dichloramine—In the case of Chloramine and Dichloramine the conditions are such as to restore hydrogen to the original amino-nitrogen

atom, the chlorine splitting off in the form of hypochlorous acid. This is a form of hydrolysis and is explained by the following equations:



chloramine — water — toluene-sodium sulphonamide — hypochlorous acid

and



dichloramine — water — toluene sulphonamide — hypochlorous acid

The hypochlorous acid then attacks potassium iodide, each molecule liberating two atoms of iodine from two molecules of potassium iodide, as follows:

$$2HClO + 4KI + 2HC_2H_3O_2 = 2KCl + 2KC_2H_3O_2 + I_4 + 2H_2O$$

hypochlorous acid — potassium iodide — acetic acid — potassium chloride — potassium acetate — iodine — water

The liberated iodine is then estimated with standard sodium thiosulphate in the usual manner.

Arsphenamine and Neoarsphenamine—In these assays the arsenic is oxidized from the trivalent to the pentavalent condition. It is then possible to displace iodine from the acidified solution of an iodide which is provided in the assay. The liberated iodine is then estimated with standard sodium thiosulphate and is calculated to per cent of arsenic.

Chromium Trioxide—Advantage is taken here of the ability of chromium trioxide, as an oxidizing agent, to liberate iodine from an iodide, in the presence of hydrochloric acid. The following equation illustrates the reaction that takes place:

$$2CrO_3 + 6KI + 12HCl = Cr_2Cl_6 + 6KCl + 3I_2 + 6H_2O$$

chromium trioxide — potassium iodide — hydrochloric acid — chromic chloride — potassium chloride — iodine — water

The liberated iodine is then titrated with tenth-normal sodium thiosulphate in the presence of starch indicator.

Copper Sulphate—When cupric sulphate is added to an iodide solution, the cupric iodide that would be expected to form breaks down immediately into cuprous iodide with the separation of one-half of its iodine. The following equation shows what takes place:

$$2CuSO_4 + 4KI = 2CuI + I_2 + 2K_2SO_4$$

cupric sulphate — potassium iodide — cuprous iodide — iodine — potassium sulphate

Acetic acid is also used as an accessory reagent. The free iodine is then estimated as described above and the calculation is made according to the directions in the text.

Ferric Chloride—The ability of an oxidizing agent to liberate iodine, quantitatively, from an iodide is again utilized in this assay. In the presence of hydrochloric acid, ferric chloride liberates iodine from potassium iodide according to the following equation:

$$\underset{\text{ferric chloride}}{2FeCl_3} + \underset{\text{potassium iodide}}{2KI} = \underset{\text{ferrous chloride}}{2FeCl_2} + \underset{\text{potassium chloride}}{2KCl} + \underset{\text{iodine}}{I_2}$$

The iodine is then ready to be estimated in the usual manner as already described.

Iron and Ammonium Citrate—Hydrochloric acid is added to a solution of the scaled salt to displace the weaker citric acid and to form chlorides of ferric iron and ammonium. The ferric chloride then displaces iodine from potassium iodide according to the equation given under ferric chloride.

Soluble Ferric Phosphate—This is another scaled salt which, after treatment with strong hydrochloric acid, is made to liberate iodine from potassium iodide. The reaction involved is essentially the same as already illustrated under the assay for ferric chloride.

Iodine—An aqueous solution of the iodine is prepared with the aid of potassium iodide. The diluted solution is then ready for titration with tenth-normal sodium thiosulphate, starch being used as the indicator. The type equation at the head of this group is the only one involved in this assay.

Sulphur Iodide—This compound is decomposed by the potassium iodide, the sulphur being precipitated and the free iodine remaining in solution. The liberated iodine is then estimated with sodium thiosulphate in the usual manner.

Bromine—In the presence of potassium iodide the bromine forms a corresponding amount of potassium bromide and liberates an equivalent amount of free iodine, as follows:

$$\underset{\text{bromine}}{Br_2} + \underset{\text{potassium iodide}}{2KI} = \underset{\text{potassium bromide}}{2KBr} + \underset{\text{iodine}}{I_2}$$

The liberated iodine is then estimated with sodium thiosulphate in the usual manner. Owing to the volatile character of the bromine the directions given in the text should be carefully followed.

Solution of Ferric Chloride—This solution is allowed to remain in contact with hydrochloric acid and potassium iodide for thirty minutes in a warm place. The mixture is cooled, diluted, and the free iodine estimated by titration with tenth-normal sodium thiosulphate, in the presence of starch which is added when nearly all of the iodine color has disappeared. The equation under ferric chloride explains this assay.

Solution of Iron and Ammonium Acetate—(For iron content.) This solution is first evaporated to dryness and ignited, redissolved in hydrochloric acid, and again evaporated to dryness with solution of hydrogen dioxide. This procedure eliminates the volatile and organic matter and oxidizes the iron to ferric chloride. After dissolving the residue in hydrochloric acid and adding potassium iodide, the liberated iodine is estimated by titration with standard sodium thiosulphate. The equation under ferric chloride illustrates the reaction involved.

Solution of Iron Tersulphate—Ferric salts, in general, have the power to liberate iodine from iodides. The equation that illustrates the reaction upon which this assay is based is as follows:

$$\underset{\text{ferric tersulphate}}{Fe_2(SO_4)_3} + \underset{\text{potassium iodide}}{2KI} = \underset{\text{ferrous sulphate}}{2FeSO_4} + \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{iodine}}{I_2}$$

The free iodine is then ready for titration with standard sodium thiosulphate solution.

Solution of Ferric Subsulphate—The principle upon which this assay is based is the same as in the assay of solution of iron tersulphate explained on page 1467. The ferric iron liberates iodine which is subsequently estimated by titration with sodium thiosulphate.

Ferric Glycerophosphate, Ferric Hypophosphite, Ferrous Lactate, Ferric Pyrophosphate, Albuminized Iron, Peptonized Iron, Solution of Ferric Citrate, Tincture of Ferric Chloride, Ethereal Tincture of Ferric Chloride, and Saccharated Ferric Oxide.

The assay of the foregoing substances depends upon their iron content. The solvents are first removed by evaporation and any organic matter that may be present is removed by ignition. Each of the above materials is then fully oxidized and treated with hydrochloric acid, whereby it is converted into ferric chloride. The chemistry involved, from this point, is identical with that which is explained in the description of the ferric chloride assay on page 1466.

Compound Solution of Iodine—(For iodine content.) After diluting with distilled water, this solution is ready for direct titration with tenth-normal sodium thiosulphate according to the type equation given at the head of this group.

Solution of Chlorinated Soda—The acetic acid which is added liberates the available chlorine from this solution as it does from chlorinated lime. The chlorine, in turn, displaces iodine from the potassium iodide, and the iodine is estimated in the usual way with standard sodium thiosulphate solution. See the explanation of the assay under chlorinated lime.

Surgical Solution of Chlorinated Soda—Here again the chlorine, which is present in loose combination, is rendered free by the action of acetic acid. The liberation of a corresponding amount of iodine from potassium iodide, and the subsequent estimation of the iodine with standard sodium thiosulphate solution, are explained under chlorinated lime, and by the type equation which heads this group.

Phenol—The first step in this assay involves the precipitation of tribromphenol by the action of tenth-normal bromine in the presence of hydrochloric acid. This is illustrated by the following equation:

$$\underset{\text{phenol}}{C_6H_5OH} + \underset{\text{bromine}}{3Br_2} = \underset{\text{tribromphenol}}{C_6H_2Br_3OH} + \underset{\text{hydrobromic acid}}{3HBr}$$

Potassium iodide is then quickly added and the excess of bromine promptly liberates iodine from this salt, atom for atom, as follows:

$$\underset{\text{potassium iodide}}{2KI} + \underset{\text{bromine}}{Br_2} = \underset{\text{potassium bromide}}{2KBr} + \underset{\text{iodine}}{I_2}$$

Chloroform is added to act as a solvent for the iodine and the mixture is then titrated in the usual manner with standard sodium thiosulphate solution.

Liquefied Phenol—The assay process is similar to the one just described for phenol.

Resorcinol—The assay process for resorcinol is practically the same as that already described for phenol. Tribromresorcinol is precipitated by tenth-normal bromine in the presence of hydrochloric acid according to the following equation:

$$\underset{\text{resorcinol}}{C_6H_4(OH)_2} + \underset{\text{bromine}}{3Br_2} = \underset{\text{tribromresorcinol}}{C_6HBr_3(OH)_2} + \underset{\text{hydrobromic acid}}{3HBr}$$

Tincture of Iodine and Stronger Tincture of Iodine—(For iodine content.) Dilution with distilled water is alone required to prepare these substances for the estimation of free iodine by means of tenth-normal sodium thiosulphate. The equation at the head of this group explains the reaction involved.

Red Lead Oxide—The red lead, being an oxidizing agent, liberates iodine from the acidified potassium iodide solution as follows:

$$\underset{\text{lead orthoplumbate}}{Pb_2PbO_4} + \underset{\text{potassium iodide}}{2KI} + \underset{\text{acetic acid}}{8HC_2H_3O_2} =$$

$$\underset{\text{lead acetate}}{3Pb(C_2H_3O_2)_2} + \underset{\text{potassium acetate}}{2KC_2H_3O_2} + \underset{\text{water}}{4H_2O} + \underset{\text{iodine}}{I_2}$$

The iodine is then estimated in the usual manner using tenth-normal sodium thiosulphate.

Sodium Arsenate and Exsiccated Sodium Arsenate—These salts are assayed by dissolving a weighed portion in water and heating the solution to 80° C. Hydrochloric acid and potassium iodide are then added and, after standing for some time, the solution is titrated for free iodine. The hydrochloric acid decomposes both salts, forming chlorides and liberating their respective acids. The arsenic acid in being reduced to arsenous acid liberates a corresponding amount of iodine. The reactions involved are expressed by the following equations:

$$\underset{\text{potassium iodide}}{2KI} + \underset{\text{sodium arsenate}}{Na_2HAsO_4} + \underset{\text{hydrochloric acid}}{4HCl} = \underset{\text{potassium chloride}}{2KCl} + \underset{\text{sodium chloride}}{2NaCl} + \underset{\text{hydriodic acid}}{2HI} + \underset{\text{arsenic acid}}{H_3AsO_4}$$

then

$$\underset{\text{arsenic acid}}{H_3AsO_4} + \underset{\text{hydriodic acid}}{2HI} = \underset{\text{arsenous acid}}{H_3AsO_3} + \underset{\text{water}}{H_2O} + \underset{\text{iodine}}{I_2}$$

The liberated iodine is then titrated with tenth-normal sodium thiosulphate.

Solution of Sodium Arsenate and Diluted Solution of Sodium Arsenate—The above description for the assay of sodium arsenate applies equally to the estimation of this salt in the foregoing solutions.

Acetone—This assay is based upon the familiar iodoform reaction. The titration is in reality a residual one in which two standard solutions are employed. An excess of tenth-normal iodine is brought into contact with the acetone in the presence of an alkali, whereby iodoform is produced according to the following equations:

$$\underset{\text{acetone}}{CH_3COCH_3} + \underset{\text{iodine}}{3I_2} = \underset{\text{tri-iodo-acetone}}{CI_3COCH_3} + \underset{\text{hydriodic acid}}{3HI}$$

then

$$\underset{\text{tri-iodo-acetone}}{CI_3COCH_3} + \underset{\text{hydriodic acid}}{3HI} + \underset{\text{sodium hydroxide}}{4NaOH} = \underset{\text{iodoform}}{CHI_3} + \underset{\text{sodium iodide}}{3NaI} + \underset{\text{water}}{3H_2O} + \underset{\text{sodium acetate}}{CH_3COONa}$$

Hydrochloric acid is then added to liberate the excess of iodine from combination with the alkali and the mixture is ready for titration with standard thiosulphate solution. A blank determination is conducted, omitting the acetone, and by comparing the two determinations the amount of iodine consumed by the acetone can be calculated. Starch test solution is used as the indicator in each of the above determinations.

In the presence of considerable iodine, starch as an indicator forms bluish-black lumps that are difficult to dissolve, hence the indicator should not be added until nearly all of the iodine color has been discharged. The remaining iodine can easily be detected on adding the starch because of the pronounced blue color which appears, even in great dilution. The titration of iodine must always be carried out in cold liquids.

It will be observed that this method of analysis can be applied to oxidizing agents as a class because of their ability to liberate iodine in an acidulated solution of an iodide.

Direct Titration with Iodine.

The assays in this group involve the direct oxidation of a substance by means of tenth-normal iodine.

Sodium Thiosulphate—Just as iodine can be estimated with tenth-normal sodium thiosulphate so can sodium thiosulphate be estimated with tenth-normal iodine. The equation to illustrate this reaction is the one given at the head of the preceding group on page 1465. Starch is again used as the indicator and the appearance of a permanent blue color is evidence of the completion of the titration.

Antimony and Potassium Tartrate—A cold, saturated solution of sodium bicarbonate is added to an aqueous solution of this salt, starch indicator is added, and the mixture is titrated with tenth-normal iodine until a permanent blue color appears. This reaction is based upon the oxidation of the tartar emetic to sodium metantimonate, as expressed by the following equation:

$$\underset{\text{tartar emetic}}{2KSbO(C_4H_4O_6)} + \underset{\text{iodine}}{2I_2} + \underset{\text{sodium bicarbonate}}{8NaHCO_3} = \underset{\text{sodium metantimonate}}{2NaSbO_3} + \underset{\text{sodium iodide}}{4NaI} +$$

$$\underset{\text{potassium and sodium tartrate}}{2KNaC_4H_4O_6} + \underset{\text{carbon dioxide}}{8CO_2} + \underset{\text{water}}{4H_2O}$$

The equivalent weight of tartar emetic for each cc. of tenth-normal iodine consumed in the titration, is given in the official text.

Arsenic Trioxide—This compound is dissolved in boiling distilled water with the aid of sodium hydroxide T.S. and is thereby converted into sodium arsenite according to the following equation:

$$\underset{\text{arsenic trioxide}}{As_2O_3} + \underset{\text{sodium hydroxide}}{6NaOH} = \underset{\text{sodium arsenite}}{2Na_3AsO_3} + \underset{\text{water}}{3H_2O}$$

The solution is neutralized with sulphuric acid to prevent the iodine from reacting with the excess of free alkali. Sodium bicarbonate is then added to the mixture and tenth-normal iodine introduced until a permanent blue color appears, using starch as the indicator. The sodium arsenite is thereby oxidized to arsenate as follows:

$$\underset{\text{sodium arsenite}}{Na_3AsO_3} + \underset{\text{iodine}}{I_2} + \underset{\text{water}}{H_2O} = \underset{\text{sodium arsenate}}{Na_3AsO_4} + \underset{\text{hydriodic acid}}{2HI}$$

The sodium bicarbonate reacts with the hydriodic acid as rapidly as it is formed and thus enables the reaction to go entirely in the one direction.

Antimony Oxide—An aqueous solution of tartaric acid is used for the purpose of dissolving the antimony oxide. The acid is nearly neutralized with sodium carbonate solution, the antimony is then oxidized to the pentavalent condition

by titrating with tenth-normal iodine in the presence of an excess of sodium bicarbonate, using starch as the indicator. The titration with iodine V.S. should be carried out immediately after adding the sodium bicarbonate solution to avoid the separation of an insoluble basic salt of the antimony. The chemical principles involved in this assay are similar to those outlined in the foregoing description of the assay for arsenic trioxide.

Solution of Arsenous Acid—Since the arsenic compound is already in solution all that needs to be done is to dilute with distilled water, add the excess of sodium bicarbonate and the starch indicator, and the mixture is ready for titration with tenth-normal iodine. The reaction is illustrated by the following equation:

$$\underset{\text{arsenous acid}}{H_3AsO_3} + \underset{\text{iodine}}{I_2} + \underset{\text{water}}{H_2O} = \underset{\text{arsenic acid}}{H_3AsO_4} + \underset{\text{hydriodic acid}}{2HI}$$

The sodium bicarbonate neutralizes the free acid that forms and thereby prevents the reaction from going in the reverse direction.

Solution of Arsenous and Mercuric Iodide—(For arsenous iodide content.) As in the above cases the arsenic is oxidized from the trivalent to the pentavalent form at the expense of tenth-normal iodine. Sodium bicarbonate is used in excess for reasons explained above, and starch is used as the indicator

Solution of Potassium Arsenite—The indefinite alkalinity of this solution is first removed by making the solution faintly acid with diluted hydrochloric acid. An excess of sodium bicarbonate is then added and the liquid titrated with tenth-normal iodine, starch being used as the indicator. The following equation illustrates the reaction:

$$\underset{\text{potassium metarsenite}}{KAsO_2} + \underset{\text{iodine}}{I_2} + \underset{\text{water}}{H_2O} = \underset{\text{potassium metarsenate}}{KAsO_3} + \underset{\text{hydriodic acid}}{2HI}$$

The purpose of the added sodium bicarbonate is explained under solution of arsenous acid, see above.

Residual Titrations with an Excess of Iodine.

These assays require residual titrations involving the use of an excess of tenth-normal iodine, and the subsequent estimation of the residual iodine with tenth-normal sodium thiosulphate.

Mild Mercurous Chloride—The prolonged contact, with agitation, of the mild mercurous chloride with tenth-normal iodine and potassium iodide, converts it into mercurous iodide and subsequently into mercuric iodide which is soluble in the presence of the potassium iodide. The reactions involved in these changes are as follows:

$$\underset{\text{mercurous chloride}}{HgCl} + \underset{\text{potassium iodide}}{KI} = \underset{\text{mercurous iodide}}{HgI} + \underset{\text{potassium chloride}}{KCl}$$

The iodine then oxidizes the mercurous iodide to mercuric iodide as follows:

$$\underset{\text{mercurous iodide}}{2HgI} + \underset{\text{iodine}}{I_2} = \underset{\text{mercuric iodide}}{2HgI_2}$$

The residual iodine is then estimated by titration with tenth-normal sodium thiosulphate in the usual manner.

Yellow Iodide of Mercury—The details for this assay process are practically the same as those described under mild mercurous chloride except that the first equation is not involved, since mercurous iodide is the starting point in the determination.

Titrations with Potassium Dichromate.

These assays require oxidation by direct titration with tenth-normal potassium dichromate.

Saccharated Ferrous Carbonate—This is first dissolved in diluted sulphuric acid and the solution diluted with distilled water. The volumetric solution is carefully added until a drop of the mixture, when removed and brought into contact with a drop of potassium ferricyanide test solution, ceases to give a blue color. The cause of this blue color is the formation of ferrous ferricyanide, or Turnbull's blue, and its failure to appear is evidence that all of the iron has been oxidized to the ferric condition. The reaction that takes place between the ferrous carbonate and the sulphuric acid, in which it is dissolved, is shown by the following equation:

$$\underset{\text{ferrous carbonate}}{FeCO_3} + \underset{\text{sulphuric acid}}{H_2SO_4} = \underset{\text{ferrous sulphate}}{FeSO_4} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

The subsequent reaction between the ferrous sulphate and tenth-normal potassium dichromate is expressed as follows:

$$\underset{\text{ferrous sulphate}}{6FeSO_4} + \underset{\text{potassium dichromate}}{K_2Cr_2O_7} + \underset{\text{sulphuric acid}}{7H_2SO_4} = \underset{\text{ferric sulphate}}{3Fe_2(SO_4)_3} + \underset{\text{chromic sulphate}}{Cr_2(SO_4)_3} + \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{water}}{7H_2O}$$

The number of cc. of tenth-normal potassium dichromate is calculated to ferrous carbonate by applying the factor given in the official text.

Pills of Ferrous Carbonate and Mass of Ferrous Carbonate—These preparations are dissolved in diluted sulphuric acid and the method for estimating the ferrous carbonate is identical with that already described above for saccharated ferrous carbonate.

Residual Titrations Using an Excess of Oxalic Acid.

These assays require the precipitation of insoluble oxalates with tenth-normal oxalic acid, in excess, and the estimation of residual oxalic acid by titration with tenth-normal potassium permanganate, in the presence of diluted sulphuric acid.

When oxalic acid is determined by means of potassium permanganate or vice versa, the reaction involved is expressed by the following equation:

$$\underset{\text{oxalic acid}}{5H_2C_2O_4} + \underset{\text{potassium permanganate}}{K_2Mn_2O_8} + \underset{\text{sulphuric acid}}{3H_2SO_4} = \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{manganous sulphate}}{2MnSO_4} + \underset{\text{carbon dioxide}}{10CO_2} + \underset{\text{water}}{8H_2O}$$

This reaction is best conducted at a steaming, but not a boiling, temperature. Potassium permanganate serves as its own indicator.

The assay methods for the following belong to this group.

Precipitated Calcium Carbonate and Prepared Chalk—These are first converted into calcium chloride by dissolving in diluted hydrochloric acid, thus:

$$\underset{\text{calcium carbonate}}{CaCO_3} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{calcium chloride}}{CaCl_2} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

After boiling to remove the carbon dioxide, this solution is treated with an excess of tenth-normal oxalic acid and the mixture made alkaline with ammonia to insure complete precipitation of the calcium oxalate. The following equation illustrates the reaction:

$$\underset{\text{calcium chloride}}{CaCl_2} + \underset{\text{oxalic acid}}{H_2C_2O_4} = \underset{\text{calcium oxalate}}{CaC_2O_4} + \underset{\text{hydrochloric acid}}{2HCl}$$

The excess of ammonia promptly takes care of the hydrochloric acid that forms, yielding ammonium chloride. The mixture is then allowed to stand in a warm place. After diluting to a definite volume, and agitating, it is filtered and an aliquot portion of the filtrate, to which diluted sulphuric acid has been added, is titrated with standard potassium permanganate solution until a permanent pink color appears.

Calx—The lime is freshly ignited and the residue converted into calcium chloride by dissolving it in diluted hydrochloric acid as follows:

$$\underset{\text{calcium oxide (lime)}}{CaO} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{calcium chloride}}{CaCl_2} + \underset{\text{water}}{H_2O}$$

From this point the procedure is the same as described above for precipitated calcium carbonate.

Solution of Lead Subacetate and Diluted Solution of Lead Subacetate—When these solutions are treated with an excess of standard oxalic acid solution, the insoluble lead oxalate is precipitated according to the following equation:

$$\underset{\text{lead subacetate}}{Pb_2O(CH_3COO)_2} + \underset{\text{oxalic acid}}{2H_2C_2O_4} = \underset{\text{lead oxalate}}{2PbC_2O_4} + \underset{\text{acetic acid}}{2CH_3COOH} + \underset{\text{water}}{H_2O}$$

After diluting the mixture to a definite volume and thorough agitation, it is filtered and an aliquot portion of the filtrate, to which diluted sulphuric acid has been added, is titrated with standard potassium permanganate solution until a permanent pink color appears.

Lead Acetate—A definite weight of the salt is dissolved in recently boiled distilled water. The addition of tenth-normal oxalic acid to an aliquot portion of this solution precipitates lead oxalate as follows:

$$\underset{\text{lead acetate}}{Pb(C_2H_3O_2)_2} + \underset{\text{oxalic acid}}{H_2C_2O_4} = \underset{\text{lead oxalate}}{PbC_2O_4} + \underset{\text{acetic acid}}{2HC_2H_3O_2}$$

The remaining part of the assay is practically the same as already described for solution of lead subacetate (see above).

Lead Monoxide—This oxide is converted into lead acetate by dissolving it in a solution of glacial acetic acid, according to the following equation:

$$\underset{\text{lead monoxide}}{PbO} + \underset{\text{glacial acetic acid}}{2HC_2H_3O_2} = \underset{\text{lead acetate}}{Pb(C_2H_3O_2)_2} + \underset{\text{water}}{H_2O}$$

From this point the procedure is the same as has been described above under solution of lead subacetate.

Direct Titrations with Potassium Permanganate.

These assays require direct titrations involving oxidation by means of tenth-normal potassium permanganate.

Ferrous Sulphate—A solution of the ferrous sulphate in diluted sulphuric acid is oxidized by standard potassium permanganate solution according to the following equation:

$$\underset{\text{ferrous sulphate}}{10FeSO_4} + \underset{\text{potassium permanganate}}{K_2Mn_2O_8} + \underset{\text{sulphuric acid}}{8H_2SO_4} = \underset{\text{ferric sulphate}}{5Fe_2(SO_4)_3} + \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{manganous sulphate}}{2MnSO_4} + \underset{\text{water}}{8H_2O}$$

The end of the reaction is shown by the appearance of a permanent pink color which signifies that the permanganate is no longer being reduced.

Exsiccated Ferrous Sulphate—The assay process for this salt is identical with the one just described for ferrous sulphate.

Reduced Iron—Mercuric chloride solution converts the iron into ferrous chloride and metallic mercury is displaced. The ferrous chloride is then oxidized by standard potassium permanganate and the volume required is calculated to metallic iron.

Solution of Hydrogen Dioxide—A definite weight of this solution is diluted with distilled water and treated with diluted sulphuric acid, which serves as an accessory reagent. The mixture is then titrated with tenth-normal potassium permanganate until a permanent pink color appears. The reaction that takes place is illustrated by the following equation:

$$\underset{\text{hydrogen dioxide}}{5H_2O_2} + \underset{\text{potassium permanganate}}{K_2Mn_2O_8} + \underset{\text{sulphuric acid}}{3H_2SO_4} = \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{manganous sulphate}}{2MnSO_4} + \underset{\text{water}}{8H_2O} + \underset{\text{oxygen}}{5O_2}$$

NOTE—It will be observed that only half of the evolved oxygen comes from the hydrogen dioxide, the other half coming from the potassium permanganate. Due consideration should be given to this if the volume of the evolved gas is being measured.

Sodium Perborate—The conditions here are the same as those provided in the assay of solution of hydrogen dioxide. Each molecule of sodium perborate undergoes hydrolytic decomposition, yielding one molecule of hydrogen dioxide as follows:

$$\underset{\text{sodium perborate}}{NaBO_3 \cdot 4H_2O} + \underset{\text{water}}{H_2O} = \underset{\text{hydrogen dioxide}}{H_2O_2} + \underset{\text{sodium metaborate}}{NaBO_2} + \underset{\text{water}}{4H_2O}$$

The permanganate titration that follows is explained in the above description for the assay of hydrogen dioxide.

No indicator is required in the titration of substances in this group since the potassium permanganate itself supplies the necessary evidence that the reaction is complete by producing a permanent pink color.

Residual Titration with Excess of Potassium Permanganate.

The substances assayed by this method require oxidation by means of tenth-normal potassium permanganate and the subsequent titration of the residual permanganate with tenth-normal oxalic acid.

Sodium Nitrite—An aqueous solution of this salt is delivered, by means of a pipette, into an excess of acidified permanganate solution, in such a way as to prevent the escape of nitrous acid. The reaction is expressed as follows:

$$\underset{\text{sodium nitrite}}{5NaNO_2} + \underset{\text{potassium permanganate}}{K_2Mn_2O_8} + \underset{\text{sulphuric acid}}{3H_2SO_4} = \underset{\text{sodium nitrate}}{5NaNO_3} + \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{manganous sulphate}}{2MnSO_4} + \underset{\text{water}}{3H_2O}$$

The liquid is warmed and allowed to stand. The excess of permanganate is then estimated by titration with tenth-normal oxalic acid. The equation that illustrates this reaction appears on page 1472.

Titration of an Excess of Ferrous Sulphate with Potassium Permanganate.

The substances assayed by this method require reduction by means of acidulated ferrous sulphate test solution and estimation of the residual ferrous sulphate by titrating with tenth-normal potassium permanganate.

Potassium Chlorate—This salt is reduced to potassium chloride at the expense of a corresponding amount of ferrous sulphate, according to the following equation:

$$\underset{\text{potassium chlorate}}{KClO_3} + \underset{\text{ferrous sulphate}}{6FeSO_4} + \underset{\text{sulphuric acid}}{3H_2SO_4} = \underset{\text{potassium chloride}}{KCl} + \underset{\text{ferric sulphate}}{3Fe_2(SO_4)_3} + \underset{\text{water}}{3H_2O}$$

After boiling the mixture for ten minutes it is cooled and the unused ferrous sulphate is estimated by titration with tenth-normal potassium permanganate, in the presence of manganous sulphate T.S. This reaction is explained by the equation on page 1474. A blank test is conducted by titrating an equal volume of the same acidified ferrous sulphate solution but omitting the potassium chlorate. The amount of tenth-normal potassium permanganate, equivalent to the potassium chlorate, can then be calculated by noting the difference in the amounts of standard solution required in the two titrations.

Titration with Oxalic Acid, Used as a Reducing Agent.

The method of assay is dependent upon reduction by means of tenth-normal oxalic acid.

Potassium Permanganate—An aqueous solution of this salt is acidified with sulphuric acid, warmed to about 80° C., and titrated with the standard oxalic acid solution until the color of the permanganate is completely discharged. The equation which explains this reaction will be found on page 1472.

GRAVIMETRIC METHODS OF ANALYSIS

The assay methods of this type generally involve the separation and weighing of a substance of definite composition. The weight of this substance is then calculated back to a corresponding weight of the material being determined. These methods are also arranged in groups according to the points of resemblance or difference, which appear in the various procedures. The classification adopted is as follows:

1. Methods involving evaporation of the solvent.
2. Decomposition by direct heat and weighing the residue.
3. Precipitation and subsequent weighing of the precipitate.
4. Precipitation followed by ignition and decomposition of the precipitate.
5. Miscellaneous gravimetric processes.

The Evaporation of the Solvent.

Determinations by this method are based upon the removal of the solvent by evaporation and noting the constant weight of the residue.

Spirit of Glyceryl Trinitrate—Considerable caution is required in handling nitroglycerin, hence the alcohol is allowed to evaporate spontaneously and the residue is dried to constant weight over concentrated sulphuric acid.

Compound Solution of Iodine—(For potassium iodide content.) The water and the iodine are removed from this solution with the aid of heat on a water bath. More distilled water may be added from time to time to assist in removing the last traces of iodine. When a constant weight of white residue is obtained, it should respond to the identity tests for potassium iodide.

Tincture of Iodine—(For potassium iodide content.) The alcohol and the iodine are removed by evaporation with the aid of a water bath. Small portions of distilled water may be added from time to time in order to remove the last traces of iodine which is betrayed by its color. When a white residue of constant weight is obtained, it should respond to the identity tests for potassium iodide.

In the following group of assays an active principle is liberated by means of an acid or an alkali and separated by the use of successive portions of an immiscible solvent, the solvent being subsequently removed by evaporation:

Barbital-Sodium—This compound is first decomposed by diluted hydrochloric acid which combines with the sodium to form sodium chloride. The liberated barbital is then extracted from the mixture with successive portions of ether. The ether is evaporated from the combined extractions and the residue is dried at 100° C. and weighed.

Citrated Caffeine—This substance is first dissolved in hot distilled water and decomposed by sodium hydroxide test solution which reacts to form sodium citrate and free caffeine. The liberated caffeine is then extracted from the mixture with successive portions of chloroform. The chloroform is removed from the combined extractions by evaporation on a water bath and the caffeine is dried to constant weight at a temperature not above 80° C.

Caffeine Sodio-Benzoate and Caffeine Sodio-Salicylate—(For caffeine content.) The description of these assays is essentially the same as the one just given for citrated caffeine.

Quinine and Urea Hydrochloride—The quinine is liberated from an aqueous solution of this compound by the addition of ammonia water. The alkaloid is then extracted from the mixture with successive portions of chloroform. The chloroform is removed from the combined extractions by evaporation on a water bath and, after redissolving in ether and evaporating, the residue of quinine is dried and weighed. The weight of quinine found is then calculated to indicate the weight of quinine and urea hydrochloride originally present.

Quinine Tannate—The quinine is liberated from an aqueous solution of this salt by treatment with an excess of ammonia water. Successive portions of ether are then used to extract the quinine from the mixture, the ether is evaporated from the combined ethereal liquids, and the residue of quinine dried and weighed.

Storax—(For cinnamic acid content.) The esters are saponified by prolonged boiling with alcoholic potassium hydroxide, under a reflux condenser. The excess of free alkali is then carefully neutralized with sulphuric acid, in the presence of phenolphthalein. After removing the alcohol by evaporation, distilled water is added to obtain the potassium cinnamate in aqueous solution and foreign matter is removed by extraction with ether. The potassium cinnamate in the aqueous solution is then decomposed by adding an excess of diluted sulphuric

acid which liberates cinnamic acid and forms potassium sulphate. The cinnamic acid is next extracted from this mixture with successive portions of ether, the ether is distilled off, and the cinnamic acid dissolved in boiling distilled water. This solution is filtered while hot and the crystals of cinnamic acid are allowed to separate from the filtrate. Finally crystals are collected on a filter with the aid of suction, dried, and weighed.

Theobromine Sodio-Salicylate—(For theobromine content.) The theobromine is liberated by careful titration with normal hydrochloric acid, in the presence of phenolphthalein as the indicator, a trace of ammonia water being added, if necessary, to render the mixture slightly alkaline. Under these conditions the mixture is allowed to stand with occasional stirring. The separated theobromine is then collected on a weighed filter and washed with successive portions of ice-cold distilled water. The filter and precipitate are finally dried at 100° C. and weighed.

Decomposition by Applying Direct Heat.

These determinations involve the direct ignition of a substance to obtain the weight of a residue in the form of oxide.

Bismuth Subcarbonate, Bismuth Subgallate, Bismuth Subnitrate, and *Bismuth Subsalicylate*—All of these compounds of bismuth are basic salts and are of slightly variable composition. Each one, however, is required to yield, when ignited to constant weight, a given percentage of bismuth trioxide (Bi_2O_3). It is not difficult to expel the volatile matter from the subcarbonate and the subnitrate, but in the other two salts a slight modification of the procedure is necessary, as the residue from the ignition of the subgallate, or the subsalicylate, is cooled, treated with nitric acid, and re-ignited. This is done for the purpose of oxidizing any organic matter or carbon, and to prevent the reduction of the bismuth trioxide to metallic bismuth which would vitiate the results of the assay. *Caution—Metallic bismuth readily forms fusible alloys with metals, hence bismuth salts should not be ignited in platinum crucibles.*

Bismuth Magma—This is evaporated to dryness and the residue ignited to bismuth oxide in the usual manner.

Glycerite of Bismuth—The bismuth is first precipitated as sulphide by using hydrogen sulphide in the presence of free hydrochloric acid. This is then converted into nitrate, by solution in nitric acid. The bismuth is subsequently precipitated from this solution as basic carbonate which is washed and ignited to bismuth oxide in the usual manner.

Precipitation Followed by Ignition.

This method applies to substances which are estimated, by ignition, as an oxide, after first precipitating them in some other form.

Alum—Alum is first dissolved in distilled water containing ammonium chloride, which serves as an accessory reagent by making the subsequent precipitation more complete. Ammonia water is added in slight excess to the boiling solution and aluminum hydroxide is precipitated. Using ammonia-alum as an example, the reaction is expressed as follows:

$$\underset{\text{aluminum and ammonium sulphate}}{Al(NH_4)(SO_4)_2.12H_2O} + \underset{\text{ammonium hydroxide}}{3NH_4OH} = \underset{\text{aluminum hydroxide}}{Al(OH)_3} + \underset{\text{ammonium sulphate}}{2(NH_4)_2SO_4} + \underset{\text{water}}{12H_2O}$$

The precipitated aluminum hydroxide is then collected on a filter, washed, dried, and ignited. In the ignition the hydroxide is converted into aluminum trioxide according to the following equation:

$$\underset{\text{aluminum hydroxide}}{2Al(OH)_3} = \underset{\text{aluminum oxide}}{Al_2O_3} + \underset{\text{water}}{3H_2O}$$

The ignition is continued until the weight of the residue becomes constant.

Exsiccated Alum—The assay for exsiccated alum is essentially identical with that given above for alum.

Aluminum Chloride and Aluminum Sulphate—The equations involved in the actual precipitations are expressed as follows:

$$\underset{\text{aluminum chloride}}{AlCl_3} + \underset{\text{ammonium hydroxide}}{3NH_4OH} = \underset{\text{aluminum hydroxide}}{Al(OH)_3} + \underset{\text{ammonium chloride}}{3NH_4Cl}$$

$$\underset{\text{aluminum sulphate}}{Al_2(SO_4)_3} + \underset{\text{ammonium hydroxide}}{6NH_4OH} = \underset{\text{aluminum hydroxide}}{2Al(OH)_3} + \underset{\text{ammonium sulphate}}{3(NH_4)_2SO_4}$$

The remaining parts of these assays are identical with the description given above for the assay of alum.

Solution of Aluminum Acetate and Solution of Aluminum Subacetate—Aluminum hydroxide is precipitated from these solutions by means of ammonia water, in the presence of ammonium chloride. This is then separated by filtration, washed, dried, and ignited to aluminum oxide, as described under the above assay for alum.

Calcium Glycerophosphate—This salt is dissolved in distilled water with the aid of acetic acid. The mixture is heated to boiling and treated with an excess of ammonium oxalate T.S., which causes the precipitation of calcium oxalate. This precipitate is collected on a filter, washed, dried, and ignited to constant weight. The decomposition during this ignition is illustrated by the following equation:

$$\underset{\text{calcium oxalate}}{CaC_2O_4} = \underset{\text{calcium oxide}}{CaO} + \underset{\text{carbon dioxide}}{CO_2} + \underset{\text{carbon monoxide}}{CO}$$

NOTE—Calcium glycerophosphate may also be determined gravimetrically by direct ignition to calcium pyrophosphate. The decomposition is expressed as follows:

$$\underset{\text{calcium glycerophosphate}}{2C_3H_5(OH)_2PO_4Ca} + \underset{\text{oxygen (air)}}{7O_2} = \underset{\text{calcium pyrophosphate}}{Ca_2P_2O_7} + \underset{\text{carbon dioxide}}{6CO_2} + \underset{\text{water}}{7H_2O}$$

Zinc Acetate—An aqueous solution of this salt is made alkaline with ammonia water, warmed, and then the zinc is precipitated as sulphide, by adding an excess of ammonium sulphide T.S. The reaction is expressed as follows:

$$\underset{\text{zinc acetate}}{Zn(C_2H_3O_2)_2} + \underset{\text{ammonium sulphide}}{(NH_4)_2S} = \underset{\text{zinc sulphide}}{ZnS} + \underset{\text{ammonium acetate}}{2NH_4C_2H_3O_2}$$

The precipitate is collected on a filter, washed, and dissolved in hot, diluted nitric acid, whereby the zinc sulphide is converted into nitrate, as follows:

$$\underset{\text{zinc sulphide}}{ZnS} + \underset{\text{nitric acid}}{2HNO_3} = \underset{\text{zinc nitrate}}{Zn(NO_3)_2} + \underset{\text{hydrogen sulphide}}{H_2S}$$

The solution of zinc nitrate is then evaporated to dryness, ignited to constant weight, and weighed as zinc oxide, the final decomposition being expressed as follows:

$$\underset{\text{zinc nitrate}}{Zn(NO_3)_2} = \underset{\substack{\text{zinc}\\\text{oxide}}}{ZnO} + \underset{\substack{\text{nitrogen}\\\text{tetra-oxide}}}{2NO_2} + \underset{\text{oxygen}}{O}$$

Zinc Sulphate and Zinc Phenolsulphonate—The descriptions of these assays are identical with that given above for zinc acetate.

Gravimetric Estimation as Sulphide.

Determinations of this type are based upon the separation and the weighing of an insoluble sulphide.

Corrosive Mercuric Chloride—The mercury is completely precipitated from an acidified solution of this salt by means of hydrogen sulphide, the reaction being expressed as follows:

$$\underset{\substack{\text{mercuric}\\\text{chloride}}}{HgCl_2} + \underset{\substack{\text{hydrogen}\\\text{sulphide}}}{H_2S} = \underset{\substack{\text{mercuric}\\\text{sulphide}}}{HgS} + \underset{\substack{\text{hydrochloric}\\\text{acid}}}{2HCl}$$

The mercuric sulphide is then collected on counterbalanced filters and washed successively with distilled water, alcohol, and with carbon tetrachloride to remove free sulphur. It is then dried at 110° C. until of constant weight. The observed weight is then calculated to a corresponding weight of mercuric chloride, by applying the factor given in the U. S. P. text.

Ammoniated Mercury—This compound is converted into mercuric chloride by dissolving it in a warm solution of hydrochloric acid, according to the following equation:

$$\underset{\substack{\text{ammoniated}\\\text{mercury}}}{HgNH_2Cl} + \underset{\substack{\text{hydrochloric}\\\text{acid}}}{2HCl} = \underset{\substack{\text{mercuric}\\\text{chloride}}}{HgCl_2} + \underset{\substack{\text{ammonium}\\\text{chloride}}}{NH_4Cl}$$

From this point the assay is similar to that just given above for mercuric chloride.

Poison Tablets of Corrosive Mercuric Chloride—An aqueous solution of one of the tablets is used in the determination, a single tablet being taken to check the individual content of corrosive mercuric chloride. The assay is identical with that explained above under corrosive mercuric chloride.

The Precipitation of Barium Sulphate.

The following assays involve the precipitation of barium sulphate and its subsequent ignition to constant weight:

Sodium Sulphate—A hot, acidulated solution of this salt is treated with an excess of barium chloride T.S. whereby the sulphate reacts with a corresponding amount of barium as follows:

$$\underset{\substack{\text{sodium}\\\text{sulphate}}}{Na_2SO_4} + \underset{\substack{\text{barium}\\\text{chloride}}}{BaCl_2} = \underset{\substack{\text{barium}\\\text{sulphate}}}{BaSO_4} + \underset{\substack{\text{sodium}\\\text{chloride}}}{2NaCl}$$

The barium sulphate is then collected on a filter, washed, dried, and ignited to constant weight, the weight being calculated to sodium sulphate by applying the factor given in the U. S. P. text.

Potassium Sulphate—The description of this assay is identical with the one given above for sodium sulphate.

Sulphonated Bitumen—(For ammonium sulphate content.) After thoroughly washing the sulphonated bitumen with alcohol and a mixture of alcohol and ether, neither of which dissolve the ammonium sulphate, the residue is dried, cooled, and washed with warm acidulated water. The ammonium sulphate is determined in the aqueous filtrate by means of barium chloride solution, as described on page 1479 in the assay of sodium sulphate.

Sublimed Sulphur, Precipitated Sulphur, and Washed Sulphur—Each of the forms of sulphur is first converted into soluble potassium polysulphides by boiling with potassium hydroxide. The sulphides are then oxidized to potassium sulphate by means of hydrogen dioxide. The following is a typical equation showing the oxidation of one of these polysulphides:

$$\underset{\text{potassium sulphide}}{K_2S} + \underset{\text{hydrogen dioxide}}{4H_2O_2} = \underset{\text{potassium sulphate}}{K_2SO_4} + \underset{\text{water}}{4H_2O}$$

The solution containing potassium sulphate is then acidified with hydrochloric acid and treated, while hot, with an excess of barium chloride T.S., whereby the original sulphur is completely precipitated as barium sulphate. This is then filtered off, washed, dried, and ignited to constant weight.

Sulphonated Bitumen—(For sulphur content.) A mixture of the sulphonated bitumen and sodium peroxide is ignited by means of a red-hot iron wire, in a nickel crucible, and the fused mass is then boiled with acidulated distilled water. The sulphur is thus converted, by means of this fusion and oxidation, into sodium sulphate. This is then precipitated as barium sulphate by means of barium chloride solution, as explained in the above assay for sodium sulphate. The weight of barium sulphate found is then calculated to sulphur by using the corresponding molecular and atomic weights.

Gravimetric Estimation as Lithium Sulphate.

Lithium Benzoate—Weighed portions of the dried powder, and of ammonium sulphate, are mixed and ignited in a crucible until the weight is constant. Double decomposition takes place as follows:

$$\underset{\text{lithium benzoate}}{2LiC_7H_5O_2} + \underset{\text{ammonium sulphate}}{(NH_4)_2SO_4} = \underset{\text{lithium sulphate}}{Li_2SO_4} + \underset{\text{ammonium benzoate}}{2(NH_4)C_7H_5O_2}$$

The residue, after ignition, consists only of lithium sulphate, the ammonium benzoate having been removed by reason of its volatile character. The weight of lithium sulphate found is then calculated to lithium benzoate by making use of the factor given in the N. F. text.

The Gravimetric Estimation of Magnesium.

These assays require the precipitation of magnesium-ammonium phosphate and the subsequent weighing of the ignited residue of magnesium pyrophosphate.

Magnesium Sulphate—The addition of the sodium phosphate T.S. and ammonia T.S. causes the precipitation of the magnesium as magnesium-ammonium phosphate. The reaction is expressed as follows:

$$\underset{\text{magnesium sulphate}}{MgSO_4} + \underset{\text{sodium phosphate}}{Na_2HPO_4} + \underset{\text{ammonia}}{NH_3} = \underset{\text{magnesium-ammonium phosphate}}{MgNH_4PO_4} + \underset{\text{sodium sulphate}}{Na_2SO_4}$$

The precipitate is then filtered, washed, dried, and ignited to constant weight. During the ignition, the magnesium-ammonium phosphate is converted into magnesium pyrophosphate by the loss of ammonia and water, according to the following equation:

$$\underset{\text{magnesium-ammonium phosphate}}{2MgNH_4PO_4} = \underset{\text{magnesium pyrophosphate}}{Mg_2P_2O_7} + \underset{\text{ammonia}}{2NH_3} + \underset{\text{water}}{H_2O}$$

The weight of the residue is then calculated to magnesium sulphate, using the factor given in the U. S. P. text.

Solution of Magnesium Citrate—This solution is first evaporated to dryness and the residue ignited to convert the magnesium citrate into magnesium oxide and to remove most of the carbonaceous matter. Each molecule of magnesium citrate yields three molecules of magnesium oxide, as follows:

$$\underset{\text{magnesium citrate}}{2Mg_3(C_6H_5O_7)_3} + \underset{\text{oxygen}}{51O} = \underset{\text{magnesium oxide}}{6MgO} + \underset{\text{carbon dioxide}}{36CO_2} + \underset{\text{water}}{15H_2O}$$

The insoluble oxide is then dissolved in diluted hydrochloric acid to convert it into magnesium chloride, according to the following equation:

$$\underset{\text{magnesium oxide}}{MgO} + \underset{\text{hydrochloric acid}}{2HCl} = \underset{\text{magnesium chloride}}{MgCl_2} + \underset{\text{water}}{H_2O}$$

The magnesium is precipitated from this solution by means of sodium phosphate T.S. and ammonia T.S., in the form of magnesium-ammonium phosphate, as explained under the assay of magnesium sulphate, page 1480. The ignition of this precipitate to magnesium pyrophosphate is also explained under magnesium sulphate (see above).

The Gravimetric Estimation of Manganese.

These assays require the precipitation of an insoluble compound of manganese and its subsequent ignition to manganous-manganic oxide.

Soluble Manganese Citrate—The manganese in this salt is first oxidized from the divalent to the tetravalent condition by means of peroxide of hydrogen in the presence of ammonia water which immediately precipitates manganic hydroxide. This precipitate is then filtered, washed, dried and ignited to constant weight, yielding a residue of manganous-manganic oxide (Mn_3O_4).

Soluble Manganese Glycerophosphate—The manganese is precipitated chiefly as sulphide in the presence of ammonia water and the mixture is boiled. The precipitate is then filtered, washed, dried, and ignited in an open crucible until its weight becomes constant. During this ignition the manganese is oxidized to manganous-manganic oxide (Mn_3O_4).

GASOMETRIC METHODS OF ANALYSIS

This type of assay method is based upon the evolution of a gas of definite composition. After adjusting the volume of the evolved gas to normal conditions of temperature and pressure, the corrected volume is converted into weight. The weight of the evolved gas is then calculated to a corresponding weight of the substance being determined. The following official substances are assayed by this general method:

Amyl Nitrite—The reagents that bring about the evolution of gas from amyl nitrite are potassium iodide and sulphuric acid, alcohol serving as the mutual

solvent. The gas evolved is nitric oxide (NO) and this gas is measured by means of an apparatus called a nitrometer, a full description of which is given on page 1517. The reaction involved is expressed as follows:

$$\underset{\text{amyl nitrite}}{2C_5H_{11}NO_2} + \underset{\substack{\text{potassium}\\\text{iodide}}}{2KI} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{2H_2SO_4} = \underset{\text{amyl alcohol}}{2C_5H_{11}OH} + \underset{\substack{\text{potassium}\\\text{bisulphate}}}{2KHSO_4} + \underset{\text{iodine}}{I_2} + \underset{\substack{\text{nitric}\\\text{oxide}}}{2NO}$$

Factors for the correction of the temperature and the barometric pressure are given in the U. S. P. text, page 1518.

Spirit of Ethyl Nitrite—This preparation is first agitated with potassium bicarbonate to neutralize free acid. An alcoholic solution of the product is then made to react with potassium iodide and sulphuric acid in a nitrometer (see page 920). Nitric oxide (NO) is evolved, according to the following equation:

$$\underset{\text{ethyl nitrite}}{2C_2H_5NO_2} + \underset{\substack{\text{potassium}\\\text{iodide}}}{2KI} + \underset{\substack{\text{sulphuric}\\\text{acid}}}{2H_2SO_4} = \underset{\text{ethyl alcohol}}{2C_2H_5OH} + \underset{\substack{\text{potassium}\\\text{bisulphate}}}{2KHSO_4} + \underset{\text{iodine}}{I_2} + \underset{\text{nitric oxide}}{2NO}$$

The factors for correcting the temperature and the barometric pressure are given in the U. S. P. text, page 1518.

SPECIAL ASSAY METHODS

Determining the Ability of a Soluble Sulphide to Precipitate Heavy Metals.

Sulphurated Potassa—The value of sulphurated potassa is estimated by having it precipitate copper sulphide from a solution containing a given weight of copper sulphate. One Gm. of the sulphurated potassa is required to precipitate 1 Gm. of copper sulphate from aqueous solution, subsequently testing for copper in the filtrate. Although the sulphurated potassa is a complex sulphide, the principle of the reaction may be illustrated by the following equation:

$$\underset{\substack{\text{copper}\\\text{sulphate}}}{CuSO_4} + \underset{\substack{\text{potassium}\\\text{sulphide}}}{K_2S} = \underset{\substack{\text{copper}\\\text{sulphide}}}{CuS} + \underset{\substack{\text{potassium}\\\text{sulphate}}}{K_2SO_4}$$

The Absorption of a Gas in a Solvent.

Oxygen—This assay depends upon the solubility of oxygen gas in an alkaline solution of pyrogallol. A measured volume of the gas is agitated with the alkaline solution of pyrogallol, in a calibrated tube, whereby, due to the absorption of the oxygen, a shrinkage in the volume of the gas is observed and noted.

Determination of Optical Rotation by Means of the Polariscope.

Spirit of Camphor—After taking the mean of several readings of the optical rotation of the spirit, the solvent is completely removed by evaporation. The residue of camphor is then sublimed and a weighed portion is dissolved in alcohol, to make a solution of standard strength. The mean of several polariscope readings from this solution is then taken as before. The two readings should be identical. If different, the amount of camphor in the original spirit can be calculated by following the directions given in the text of the U. S. P. assay, page 309.

The Estimation of Aldehydes and Ketones in Volatile Oils.

Determinations that depend upon the removal of an aldehyde or a ketone by means of sodium bisulphite, subsequently noting the volume of residual liquid.

Oil of Caraway, Oil of Cinnamon, and Oil of Spearmint—The active principles sought in the assay of these oils are the ketone, *carvone*, in both oil of caraway and oil of spearmint and the aldehyde, *cinnaldehyde*, in oil of cinnamon.

Aldehydes and ketones have the general property of combining with the alkaline bisulphites to form condensation products which separate from the oil. The reaction may be illustrated as follows:

$$NaHSO_3 + C_{10}H_{14}O = C_{10}H_{14}\begin{matrix}ONa\\HSO_3\end{matrix}$$

sodium bisulphite — carvone — carvone-sodium bisulphite

The sodium sulphite undergoes hydrolysis in solution, yielding sodium bisulphite and sodium hydroxide, as follows:

$$Na_2SO_3 + H_2O = NaHSO_3 + NaOH$$

sodium sulphite — water — sodium bisulphite — sodium hydroxide

The liberated alkali is constantly neutralized by the addition of more sodium bisulphite in solution.

The shrinkage in volume of the immiscible oil corresponds to the volume of carvone, or of cinnaldehyde present in the original oil.

Estimation of Ascaridol.

Oil of Chenopodium—A measured volume of this oil is agitated with a solution of acetic acid in a cassia flask (see Fig. 533). This renders the ascaridol water-soluble. The proportion of ascaridol present in the oil can then be determined by noting the volume of immiscible oil that remains.

Determinations by Electrolysis.

Alternate methods for the estimation of copper, mercury, silver and zinc by electrolysis are provided in the U. S. P. X., and are fully explained in the section on "Electrolytic Determinations", page 1515.

FIG. 533

Cassia flask

The Estimation of Phenols in Volatile Oils.

One of the main chemical properties of a phenol is its power to react with caustic alkali to form a water-soluble substance known as a phenolate.

Oil of Clove—A carefully measured volume of oil of clove is agitated with standard potassium hydroxide solution, in a cassia flask (see Fig. 533), and the volume of immiscible oil remaining after the agitation is noted. This is explained by the fact that eugenol, the chief constituent of oil of clove, is a phenol. During the agitation the eugenol is separated from the oil in the form of a water-soluble compound. The oily, non-eugenol residue is measured and its volume is subtracted from the volume of the original oil. The difference in volume corresponds to the volume of eugenol which has undergone the change described, or the amount present in the oil of clove.

Oil of Pimenta and Oil of Thyme—The assay of these oils involves the estimation of the phenols, eugenol and thymol, respectively. Both of these are

determined by agitation with caustic alkali solution, according to the method described above for oil of clove. The alkali prescribed in the oil of thyme assay is sodium hydroxide.

The Estimation of Phenols in Compound Solution of Cresol.

Liquor Cresolis Compositus—This solution is made possible by the combination of the cresol with caustic alkali to form water-soluble cresolates. In the assay these cresolates are decomposed by sodium bicarbonate as follows:

$$\underset{\text{sodium cresolate}}{C_6H_4CH_3ONa} + \underset{\substack{\text{sodium}\\\text{bicarbonate}}}{NaHCO_3} = \underset{\text{cresol}}{C_6H_4CH_3OH} + \underset{\substack{\text{sodium}\\\text{carbonate}}}{Na_2CO_3}$$

The liberated cresol is then distilled with purified kerosene and is subsequently removed from the kerosene distillate by agitation with a measured volume of aqueous sodium hydroxide solution. This treatment changes the cresol back into a soluble cresolate, increasing the volume of aqueous liquid. It is this increase in volume that is recorded as being due to the cresol. The cresol is later separated from the aqueous solution by adding an excess of hydrochloric acid. After washing the separated cresol with saturated salt solution, and drying with potassium carbonate, it should then meet the requirements for cresol as indicated in the text.

The Determination of Invert Sugar by Means of Fehling's Solution.

Sucrose—Fehling's solution is not directly reduced by pure sucrose. The presence of invert sugar, which is composed of equal molecules of the reducing sugars, dextrose and levulose, does effect a reduction of the copper salt with the formation of red cuprous oxide. The weight of dried cuprous oxide obtained should not exceed the figure given in the U. S. P. text and corresponds to not more than 0.5 per cent of invert sugar in the sucrose.

CHAPTER LXXXVIII

PROXIMATE ASSAYS

Proximate assays are applied particularly to the examination of vegetable drugs or other plants to determine the amount of medicinally active ingredients or other valuable constituents which may be present. The separations are dependent largely upon the use of various solvents, resulting from elaborate and painstaking research. Little use is made of the reagents customarily employed in chemical analyses, such as strong mineral acids and various salts; but chloroform, ether, alcohol, amyl alcohol, petroleum benzin, and other solvents assume an important rôle.

The term proximate assay is generally associated with the alkaloidal content of vegetable drugs and, while this is correct, there are many other important applications of the term.

The determination of the alcohol-soluble constituents in resinous drugs, as in asafetida, the volatile oil in aromatic drugs, as in clove, the fixed oil in various seeds, as in linseed, or in other oil-bearing portions of plants, and even the estimation of the sugar content of the sugar cane or of the sugar beet are examples of proximate assays. By proximate assay, therefore, is meant the determination of the amount of any organic constituent which may be present in any vegetable drug or plant.

Alkaloidal assays present, however, the most important application of proximate assay methods with which the pharmacist has to deal.

ALKALOIDAL ASSAYS

Work of a quantitative nature must necessarily be done with great care and in conducting proximate assays of alkaloidal drugs particular attention must be paid to all details.

The alkaloidal substances to be separated are organic chemical compounds, which are difficult to extract from the drug. They are present in comparatively small quantities and in many cases are easily destroyed by improper manipulation.

These assays are conducted largely through the use of immiscible solvents, such as chloroform, ether, amyl alcohol, etc., except where the properties of the alkaloid sought necessitates a special method, as for morphine in opium. Advantage is taken of the fact that the free alkaloids are practically insoluble in water (except colchicine and a few others), whereas they are very soluble in one or more of the immiscible solvents, such as chloroform, ether, etc. The salts of the alkaloids behave in the reverse manner, being practically insoluble in the immiscible solvents and soluble in water. There are several exceptions, such as the salts of caffeine, theobromine, colchicine, etc., which are feebly basic and dissociate easily with the liberation of the free alkaloid.

Three general steps are required for the separation and estimation of alkaloids:

1. Extraction of the alkaloid from the drug.
2. Purification of the alkaloid.
3. Estimation of the amount of alkaloid obtained, either by weighing or titrating.

Extraction of the Crude Drug.

The drug is reduced to the proper fineness by grinding (see page 157), and then subjected to any special treatment which may be directed, as in the caffeine assay in coffee when the fat is first removed by petroleum benzin. The powdered drug is then ready for extraction, the method depending upon the alkaloid present. Special methods for certain alkaloids are necessary.

The extraction methods may be divided into three classes:

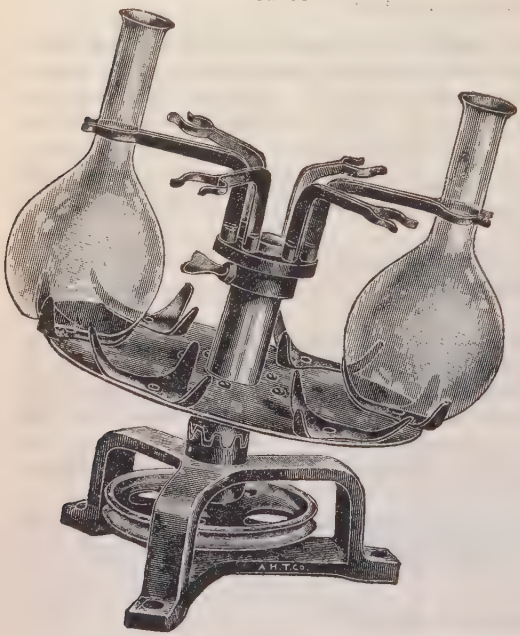
1. Extraction with water. (Estimation of morphine in opium, and colchicine in colchicum corm and seed.)

2. Extraction with an acid-aqueous solution. (Not required by any official assay.)

3. Extraction with chloroform, ether, or with a mixture of the two, or with purified petroleum benzin, an alkali, usually ammonia water, being added to liberate the alkaloids. (Belladonna, nux vomica, conium, etc.)

The extraction process under class 3 is used extensively in the U. S. P. X and N. F. V and is further subdivided into two methods of procedure as follows:

Fig. 534



Mechanical shaker

Type Process A—Aliquot Part Method—A definite weight of drug is macerated and agitated with a specific volume of solvent. A definite fractional portion of the saturated solvent is then taken for the continuation of the assay. This represents a correspondingly smaller quantity of the drug than was originally taken.

Type Process B—Total Extraction Method—A definite weight of the drug is percolated with the immiscible solvent until the alkaloid is completely extracted.

The extraction of crude drugs by type process A necessitates frequent shaking and when more than an occasional sample is to be examined the employment of a mechanical shaker will save much time, and will also insure more complete extraction of the drug (see Figs. 534 and 535).

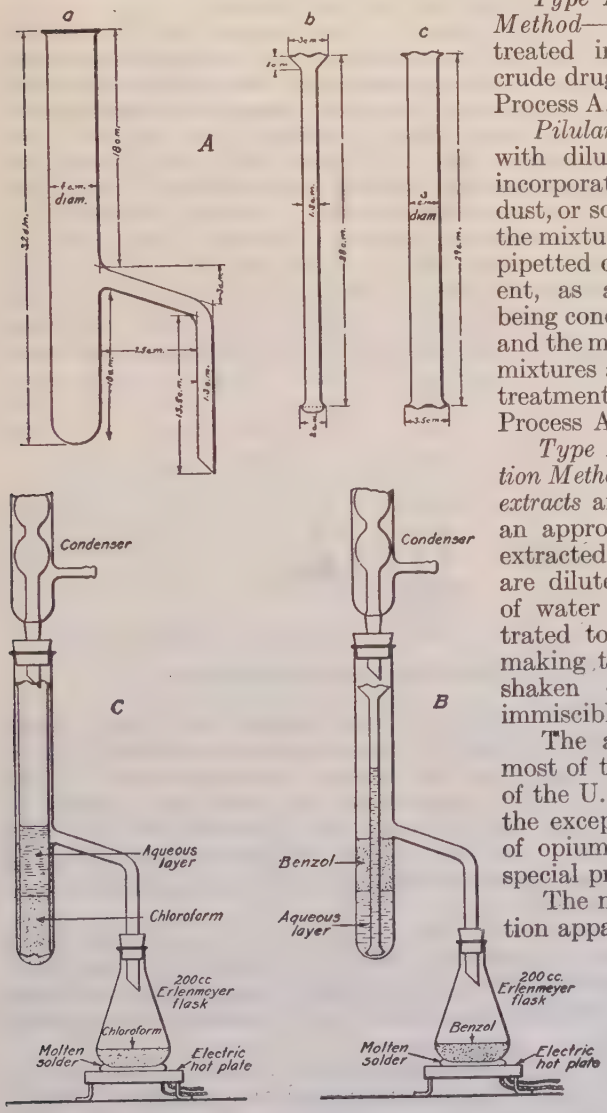
Fig. 535

Mechanical shaker

Extraction of Galenicals.

The assay processes for extracts, fluidextracts, tinctures, and powdered extracts of an alkaloidal drug are similar to those described for the crude drug, the details being as follows;

FIG. 536



Automatic extraction apparatus for alkaloids

Type Process C—Aliquot Part Method—Powdered extracts are treated in the same manner as crude drugs, explained under Type Process A.

Pilular extracts are liquefied with dilute alcohol, the solution incorporated with sufficient sawdust, or some other absorbent, and the mixture dried. *Fluidextracts* are pipetted directly upon the absorbent, as are also *tinctures* after being concentrated by evaporation and the mixture dried. These dried mixtures are then subjected to the treatment described under Type Process A for crude drugs.

Type Process D—Total Extraction Method—Powdered and *pilular extracts* are liquefied by the use of an appropriate solvent and then extracted directly. *Fluidextracts* are diluted with an equal volume of water and *tinctures* are concentrated to a small volume. After making the mixture alkaline it is shaken out, directly, with the immiscible solvent.

The above methods apply to most of the galenical preparations of the U. S. P. X and N. F. V with the exception of the preparations of opium and colchicum for which special procedures are required.

The need for automatic extraction apparatus for use in the assay of alkaloidal galenicals prompted the designing of an improved apparatus by chemists of the Drug Control Laboratory of the Bureau of Chemistry[1], Department of Agriculture. The simple type is easily constructed, requires only a small amount of solvent and practically no attention, and gives a clear extraction in one operation.

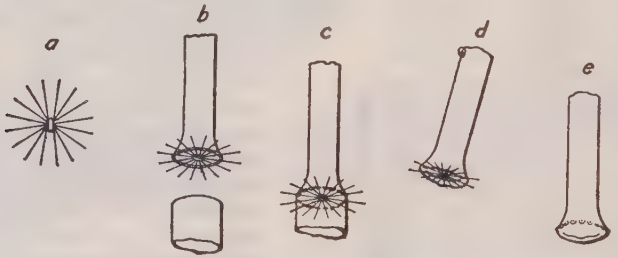
Automatic Extraction Apparatus—In the simple type of apparatus (Fig. 536)

[1] Automatic Devices for Extracting Alkaloidal Solutions by S. Palkin, A. G. Murray, and H. R. Watkins. Ind. and Eng. Chem., 1925, page 612.

the same jacket, condenser, and boiling flask are used for light and heavy solvents. For light solvents the funnel tube (*b*), containing very small openings at its lower end, is used in the jacket, as shown in *B*. For heavy solvents, as shown in *C*, the wide tube (*c*) open at both ends is used. The manner in which the extractors function is shown by the illustrations.

The construction of the funnel tube (*b*) is shown in Fig. 537. For the purpose of forming in the lower end of this tube a large number of very small openings, which break the solvent into a spray of minute droplets a "spider" (*a*) made of nichrome wire of the proper diameter is attached to the expanded end of the funnel tube (*b*). Another piece of tubing is then sealed to this expanded end, so as to leave the wires of the spider projecting through the walls of the tube (*c*). The tube below the spider is now sealed off as close to the wires as practicable (*d*). Upon dissolving the wire in nitro-hydrochloric acid, uniform openings of the size desired are formed (*e*). Soft glass is not as suitable for this purpose as hard glass, as the soft glass tends to flow over the wire, thus making subsequent solution in acid difficult. Pyrex is a suitable glass for this part of the apparatus. On account of the small diameter of the wire used (0.31 mm.), the spider cannot be made of copper because that metal would not

FIG. 537



Construction of funnel tube for automatic extraction apparatus

withstand the heat necessary to soften the glass. Although nichrome is resistant to the action of individual acids, there is no particular difficulty in dissolving it in boiling aqua regia. The spider is readily made as follows: Eight pieces of the nichrome wire, about 2.5 cm. long, are made into a bundle by binding the wires at the center with a short piece of stout copper wire, bent over and pressed tight with pliers. The sixteen branches are then spread out so as to extend radially from the copper band as a center and spaced equally apart, as shown in (*a*) (Fig. 537).

The completed funnel tube may be tested by forcing water through it under slight pressure, as the head is insufficient for water, although quite adequate for a hot solvent. These two extremely simple types of apparatus are sufficient for the great majority of extractions required in the pharmaceutical proximate assay.

For use with substances more difficult to extract, modified apparatus is suggested, in which the solvent enters the aqueous solution wholly or partly in the form of vapor, thus producing vigorous agitation and more rapid extraction than is obtained by the simple forms (see the original article).

Preparation of Solution—To obtain a clean alkaloidal residue by one extraction, the fluidextract or tincture is de-alcoholized and partially purified as follows: 25 cc. of the fluidextract (for tinctures use 100 cc.) and 3 cc. of normal sulphuric acid are evaporated on a steam bath to about 10 cc. and the resulting concentrate is diluted to 50 cc. and filtered.

Extraction—The apparatus shown in *B*, Fig. 536, is used. A 20 cc. portion of the filtrate (representing 10 cc. of the original sample) is pipetted into the extractor, which has been fitted to a 200 cc. Erlenmeyer flask. Two cc. of 8 per cent ammonium hydroxide solution and about 25 cc. of benzene are then added and the whole is slightly shaken to prevent the settling of any solid matter on the bottom of the extractor. The narrow funnel tube (*A*, *b*) (with the fine holes at the bottom) is introduced, and benzene is added until about 50 cc. overflows into the flask. The extractor is then arranged as shown in *B*. When the apparatus is in full operation there should be brisk boiling.

NOTE—Care should be taken not to permit the boiling to go on so rapidly as to cause the emulsion to be carried over into the flask. If this cannot be prevented, the extraction is allowed to proceed to completion, when the extracted aqueous liquid is discarded and the contents of the flask returned to the extractor, the flask washed with about 20 cc. of water and some fresh benzene, again transferred to the extractor, and the extraction repeated.

A fine spray of benzene should rise through the aqueous layer. The extraction is carried on for one or two hours. When complete, the benzene overlying the aqueous layer is separated and added to the main concentrate in the flask, which is connected to a clean, dry extractor (*A*), and the bulk of the solvent is recovered. The remainder of the solvent in the flask is then evaporated on a steam bath, the residue of alkaloids is taken up in a little absolute alcohol, and the evaporation is repeated to remove all traces of ammonia. The amount of alkaloid is determined in the usual way by titration.

Ipecac preparations are treated in a similar manner, but the solvent is ether, since the Pharmacopœial standard is based on the ether-soluble alkaloids. A 20 cc. portion of the fluidextract, with 5 cc. of normal sulphuric acid in a 100 cc. volumetric flask, is evaporated to a small volume, diluted, etc., and a 20 cc. aliquot portion of the filtrate (representing 4 cc. of the original fluidextract) is taken for the extraction.

Purification of the Alkaloid.

With the exception of the method using the automatic extraction apparatus, and in cases of tablets containing the pure alkaloids or their salts, the initial extraction is unsuitable for evaporating for final determination. The immiscible solvents remove other constituents such as oils, tannins, and soluble coloring, and these would interfere with the end-point in a titration or would add to the weight in a gravimetric assay. The purification of the alkaloid is therefore necessary. The methods used for this purpose vary according to the physical properties of the alkaloid sought.

1. *Crystallization*—While practically all alkaloids manufactured on a commercial scale are purified by crystallization, there is only one official assay which utilizes this method.

The value of opium and its products is based upon the morphine content and in this assay the morphine is separated by crystallization from many other alkaloids present. (See Opium assay, page 1498.)

2. *By Precipitation of Interfering Substances*—In the assay of colchicum corm and seed, a special method for removing interfering substances is necessary, since colchicine is feebly basic and does not form stable salts and also because it is very soluble in water. Coloring matter and other interfering substances are therefore removed by precipitation, by the addition of an excess of lead acetate.

3. *By Immiscible Solvents*—This method finds a greater use than any other in the U. S. P. and N. F. The alkaloid which has been removed in its free state from the crude drug or galenical by the use of some organic solvent is further purified by washing the organic solvent in a separatory funnel (Fig. 344) with

dilute acid. This converts the free alkaloid into the corresponding salt of the acid employed, when it is soluble in an aqueous solution only. For the final estimation it is necessary to have the free alkaloid and this is obtained by adding an excess of some alkali, usually ammonia water, to the acid washings. The alkaloid thus liberated by the addition of the alkali is then removed from the resulting alkaline mixture, by the use of an additional quantity of the immiscible solvent.

The operations involved in the transposition of the free alkaloid to the alkaloidal salt and then again to the free alkaloid, remove nearly all of the substances which might interfere with its final quantitative estimation.

4. *By Distillation*—A few of the alkaloids are volatile and may be separated or purified by steam distillation. The most important of this group are nicotine and coniine. Conium which is official in the National Formulary is assayed by the immiscible solvent method. Tobacco, which is not official, is assayed commercially for nicotine by the steam distillation method.[1]

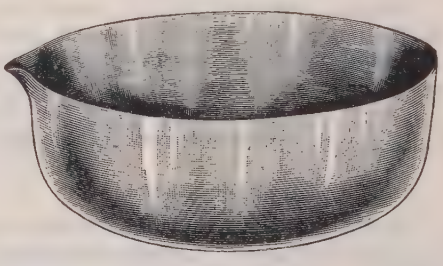
Estimation of the Alkaloid.

All of the U. S. P. X and N. F. V methods of separation and purification leave the alkaloid in the free state and in solution (except the opium assay

Fig. 538

Glass dish

Fig. 539



Platinum dish

where the morphine is crystallized) in some organic solvent as chloroform, ether, or petroleum benzin.

There are two methods official for estimating the amount of alkaloid or alkaloids, namely, the volumetric or titration method and the gravimetric or direct weighing method. The volumetric method is used wherever possible. It is necessary, however, to resort to gravimetric methods in some instances. Caffeine, hydrastine, and a few other alkaloids are only feebly basic and therefore do not lend themselves to titration. The total alkaloids of cinchona are also estimated gravimetrically.

By whichever method the estimation is carried out the alkaloid or mixture of alkaloids must first be separated from the organic solvent. The most economical procedure involves the recovering of the organic solvent for use in a subsequent assay. To do this the alkaloidal solution is very carefully distilled on a water bath until approximately 25 cc. of the solvent remains in the flask.

1. *Direct Gravimetric Method*—All of the official gravimetric methods require the direct weighing of the separated alkaloid or alkaloids. Either the entire final alkaloidal solution, or the alkaloidal solution in the distillation flask, is placed in a tared, glass dish (Fig. 538), or beaker, or preferably in a vessel of platinum (see Fig. 539). The original containers are rinsed with

[1] See the Official Methods of Analysis Association of Official Agricultural Chemist.

small quantities of the same solvent. Final evaporation to dryness is then carried out on a water bath and the residue treated at least twice with small portions of ether or alcohol and evaporated to dryness each time. This removes traces of chloroform. The residue in the dish is finally dried to constant weight at 100° C. (caffeine at 80° C.), the increase in weight being due to the alkaloid or alkaloids in the dish.

2. *Indirect Gravimetric Method*—With many organic and inorganic chemicals, the alkaloids and their salts form compounds which are insoluble in water. Advantage is often taken of this fact in identifying alkaloids and also occasionally in estimating them. The amount of quinine and cinchonidine in cinchona is estimated by the British Pharmacopœia by weighing the insoluble tartrates. Nicotine in tobacco and its extracts is estimated by precipitating the alkaloid with silico-tungstic acid, separating, purifying, and igniting this compound and calculating to nicotine by the use of a factor.

3. *Volumetric Method*—Volumetric alkaloidal assays are based upon the same principles as the volumetric assays of the inorganic chemicals (see page 1449). The alkaloids are capable of forming additive salts with acids, *i.e.*,

$$\underset{\text{morphine}}{2C_{17}H_{19}O_3N} + \underset{\substack{\text{sulphuric}\\ \text{acid}}}{H_2SO_4} = \underset{\text{morphine sulphate}}{(C_{17}H_{19}O_3N)_2.H_2SO}$$

It is this property of which advantage is taken in the volumetric assays.

The treatment of the final extraction is the same as has been explained under the gravimetric method, although a tared dish need not be used. If a porcelain evaporating dish is used for the evaporation, it will aid in the titration by providing a white background against which to observe the color change of the indicator.

To insure a complete reaction between the volumetric acid which is to be used and the partly purified alkaloid, it is usually the custom to add a few cc. of neutral alcohol to bring the alkaloid into solution before adding the acid. Ether or chloroform may also be used in this manner, then the volumetric acid and the distilled water added, and the solvent expelled by gently heating while stirring.

An excess of the standard acid (volumetric solution) is always added in the U. S. P. methods. This insures complete reaction with the alkaloid and leaves an excess of acid which must then be determined so that the amount which has been combined may be calculated. This is accomplished by titrating the excess of acid with fiftieth-normal sodium hydroxide, using an indicator to determine the end-point. Cochineal or methyl red are suitable indicators; the latter, however, is more stable and gives a sharper end-point. The fiftieth-normal sodium hydroxide should be prepared and stored as directed in the U. S. P. and should show no turbidity upon the addition to a small portion of a few drops of a saturated solution of barium hydroxide (*carbonate*). The alkali solution to be used should be standardized against the standard acid solution which is being used, using the same indicator and the same volume of water. When titrating the excess of alkali, in estimating the alkaloid in a proximate assay, the end-point of the reaction should be decided at the same degree of color as was used in standardizing the alkali.

The calculation required for determining the amount of alkaloid found is illustrated by the following typical titration:

Titration of empirical $\frac{N}{50}$ *NaOH*—

Measure exactly 10 cc. of a standard $\frac{N}{10}$ H_2SO_4, add methyl red and titrate: it requires 40 cc. of an empirical $\frac{N}{50}$ NaOH.

The 10 cc. of $\frac{N}{10}$ acid $\times$ 5 = 50 cc. of a strictly standard $\frac{N}{50}$ acid and in this example it corresponds to 40 cc. of the empirical $\frac{N}{50}$ alkali solution.

The alkali is therefore stronger than normality and the factor is $\frac{50}{40}$ of the normal strength, that is, every cc. of alkali solution used is equal to 1.25 cc. of standard $\frac{N}{50}$ alkali.

Alkaloidal Titration in an Assay of Nux Vomica—

To the alkaloids from 5 Gm. of nux vomica add 5 cc. of neutral alcohol to bring them into solution, then add 10 cc. of the $\frac{N}{10}$ acid. Warm gently to complete the reaction between the acid and the alkaloids. Now add a few drops of methyl red indicator, 25 cc. of distilled water, and titrate with the empirical $\frac{N}{50}$ alkali. There is now required 24 cc. of the empirical $\frac{N}{50}$ alkali to neutralize the excess of $\frac{N}{10}$ acid. The 24 cc. of empirical $\frac{N}{50}$ NaOH $\times$ 1.25 = 30 cc. of a strictly standard $\frac{N}{50}$ NaOH. Then 30 cc. of standard $\frac{N}{50}$ NaOH $\div$ 5 = 6 cc. of $\frac{N}{10}$ NaOH and 6 cc. $\frac{N}{10}$ NaOH is the equivalent of the uncombined $\frac{N}{10}$ H_2SO_4. As 10 cc. of $\frac{N}{10}$ H_2SO_4 was originally taken, by subtracting the 6 cc. of $\frac{N}{10}$ NaOH it is found that 4 cc. of $\frac{N}{10}$ H_2SO_4 was consumed by the alkaloids.

Each cc. of $\frac{N}{10}$ H_2SO_4 represents 0.03642 Gm. of nux vomica alkaloids. Multiply this by 4 cc. of the consumed $\frac{N}{10}$ H_2SO_4: it shows 0.14568 Gm. of alkaloids from the nux vomica.

Now 10 Gm. of nux vomica was originally extracted with 100 cc. of ether-chloroform and half of this used. Therefore the 0.14568 Gm. (or 145.68 mg.) of alkaloids has been obtained from 5 Gm. of nux vomica. The per cent strength of the nux vomica is then 0.1456 Gm. $\times$ 20 = 2.912 Gm. in 100 Gm. or 2.912 per cent.

If reference is made to the molecular weight of strychnine, it will be found to be 334.3. This is not the weight (364.2) that is used for calculating the alkaloidal content of nux vomica. The weight 364.2 is obtained by a calculation based on the average amount of strychnine (334.3) and brucine (466.4) normally present in nux vomica. This utilization of the molecular weight of the combined alkaloids, which is different from that of the chief alkaloid, will be found in a number of instances.

FACTORS OF IMPORTANCE IN PROXIMATE ASSAYS

1. The drug must be of proper fineness.
2. The agitation must be for a definite time.
3. The extraction must be for the required period.
4. The extraction with immiscible solvents must be complete. Test with mercuric potassium iodide T.S. or iodine T.S.
5. There must be a sharp separation of immiscible solvents.
6. Carefully avoid loss of material by spurting, on account of pressure created in the separatory funnel.
7. Avoid emulsions; these can often be broken up by rotating a rubber tipped stirring rod against the walls of the separatory funnel, by gently warming, by adding more solvent, or by the addition of a few cc. of alcohol, delivered into the organic solvent.
8. To ensure freedom of the final organic extraction from ammonium salts, filter through paper wetted with the solvent. If the alkaloid is pure it may spatter when final portions of the solvent are evaporated. The addition of a few cc. of alcohol will generally prevent this.

9. Do not subject the alkaloids of hyoscyamus to a high temperature. In examining hyoscyamus remove the dish from the source of heat just before the last few cc. of solvent are evaporated, and continue the evaporation spontaneously.
10. In gravimetric assays avoid drying at too high a temperature.
11. In volumetric assays be sure that all of the alkaloid is brought into solution so that it may react with the standard acid.

The Official General Directions for Alkaloidal Assays are as Follows:

Fineness of Powders

The portion to be assayed, which must represent the entire drug, is to be in powder of specified fineness. This is interpreted to mean that the drug powder must not be coarser than the size specified, but finer powders may be used.

Extraction of the Alkaloids

Extraction with Immiscible Solvents—For the extraction of alkaloids from an ethereal or chloroformic solution, use dilute acid. The strength of the acid and the quantity employed are left to the discretion of the operator, but it is advisable to use the smallest quantity which can be conveniently handled. Shaking should not be violent, but should be sufficient to mix the liquids thoroughly without forming an emulsion. The extraction with acid must be repeated until the alkaloid is completely removed from the ethereal or chloroformic liquids. Each portion of acid solution as drawn off should be filtered through cotton or filter paper. If preferred, the combined acid solutions may be washed with a little chloroform or ether, this in turn washed with distilled water, and the water added to the acid solution.

In shaking out an alkaline aqueous solution with an immiscible solvent, the process must be repeated until the extraction of the alkaloid is complete. Each portion of solvent as drawn off should be filtered through cotton or filter paper.

Care must be taken to avoid loss of alkaloidal solutions through imperfect separation, creeping, or other similar conditions.

Ether-Chloroform Mixture—When a mixture of ether and chloroform is employed, the proportion of the mixture is to be three volumes of ether and one volume of chloroform, cooled to working temperature after being mixed.

Evaporation of Solvents—The evaporation of the final alkaloidal solution may be conducted by distillation, by evaporation on a water bath, or by means of a current of warm air. In evaporating chloroform solutions, the residue should be treated with ether or alcohol, which is in turn evaporated to carry off the last traces of chloroform.

As the alkaloids from hyoscyamus are very sensitive to heat, a solution of these alkaloids should not be evaporated to dryness on a water bath. After the last trace of chloroform has evaporated spontaneously, 1 or 2 cc. of neutral alcohol should be added and warmed but not entirely evaporated, then cooled and titrated immediately.

Titration of the Alkaloid—When the alkaloid is to be estimated by titration, the residue is dissolved in neutralized alcohol, the volumetric acid, accurately measured, is added, and followed by a convenient quantity of distilled water. The excess of acid is immediately determined by titration with fiftieth-normal sodium hydroxide. If preferred, the residue is dissolved in ether or chloroform, the volumetric acid and distilled water added, and the ether or chloroform expelled by gentle heat before titrating.

Indicators—The indicators to be employed in the titration of alkaloids are cochineal T.S. and methyl red T.S. These are interchangeable and either may be used at the discretion of the operator.

Gravimetric Determination—When the alkaloid is to be estimated gravimetrically, the solvent is evaporated, as above directed, in a tared flask or beaker. The residue is dried to constant weight at 100° C. and weighed.

Type Processes for Alkaloidal Assays

Type Process A for Drugs—Aliquot Part Method

Extraction of the Drug—Place the accurately weighed drug in a dry flask or bottle of suitable capacity, add the required volume of solvent, accurately measured, stopper securely with a well-fitting cork stopper and shake. Allow to stand for at least five minutes, add 10 cc. of ammonia T.S., stopper tightly, and shake for one hour in a mechanical shaker, or intermittently during two hours. In the case of intermittent shaking, agitation must be vigorous for at least one minute and be repeated at intervals of not more than fifteen minutes. Allow the mixture to stand overnight, again shake intermittently during one-half hour, and then allow the drug to settle. If the supernatant liquid is not clear, add a few cc. of distilled water, shake vigorously, and again allow to settle.

Decant an aliquot part of the liquid, accurately measured at approximately the same temperature at which the original solvent was measured. Transfer the liquid to a separator, rinsing the measuring container with a small quantity of the solvent and adding the rinsing to the separator.

Shaking out with Acid—Completely extract the alkaloid from the ethereal or chloroformic solution by shaking with successive portions of dilute sulphuric acid, and filtering each portion drawn off or washing with ether or chloroform if preferred. After extracting with several portions of acid, test a few drops of the last portion used for the presence of alkaloid. Extraction must be continued until not more than a very faint cloudiness results upon the addition of a drop of mercuric potassium iodide T.S. or, in the case of hydrastis or colchicum, upon the addition of a drop of iodine T.S.

Shaking out with Immiscible Solvent—Add a portion of the specified solvent to the combined acid solutions and make the mixture alkaline with ammonia T.S. Completely extract the alkaloid from the aqueous liquid with successive portions of the solvent, filtering each portion as drawn off. After extracting with several portions of the solvent, evaporate about 1 cc. of the last portion used, dissolve the residue in a few drops of dilute acid, and test for the presence of alkaloid. Extraction must be continued until not more than a very faint cloudiness results upon the addition of a drop of mercuric potassium iodide T.S. or, in the case of hydrastis or colchicum, upon the addition of a drop of iodine T.S.

Determination of Alkaloidal Content—Determine the alkaloid volumetrically or gravimetrically as directed.

Type Process B for Drugs—Total Extraction Method

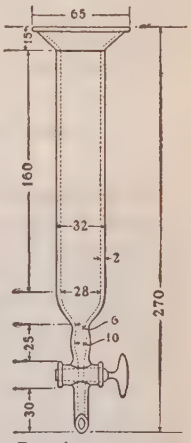
Extraction of the Drug—Place an accurately weighed quantity of the ground drug in a small cylindrical percolator (see Fig. 540), previously prepared by packing the outlet with cotton. Add a sufficient amount of the solvent to saturate the drug completely and mix thoroughly. Cover the percolator and allow it to stand at least five minutes, then add 5 cc. of ammonia T.S., and mix this thoroughly with the drug. After macerating for one hour, pack the

drug firmly, place a pledget of cotton above it and percolate slowly with the solvent until the drug is completely extracted. The percolation must be continued until upon evaporating 3 or 4 cc. of the percolate, dissolving the residue in a few drops of dilute acid, and adding a drop of mercuric potassium iodide T.S., only a very faint cloudiness results.

Any suitable percolator may be used, but one similar in form and size to that illustrated is recommended.

From this point proceed as directed under *Type Process A*, beginning with the words "Transfer the liquid to a separator", page 1494.

FIG. 540



Percolator recommended for Type Process B (measurements are given in millimeters).

TYPE PROCESS C FOR GALENICAL PREPARATIONS—ALIQUOT PART METHOD

Preparation of the Sample—*Powdered Extracts*—When powdered extracts are assayed by the aliquot part method, they are to be treated as directed, under the powdered drug. If the extract has a tendency to form lumps in the solvent, mix it with an equal bulk of clean sand or powdered pumice. If lumps form after the addition of the ammonia, they should be disintegrated by the addition of a little water.

Pilular Extracts—Liquefy an amount of extract, accurately weighed, approximating the quantity directed, by warming with sufficient diluted alcohol, or with the menstruum used in making the extract, stirring with a glass rod. To the thoroughly liquefied extract, contained in a small evaporating dish, add sufficient sawdust or other suitable material (see below) to absorb the liquid, and dry at a temperature not exceeding 60° C. Transfer the dry mixture to a flask or bottle containing the specified quantity of solvent, and remove any traces of material adhering to the dish by rinsing with successive small portions of ammonia T.S., using a total of 10 cc. and adding the ammoniacal rinsings to the solvent. Continue as directed under Type Process A, beginning with the words "stopper tightly and shake for one hour", page 1494, fourth line.

Fluidextracts—Pipette the fluidextracts directly upon the sawdust, or other suitable material (see below), contained in a small evaporating dish, dry at a temperature not exceeding 60° C. and transfer as directed under *Pilular Extracts* to a flask or bottle containing the specified quantity of solvent. Proceed as directed under Type Process A, beginning with the words "stopper tightly and shake for one hour", page 1494, fourth line.

Tinctures—Concentrate the specified quantity of tincture by evaporation at a temperature not exceeding 60° C. to a volume of about 10 to 15 cc., add sufficient sawdust or other suitable material (see below) to absorb the liquid, and continue the heat until dry. Transfer the dry mixture, as directed under *Pilular Extracts*, to a flask or bottle containing the specified quantity of solvent. Then proceed as directed under Type Process A, beginning with the words "stopper tightly and shake for one hour", page 1494, fourth line.

Absorbents—The absorbent employed may be sawdust, gauze, cheesecloth, paper pulp, asbestos fiber, absorbent cotton, or any similar suitable substance. Sawdust should be clean, not resinous, and must not show the presence of alkaloids when tested as follows: Macerate 5 Gm. in 50 cc. of ether-chloroform mixture and 10 cc. of ammonia T.S., shaking frequently during two hours. Decant 10 cc. of the clear ethereal liquid, evaporate to dryness, and treat the

residue with 1 cc. of diluted sulphuric acid. Test portions of the acid liquid for alkaloids with mercuric potassium iodide T.S. and with iodine T.S.

If necessary, sawdust may be purified for use in assays by extracting it in a percolator, first with a 1 per cent solution of sodium hydroxide, then with a 1 per cent solution of hydrochloric acid, finally washing with distilled water until free from acid and soluble salts, and drying. The last portions of the acid percolate must give no test for alkaloid with mercuric potassium iodide T.S. or with iodine T.S.

Type Process D for Galenical Preparations—Total Extraction Method

Preparation of the Sample—*Powdered and Pilular Extracts*—Liquefy an amount of extract, accurately weighed, approximating the quantity directed, by digesting in about 10 cc. of diluted alcohol, or in the menstruum used in making the extract. Transfer the liquid to a separator containing a portion of the specified solvent, and rinse all traces of the extract from the dish, using small portions of diluted alcohol, or menstruum, and adding the rinsings to the separator. Dilute the alcoholic liquid with an equal quantity of distilled water, add sufficient ammonia T.S. to make it decidedly alkaline, and completely extract the alkaloids by shaking with successive portions of the solvent. Complete the assay as directed under Type Process A, beginning with the words "Shaking out with acid".

Fluidextracts—Pipette the fluidextracts directly into a separator containing a portion of the specified solvent, add a volume of distilled water about equal to that of the fluidextract taken, render the liquid alkaline by the addition of ammonia T.S., and completely extract the alkaloids by shaking out with successive portions of the solvent. Complete the assay as directed under Type Process A, beginning with the words "Shaking out with Acid", page 1494.

Tinctures—Concentrate the specified quantity of tincture by evaporation at a temperature not exceeding 60° C. to a volume of about 10 to 20 cc. Transfer the concentrated liquid to a separator containing a portion of the specified solvent, and rinse all traces of the liquid from the dish, using small portions of diluted alcohol, and adding the rinsings to the separator. Add a volume of distilled water equal to that of the alcoholic liquid, render the liquid alkaline by the addition of ammonia T.S., and completely extract the alkaloids by shaking out with successive portions of the solvent. Complete the assay as directed under Type Process A, beginning with the words "Shaking out with acid".

Explanations of the Proximate Assays of the U. S. P. X and N. F. V

Belladonna Leaves—Type Process B.

The ground drug, which must be at least in a fine (No. 60) powder, is extracted by type process B (see page 1494), the total extraction method. The addition of ammonia liberates the alkaloids and they are then removed by percolation with ether-chloroform mixture (see page 1493). The percolate should be concentrated by evaporation or distillation if more than 100 cc. It is then placed in a separatory funnel and shaken out with dilute acid (25, 20, 20 and 20 cc. portions of 0.5 per cent sulphuric acid). The shaking should be rotatory and not violent, to avoid emulsification. Each acid extraction is passed into a separatory funnel through filter paper placed in a funnel. A few cc. of the last extraction should be drawn off into a test tube and a drop of

mercuric potassium iodide T.S. added. No turbidity should appear, indicating that the "shaking out" has been complete. If turbidity appears, additional acid extractions should be made. The acid extractions are now rendered alkaline by the addition of ammonia water to again liberate the alkaloids. They are now extracted with several portions of chloroform (25, 20 and 20 cc.). The addition of the chloroform should be made cautiously, as the mixture may be quite warm and this might cause boiling and subsequent loss. Each chloroformic extraction is filtered as drawn off and a few cc. of the last extraction are evaporated, taken up in dilute acid, and tested with mercuric potassium iodide T.S. If turbidity results, more chloroform extractions are made until complete extraction is obtained. The extractions are now evaporated on a water bath and the alkaloids obtained and titrated as already described. The amount of alkaloid found, expressed in grams and multiplied by 10, will indicate the per cent present in the drug.

Belladonna Plaster—The plaster mass, consisting of the adhesives and the extract of belladonna, is removed from the backing by washing with chloroform. The rubber is then precipitated by adding alcohol. A small quantity of ammonia T.S. is now used to convert the alkaloidal salts of the extract into free bases, the rubber is separated, and the general process is then followed (see Belladonna Leaves, page 1496).

Belladonna Root—Type Process B. (See Belladonna Leaves, page 1496.)

Cinchona—Type Process A. Add the acid and water to the ground cinchona as directed on page 1113, and apply heat. This is done to make the subsequent liberation of the alkaloids easier by breaking up their combination with tannin. The flask in which this operation has been conducted is now cooled, the ether-chloroform mixture added, and then 10 cc. of ammonia water to liberate the alkaloids. The subsequent "shake outs" are carried on in the same manner as under Belladonna Leaves. All of the final chloroform extractions are evaporated in a weighed dish and dried at 100° C. The increased weight, expressed in grams, and multiplied by 25, will give the per cent of alkaloids in the drug.

Colchicum Corm—(See Colchicum Seed).

Colchicum Seed—The alkaloid colchicine, found in the seed or corm, is very soluble in water and therefore does not lend itself to the usual shaking out methods. The drugs are extracted with warm water to which is added lead acetate to precipitate the resins, soluble coloring matter, etc. The extraction is now filtered and the excess lead removed with sodium phosphate and the mixture again filtered. The colchicine is now extracted from the aqueous solution with chloroform and the chloroformic extractions are evaporated. A small portion of alcohol is added, it is again evaporated to dryness, and this is repeated. The addition of the alcohol breaks down any compound which the alkaloid may have formed with the chloroform. After drying at 100° C., the weight of the dish with the residue is determined, then a quantity of $\frac{N}{10}$ H_2SO_4 and distilled water are added to bring the alkaloid into solution. The solution is now filtered through a pledget of absorbent cotton to remove the impurities, the alkaloidal solution is discarded, and the cotton washed with water. The insoluble matter on the cotton is then washed with alcohol, then with ether and the washings evaporated in the dish formerly used and dried at 100° C. The dish and the impurities are again weighed and this total weight subtracted from the first total weight obtained is the weight of the colchicine in the aliquot portion of drug taken.

Extract of Belladonna—Type Process D. The extract is brought into solution by using diluted alcohol and is then extracted with chloroform after

having been made alkaline. This solution is treated exactly as directed for the percolate under the Assay of Belladonna Leaves, page 1496.

Extract of Colchicum—(See Colchicum Seed, page 1497.)

Extract of Hyoscyamus—Type Process D. (See Extract of Belladonna, page 1497.)

Extract of Nux Vomica—Type Process D. (See Extract of Belladonna, page 1497.)

Extract of Stramonium—Type Process D. (See Extract of Belladonna, page 1497.)

Fluidextract of Belladonna Leaves—Type Process D. To a definite portion of the fluidextract add an equal quantity of water and make the solution alkaline. Extract this with chloroform and treat the chloroformic extractions as directed for the chloroform percolate under Belladonna Leaves, page 1496.

Fluidextract of Belladonna Root—Type Process D. (See Fluidextract of Belladonna Leaves, above.)

Fluidextract of Cinchona—Type Process C. Pipette a portion of the fluidextract onto an absorbent substance such as sawdust, sand, or asbestos (see Absorbents, page 1495), and dry this at a temperature below 60° C. Now treat the dried material in the same manner as the crude drug, omitting the initial acid treatment.

Fluidextract of Colchicum—The fluidextract is diluted with water and then treated as directed under Colchicum Seed, page 1497.

Fluidextract of Hydrastis—Type Process D. The diluted fluidextract is treated as directed under Hydrastis, below.

Fluidextract of Hyoscyamus—Type Process D. (See Fluidextract of Belladonna Leaves, above.)

Fluidextract of Ipecac—Type Process D. (See Ipecac, below.)

Hydrastis—Type Process A. The usual method must be modified so that all of the extractions are made with ether. This eliminates the berberine but removes the hydrastine and other alkaloids. The extracted alkaloids are weighed.

Hyoscyamus—Type Process B. The percolation method is employed for the extraction of the drug, using a mixture of chloroform and ether, with chloroform alone for the final extraction. Great care should be taken in evaporating the final extraction, as the alkaloids of hyoscyamus are easily destroyed by heat. The dish should be removed from the source of heat before all of the chloroform is evaporated and the final chloroform removed by spontaneous evaporation. A small amount of alcohol is then added and the dish *warmed* slightly. Then add the acid and titrate.

Ipecac—Type Process A. In this assay use ether only as the original extracting agent and also as the final organic solvent.

Nux Vomica—Use Type Process A, page 1494.

Opium—The assay of opium is the most elaborate of the assays. This is because the morphine content alone is to be determined, which necessitates the removal of a number of other alkaloids. The alkaloid morphine is present largely as the meconate. In the official process the opium is extracted with water to remove the morphine, codeine, thebaine, and certain other alkaloids, which are present as soluble salts. The narcotine, which is present in quantities of from 1 to 9 per cent, is retained largely in the insoluble residue. The aqueous extract is now concentrated and freshly slaked lime is added. This produces a solution of calcium hydroxide in which morphine, a phenolic body, is soluble. The mixture of lime and opium extract is now filtered, and this eliminates a large amount of the codeine which is only sparingly soluble in the calcium hydroxide solution. The filtrate now contains the

morphine, thebaine, a trace of codeine, and some of the unimportant alkaloids, and the morphine is obtained from this solution by crystallization. Morphine is soluble in solutions of the fixed alkalies but is practically insoluble in very dilute ammonia solutions. Also it is sparingly soluble in ether.

Ether is now added to the aqueous solution and the solution is saturated with it by shaking. A small amount of ammonium chloride is then added, from which ammonia is liberated by the fixed alkali, calcium hydroxide. The mixture is vigorously shaken over a definite period, which removes the traces of codeine and other alkaloids, these being soluble in ether. The morphine which has thus been freed through the addition of the ammonia, gradually crystallizes.

Complete crystallization of the morphine requires several hours and is preferably carried on in a cool place. The morphine appears in abundant crystals which are sometimes large but at other times small, for no apparent reason. These crystals are separated from the mother liquor by first passing the ether through a pledget of absorbent cotton in a funnel, adding more ether to wash, and then transferring the supernatant aqueous liquids also to the funnel. The crystals in the flask are drained and then a few drops of distilled water, which has been previously saturated with morphine, are added. This is poured through the cotton and the operation repeated until the washings are colorless. This washing removes the free ammonia and interfering coloring matter without dissolving the morphine. The morphinated water is now displaced by using a few drops of distilled water. Separation and purification of the morphine is now complete and the crystals are ready to be titrated according to the usual procedure.

Opium Granulated—(See Opium, page 1498).

Opium Powdered—(See Opium, page 1498).

Stramonium—Type Process B. (See Belladonna Leaves, page 1496.)

Tincture of Belladonna—Type Process D. (See Fluidextract of Belladonna Leaves, page 1498.)

Tincture of Cinchona—Type Process C. (See Cinchona, page 1497.)

Tincture of Cinchona, Compound—Type Process C. (See Cinchona, page 1497.)

Tincture of Colchicum—A 150 cc. portion of the tincture is evaporated to small bulk and then diluted with water. The resins and coloring matter are removed with lead acetate and the procedure is then followed as already explained under Colchicum Seed, page 1497.

Tincture of Hyoscyamus—Type Process D. (See Fluidextract of Belladonna Leaves, page 1498.)

Tincture of Nux Vomica—Type Process D. (See Fluidextract of Belladonna Leaves, page 1498.)

Tincture of Opium—An 80 cc. portion of the tincture is evaporated to remove the alcohol. The solution is now treated as under opium, page 1498.

Tincture of Stramonium—Type Process D. (See Fluidextract of Belladonna Leaves, page 1498.)

Assays of the N. F. V.

Extract of Conium—The extract is mixed with a small amount of water and dilute hydrochloric acid. This acid, aqueous mixture retains the coniine while the fat and coloring matter is removed by repeated agitation with small portions of petroleum benzin. These benzin washings are discarded. The alkaloid is now liberated by adding potassium carbonate (ammonium hydroxide cannot

be used). Then petroleum benzin is again used to extract the alkaline mixture, the coniine now being removed. Several extractions are made until all alkaloid is extracted.

The combined petroleum benzin washings of the alkaline mixture are filtered through paper into a flask to remove extraneous matter, and to the filtrate is added 10 cc. of tenth-normal sulphuric acid. The benzin is now evaporated at a gentle heat, stirring frequently, the presence of the acid being necessary to fix the alkaloid since free coniine is volatile.

The excess of acid is titrated in the usual manner and from this the amount of alkaloid present is calculated.

Extract of Hydrastis—Type Process C. The extract is treated as directed for the drug hydrastis, under Type Process A (see Hydrastis, page 1498).

Extract of Ignatia—Type process C. The extract is treated as directed for the drug ignatia (see Ignatia, page 1501).

Fluidextract of Colchicum Corm—The fluidextract is diluted with water and then treated as directed for the aqueous extraction of the drug (see Colchicum Seed, page 1497).

Fluidextract of Guarana—As the alkaloid of guarana is caffeine which does not form stable salts, this necessitates a modification of the usual method of assay. The fluidextract is made alkaline and all of the alkaloid removed by repeated extraction with chloroform. The chloroform extracts are evaporated to dryness at a temperature below 80° C. to avoid loss of caffeine. A quantity of hot water is added to dissolve the alkaloid, and the solution allowed to cool. It is now filtered to remove traces of any non-alkaloidal substance extracted by the chloroform and the filtrate and washings are then completely extracted with chloroform and the chloroformic extracts evaporated in a tared dish. The dish and crude alkaloid in the dish are dried at 80° C. and weighed, and the increase in weight is estimated as caffeine from the amount of fluidextract taken.

Fluidextract of Kola—(Proceed as directed under Fluidextract of Guarana, page 1501).

Fluidextract of Nux Vomica—Type Process D. (Proceed as directed under Fluidextract of Belladonna Leaves, page 1498.)

Tincture of Colchicum Corm, Stronger—The directed quantity of tincture is evaporated to remove the alcohol and then diluted with water. This solution is now treated as directed for the aqueous extract of the drug (see Colchicum Seed, page 1497).

Tincture of Hydrastis—Type Process D. The evaporated tincture is extracted directly with ether (see Hydrastis, page 1498).

Tincture of Ignatia—Type Process D. The evaporated tincture is extracted directly with chloroform (see Fluidextract of Belladonna Leaves, page 1498).

Tincture of Ipecac—Type Process D. The evaporated tincture is extracted with ether only.

Tincture of Opium with Saffron—An 80 cc. portion of the tincture is evaporated to remove the alcohol and then assayed as under Opium, page 1498.

Coffee, Roasted—Caffeine which is the alkaloid present does not form stable salts and this necessitates a special method. A chloroformic extraction of the coffee is made in the presence of ammonia. A portion of this extract which contains the caffeine, and other undesired extractive substances, is evaporated to dryness at a low temperature. The residue is dissolved in about 10 cc. of warm, 1 per cent sulphuric acid, and allowed to cool. This solution is filtered to remove traces of fat and other material and the dish and filter washed with small portions of water. The filtrate and washings are then made

alkaline with ammonia water, then completely extracted with chloroform, and the combined chloroformic extracts evaporated to dryness in a tared dish at 80° C. The increase in weight of the dish is assumed to be due to the caffeine obtained from the coffee.

Conium—The active principle sought in the assay is coniine, a liquid, volatile alkaloid. The extraction of the drug follows the general procedure of type process A (page 1494) except that petroleum benzin is used as the solvent. To liberate the alkaloid it is necessary to use a fixed alkali instead of ammonia water. Evaporation of the final benzin extractions is made in the presence of the tenth-normal acid, as explained under Extract of Conium (page 1499).

Guarana—Caffeine is the alkaloidal constituent of the drug guarana and the assay is that already explained under Roasted Coffee (page 1500).

Ignatia—Type Process A. The aliquot part of the ether-chloroform extract of the drug is treated in the same manner as the chloroform percolate of belladonna leaves (see page 1496).

Kola—(See Guarana, above).

Assaying Alkaloidal Tablets

Among the many important medicinal articles handled by the pharmacist are tablets containing potent alkaloids. These tablets in many cases, especially hypodermic tablets, are relied upon by the physician in emergency to produce quick results. The necessity for the tablets complying with their stated alkaloidal content can be readily seen.

Degree of Accuracy—The following proposed tolerances and methods of analysis for tablets of this character were recommended by the contact committees of the American Drug Manufacturers' Association and the American Pharmaceutical Manufacturers' Association[1] on December 9, 1925, to the Bureau of Chemistry of the United States Department of Agriculture.

Proposed Tolerances in Hypodermic Tablets

Apomorphine hydrochloride	7.5 per cent
Arecoline hydrobromide	7.5 per cent
Caffeine	7.5 per cent
Caffeine and sodium benzoate—to contain of anhydrous caffeine not less than 43.5 per cent nor more than 53.7 per cent of the labeled amount of caffeine and sodium benzoate.	
Cocaine hydrochloride	9.0 per cent
Codeine phosphate—to contain of anhydrous codeine alkaloid not less than 61 per cent nor more than 75 per cent of the labeled content of codeine phosphate.	
Codeine sulphate	9.0 per cent
Morphine and atropine (morphine content)	9.0 per cent
Morphine sulphate	7.5 per cent
Physostigmine salicylate	10.0 per cent
Physostigmine sulphate	10.0 per cent
Pilocarpine hydrochloride	7.5 per cent
Procaine	7.5 per cent
Strychnine sulphate, purporting to contain 1/40 grain or more	7.5 per cent
Strychnine sulphate, purporting to contain less than 1/40 grain	9.0 per cent
Strychnine nitrate, purporting to contain 1/40 grain or more	7.5 per cent
Strychnine nitrate, purporting to contain less than 1/40 grain	9.0 per cent

Methods of Analysis—A sufficient number of tablets should be dissolved to represent 1 grain of the medicament, unless otherwise directed. In no case should less than twenty (20) tablets be used and if these contain more than 1 grain of medicament, an aliquot of the solution, representing 1 grain, should be taken for analysis.

The aqueous solution may now be extracted by hand shaking, using a separatory funnel or by the use of the automatic extraction apparatus (see page 1487).

Apomorphine Hydrochloride Hypodermic Tablets—Dissolve not less than 20 tablets in enough distilled water to make 100 cc. and take an aliquot, equivalent to at least 1 grain of apomorphine hydrochloride. To the aqueous solution add 0.5 Gm. of sodium bicarbonate and shake out with several portions of ether, until the aqueous layer is shown to be completely exhausted of alkaloid, using Mayer's reagent for the

[1] These recommendations are of April, 1926; later reports may be obtained from the Bureau of Chemistry, United States Department of Agriculture, Washington, D. C.

test. Combine the ether extracts in a separatory funnel, and wash three times with 5 cc. portions of distilled water, separating the water carefully and completely after each shaking, and collecting it in a second separatory funnel. Shake out the united water washings once with a small portion of ether. Separate completely and add the ether washings to the combined ether extracts. To the ethereal solution add a measured excess (10 cc.) of N/20 sulphuric acid. Shake the mixture thoroughly and draw off the aqueous layer into a small flask or beaker. Wash the ethereal solution twice more with small portions of distilled water and add to the acid liquid. Finally titrate the excess of acid with N/50 potassium hydroxide, using methyl red as the indicator. Each cc. of N/20 sulphuric acid corresponds to 0.015636 Gm. of apomorphine hydrochloride [$C_{17}H_{17}O_2N$ HCl.$\frac{1}{2}H_2O$].

Arecoline Hydrobromide Hypodermic Tablets—Dissolve not less than 20 tablets in enough distilled water to make 100 cc. and take an aliquot, equivalent to at least 4 grains of arecoline hydrobromide. Add an excess of N/10 silver nitrate, 3 cc. of 10 per cent nitric acid, and 3 cc. of ferric ammonium sulphate T.S. Allow to stand about five minutes, and titrate the excess of silver nitrate with N/10 potassium thiocyanate until a faint brown color persists after shaking. Each cc. of N/10 silver nitrate corresponds to 0.02359 Gm. of arecoline hydrobromide.

Caffeine Hypodermic Tablets—Follow the directions under *Caffeine and Sodium Benzoate Hypodermic Tablets*, multiplying the weight of caffeine obtained by 1.093 to obtain the weight of the caffeine [$C_8H_{10}O_2N_4.H_2O$] in the sample taken.

Caffeine and Sodium Benzoate Hypodermic Tablets—Dissolve not less than 20 tablets in a minimum amount of distilled water in a separatory funnel. Add 3.5 cc. of sodium hydroxide T.S. and shake the mixture with four successive portions of 20 cc., 10 cc., 10 cc., and 5 cc. of chloroform. Pass the chloroform solutions through a filter which has been previously moistened with chloroform, and wash the stem of the funnel and filter with a few cc. of hot chloroform to remove any adhering caffeine. Evaporate the combined chloroform solutions on a water bath and dry the residue, consisting of anhydrous caffeine [$C_8H_{10}O_2N_4$] to constant weight at 80° C.

Cocaine Hydrochloride Hypodermic Tablets—Dissolve not less than 20 tablets in sufficient distilled water to make 100 cc. and take an aliquot, equivalent to at least 1 grain of cocaine hydrochloride. Make the aqueous solution slightly alkaline with ammonia T.S. and shake out with several portions of ether until the aqueous layer is shown to be completely exhausted of alkaloid, using Mayer's reagent for test. Combine the ether extracts and evaporate one-half of the ether on a water bath.

Return the solution to a separatory funnel and wash out three times with 5 cc. portions of distilled water, separating the water carefully and completely after each shaking, and collecting it in a second separatory funnel. Shake out the water washings once with a small portion of ether. Separate completely and add the ether washing to the combined ether extracts. To the ethereal solution add a measured excess (10 cc.) of N/20 sulphuric acid, shake the mixture thoroughly and draw off the aqueous layer into a small flask or beaker. Wash the ethereal solution twice more with small portions of distilled water and add to the acid solution. Finally, titrate the excess of acid with N/50 sodium hydroxide, using methyl red as the indicator. Each cc. of N/20 sulphuric acid corresponds to 0.016983 Gm. of cocaine hydrochloride [$C_{17}H_{21}O_4N$HCl].

Codeine Phosphate Hypodermic Tablets—Follow the directions under *Codeine Sulphate Hypodermic Tablets* except that the ammonia T.S. is replaced by sodium hydroxide T.S. and the chloroform extraction is to be washed with a small quantity of distilled water. Each cc. of N/20 sulphuric acid corresponds to 0.014964 Gm. of anhydrous codeine alkaloid [$C_{18}H_{21}O_3N$].

Codeine Sulphate Hypodermic Tablets—Dissolve not less than 20 tablets in sufficient distilled water to make 100 cc. and take an aliquot, equivalent to at least 1 grain of codeine sulphate. Make the aqueous solution alkaline with ammonia T.S. and shake out with several portions of chloroform, until the aqueous solution is shown to be exhausted of alkaloid, using Mayer's reagent for the test. Evaporate the combined chloroform extracts to dryness on the water bath, and dissolve the residue in a few cc. of neutral alcohol. Add 10 cc. of N/20 sulphuric acid and titrate the excess of acid with N/50 potassium hydroxide, using methyl red as the indicator. Each cc. of N/20 sulphuric acid corresponds to 0.019663 Gm. of codeine sulphate [$(C_{18}H_{21}O_3N)_2H_2SO_4.5H_2O$].

Morphine Sulphate Hypodermic Tablets—Dissolve not less than 20 tablets in sufficient distilled water to make 100 cc. and take an aliquot, equivalent to at least 1 grain of morphine sulphate. Render the aqueous solution slightly alkaline with ammonia T.S., and shake out six times with a mixture consisting of 3 parts of chloroform and 1 part of alcohol. Evaporate the combined extracts to dryness on a water bath and dissolve the residue in a few cc. of neutral alcohol. Add 10 cc. of N/20 sulphuric acid and titrate the excess of acid with N/50 potassium hydroxide. Each cc. of N/20 sulphuric acid corresponds to 0.018962 Gm. of morphine sulphate [$(C_{17}H_{19}O_3N)_2H_2SO_4.5H_2O$].

Optional Method—Follow the directions as given under *Morphine and Atropine Hypodermic Tablets*.

Morphine and Atropine Hypodermic Tablets (for morphine content)—Take a sufficient number of tablets to represent about 8 grains of morphine sulphate, place in a 100 cc. Erlenmeyer flask, and dissolve in 12 cc. of morphinated water. Add, drop by drop, ammonia T.S., until the odor of ammonia is apparent. Shake thoroughly, and let the flask stand in a cool place overnight. Collect the crystals of morphine alkaloid on a filter, wash the crystals with morphinated water and then with a little distilled water to replace the morphinated water. Place the filter paper and contents in an Erlenmeyer flask and add 20 cc. of N/10 sulphuric acid. Break up the filter paper with a glass rod, heat for about one hour, until the alkaloid is completely dissolved, and then titrate with N/50 potassium hydroxide, using methyl red as the indicator. Each cc. of N/10 sulphuric acid corresponds to 0.037932 Gm. of morphine sulphate U. S. P. [$(C_{17}H_{19}O_3N)_2H_2SO_4.5H_2O$].

Physostigmine Sulphate or Physostigmine Salicylate Hypodermic Tablets—Follow the directions under *ApomorphineHydrochloride Hypodermic Tablets* except to evaporate ether extractions first on a water bath and finally spontaneously. Each cc. of N/20 sulphuric acid corresponds to 0.016215 Gm. of physostigmine sulphate [$(C_{15}H_{21}O_2N_3)_2H_2SO_4$] or 0.02066 Gm. of physostigmine salicylate [$C_{15}H_{21}O_2N_3C_7H_6O_3$].

Pilocarpine Hydrochloride Hypodermic Tablets—Follow the directions under *Codeine Sulphate Hypodermic Tablets*. Each cc. of N/20 sulphuric acid corresponds to 0.012234 Gm. of *pilocarpine hydrochloride* [$C_{11}H_{16}O_2N_2HCl$].

Procaine Hydrochloride Hypodermic Tablets—Follow the directions under *Codeine Sulphate Hypodermic Tablets* except to evaporate the extractions at room temperature in a tared dish. The weight of the residue multiplied by 1.1545 corresponds to the weight of the procaine hydrochloride [$C_{13}H_{20}O_2N_2HCl$] in the sample taken.

Strychnine Sulphate or Strychnine Nitrate Hypodermic Tablets—Follow the directions given under *Codeine Sulphate Hypodermic Tablets*. Each cc. of N/20 sulphuric acid corresponds to 0.021414 Gm. of strychnine sulphate [$(C_{21}H_{22}O_2N_2)_2H_2SO_4.5H_2O$], or to 0.01986 Gm. of strychnine nitrate [$C_{21}H_{22}O_2N_2HNO_3$].

CHAPTER LXXXIX

BIOLOGIC ASSAYS

THE number of drugs and their preparations to which it is necessary to apply *Biologic Assay* methods is not large. Most chemical substances such as the various bromides, chlorides, sulphates, etc., being definite chemical compounds of *known composition*, can be satisfactorily assayed by chemical methods. Chemical methods may also be used for such drugs as opium, belladonna, nux vomica, etc., in which the active constituents can be isolated in the *pure form* by chemical processes.

There are, however, a number of drugs and their preparations which *cannot* be satisfactorily assayed by chemical methods, either for the reason that their active principles are *not known* or that they *cannot be quantitatively isolated in the pure state* by any of the known chemical methods. In this list are found such important drugs in common use as *digitalis, strophanthus, squill, convallaria, apocynum, aconite, solution of epinephrine hydrochloride, solution of pituitary, ergot, cannabis, gelsemium, and veratrum.* Since there are no satisfactory chemical methods of assay for this list of drugs, recourse must be had to standardization by *biologic methods.*

The necessity for applying biologic assay methods to this class of drugs and their preparations is apparent when we consider that Edmunds and Hale[1], Roth[2], and Pittenger[3] have shown that *unstandardized preparations of these drugs vary in strength from 0 to 444 per cent.*

It is not only essential to know that a drug contains valuable medicinal properties, but in order to secure the best therapeutic results these must be present in the commercial preparations in definite and constant amounts. With the above list of drugs this assurance can be obtained only by means of *biologic standardization.*

The U. S. P. IX included the following statement in reference to *Biologic Assays:*

"Inasmuch as there are several drugs more or less extensively used in the treatment of disease for which no satisfactory chemical method of assay has been developed, other assays have been introduced in which these drugs are administered to animals and the effects noted. From the results obtained from these assays the strength of the preparation is calculated, and, if necessary, proper corrections are made so that the preparation shall conform to the standard which has been adopted. The official drugs to which these methods of assay have been applied in the following pages, are the members of the digitalis group, cannabis, and aconite, and the suprarenal gland.

"Brief descriptions of the more commonly accepted methods are given here in order, first, to direct the attention of manufacturers to them; second, to ascertain the points of weakness which may exist in them; and, finally, to outline methods and establish standards which those interested may adopt should they desire to assay their products and have them conform to the standards proposed. All preparations thus assayed and made to conform to these standards may be labeled 'Physiologically Assayed and Standardized According to the U. S. P. IX.'

---

[1] Edmunds and Hale, U. S. Hygienic Lab. Bull. No. 48, p. 10.
[2] Roth, U. S. Hygienic Lab. Bull. No. 102, p. 5.
[3] Pittenger, "Biochemic Drug Assay Methods," p. 6.

"In the case of cannabis and its preparations, the biologic assay standards are compulsory."

During the period in which the U. S. P. IX was official, the various biologic assay methods were improved to a point where it was considered advisable, in the interest of uniformity, to make a greater number of methods compulsory.

The U. S. P. X, therefore, includes compulsory biologic assays for the following drugs and preparations: Aconitine, Aconite and its tincture, Cannabis and its fluidextract, Digitalis and its tincture, Ergot and its fluidextract, Squill and its fluidextract and tincture, Strophanthus and its tincture, Solution of Epinephrine Hydrochloride, and Solution of Pituitary.

The purpose of the biologic assay, just as of the chemical assay, is to secure a means of measuring therapeutic activity and to make it possible to furnish uniform preparations. A satisfactory method which meets these requirements may or may not involve the production of physiologic reactions similar to those produced by the drug when used therapeutically. That the physiologic action chosen as a means of standardization does not parallel the clinical effect sought is not sufficient to condemn the method. It is only necessary that the effect chosen as an earmark is always indicative of a good quality of the drug or preparation, and criticisms of methods on the ground that they are *toxic* methods or that the animal chosen is biologically much different from man are made only through a lack of conception of the real purpose of the biologic test, namely, to secure *uniformity*. The determination of the real value of a drug in the treatment of disease in man is another matter entirely.

The various official biologic assay methods may be divided into the following three general types:

Type 1. *Toxic Methods* in which guinea pigs or frogs are used, the value of the drug or preparation depending upon the amount required to produce the death of the animal. Examples: The "one hour frog" method for assaying digitalis, strophanthus, and squill and the "guinea pig" method for assaying aconite.

Type 2. Assays depending upon *the amount of drug or preparation required to produce some specific effect upon the intact animal.* Examples: The assay of cannabis on dogs, the "cock's comb test" for ergot, and the assay of solution of epinephrine hydrochloride for its effect on the blood pressure of dogs.

Type 3. Assays depending upon *the amount of drug or preparation required to produce some definite effect upon an isolated organ.* Example: The action of solution of pituitary on the isolated uterus of the virgin guinea pig.

Type 1—Bio-Assay Methods

The official drugs and preparations which are assayed by Type 1 methods and the biologic assay processes adopted by the Pharmacopœia, are as follows:

DIGITALIS

Digitalis, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose (the minimum dose producing in one hour a stoppage of the ventricle of the heart in systole) not exceeding 0.006 cc. of tincture, equivalent to 0.00,000,05 Gm. of ouabain, for each gram of body weight of frog. It contains not more than 2 per cent of browned leaves, stems, flowers, or foreign organic matter, and yields not more than 5 per cent of acid-insoluble ash.

Assay—Prepare a tincture according to the official process and proceed as directed under *Tinctura Digitalis.*

Tincture of Digitalis, injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.0055 cc. and not more than 0.0065 cc. equivalent to not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each Gm. of body weight of frog.

Assay—Use healthy frogs of the same species (*Rana pipiens* Schreber) and of a fairly uniform size (20 to 30 Gm.).

Storage—Before use, the frogs should be stored in constant temperature tanks, kept in a cool room, preferably where the temperature does not rise above 15° C. The bottom of the tanks should be covered

with running water. The day before the frogs are to be used, a sufficient number should be taken from the storage tanks and placed in a tank, the temperature of which is approximately 20° C. One hour before the assay, they are weighed to within 0.5 Gm. and placed in wire cages or containers in a tank containing water to the depth of about 1 cm. (½ inch), the water being kept at a uniform temperature of 20° C. during the assay.

Dose—The doses of the tincture to be given the frogs are calculated according to the weights of the frogs and are injected into the ventral lymph sac by means of a pipette or glass syringe which is graduated in hundredths of a cubic centimeter. The injection is made into the lymph sac through the floor of the mouth, care being taken not to puncture the skin. The amount of fluid to be injected into the different frogs should be as uniform in quantity as possible, approximately 0.015 cc. for each Gm. of body weight of frog. In case the alcohol content in any preparation after dilution is higher than 20 per cent, the preparation may be subjected to careful evaporation and subsequent addition of distilled water until the original volume is restored and the alcohol content is not above the per cent named. The animal is replaced in its cage in the tank after injection, the temperature being maintained at 20° C.

About fifty-eight minutes from the time of injection, each frog is pithed, the heart is exposed, and its condition examined. For the correct end-reaction, at the expiration of one hour from the time of injection, the ventricle must be in systolic standstill, while the auricles are widely dilated. Following mechanical stimulations, feeble contractions may occur in the auricles and localized contractions in the ventricle, but no general contraction is allowable.

If, when the lymph sac is opened to expose the heart, any of the injected drug is found unabsorbed, the animal must be discarded and not considered in the results obtained.

SQUILL

Squill, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose (minimum dose producing in one hour a stoppage of the ventricle of the heart in systole) not exceeding 0.006 cc. of tincture, equivalent to 0.00,000,05 Gm. of ouabain, for each Gm. of body weight of frog.

Assay—Prepare a tincture according to the official process and proceed as directed under *Tinctura Digitalis.*

Fluidextract of Squill, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.00,055 cc. and not more than 0.00,065 cc. of fluidextract, or the equivalent in Fluidextract of not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each gram of body weight of frog.

Assay—Proceed as directed under *Scilla.*

Tincture of Squill, injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.0055 cc. and not more than 0.0065 cc., equivalent to not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each Gm. of body weight of frog.

Assay—Proceed as directed under *Tinctura Digitalis.*

STROPHANTHUS

Strophanthus, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose (the minimum dose producing in one hour a stoppage of the ventricle of the heart in systole) not exceeding 0.00,006 cc. of tincture, equivalent to 0.00,000,05 Gm. of ouabain, for each gram of body weight of frog.

Assay—Prepare a tincture by the official process and proceed as directed under *Tinctura Digitalis.*

Tincture of Strophanthus, injected into the ventral lymph sac of a frog, has a minimum systolic dose of not less than 0.00,005,5 cc. and not more than 0.00,006,5 cc., equivalent to not less than 0.00,000,046 Gm. and not more than 0.00,000,054 Gm. of ouabain, for each Gm. of body weight of frog.

Assay—Proceed as directed under *Tinctura Digitalis.*

It will be noted, therefore, that for the drugs of the *digitalis series* (digitalis, strophanthus, and squill), the so-called "one hour frog" method is employed. This method consists essentially in ascertaining the minimum dose of the drug or preparation which will bring the heart of a standard sized frog to systolic standstill in one hour.

In routine laboratory work four frogs are generally used for the first series of injections. These are injected as described above with 9/10, 10/10, 11/10 and 12/10 respectively, of the standard dose of the preparation being tested for each gram of body weight of frog. The animals are then placed in cages in the tank, arranged to maintain a temperature of 20° C., and allowed to remain there for fifty-eight minutes. They are then removed, pithed (both brain and cord), the heart is exposed, and its condition noted.

After the primary or trial assay has been carried out and the approximate strength of the preparation ascertained, a second series of frogs are injected in like manner, using doses, the limits of which are considerably narrower than the first series. A third or even fourth series of injections may be necessary to confirm the earlier results. The dose thus found is then compared with the dose of the standard, which is similarly ascertained upon another series of frogs of the same lot. From such a comparison the strength of the unknown preparation can be suitably adjusted.

The use of a standard is made necessary by the fact that frogs differ in their susceptibility to the members of the digitalis series at different seasons of the year. The condition of susceptibility is ascertained and allowed for by the use of a solution of *ouabain* as a standard which in appropriate doses is injected into a series of frogs and their resistance thus determined. The necessary strength of an unknown preparation may be calculated from the dose actually found by the ratio of the standard dose of ouabain to the dose of ouabain found necessary to kill. Thus:

Standard dose of ouabain : Found dose of ouabain :: Standard dose of drug being assayed : Necessary dose of unknown

The standard dose of ouabain is 0.00,000,05 Gm. per Gm. of body weight of frog.

The standard dose of tincture of digitalis to correspond is 0.006 cc. per Gm. of body weight of frog.

If, therefore, in a certain series of frogs the resistance to ouabain is found to be increased so that a dose of 0.00,000,075 Gm. is necessary to stop the heart in systole within one hour, the dose of the tincture of digitalis would also have to be increased to 0.009 cc. and the actual dose found calculated against this, instead of against the standard dose of 0.006 cc. For example: in frogs showing the increased resistance as indicated above, if the tincture being examined assays 0.018 cc. per Gm. of body weight of frog, it is one-half strength.

ACONITE, AND TINCTURE OF ACONITE

Aconite, in the form of the tincture, administered subcutaneously to guinea pigs, has a minimum lethal dose not exceeding 0.0004 cc. of tincture for each gram of body weight of guinea pig. Aconite contains not more than 5 per cent of its stems or 2 per cent of other foreign organic matter.

Assay—Prepare a tincture by the official process, and assay as directed under *Tinctura Aconiti.*

Tincture of Aconite, administered subcutaneously to guinea pigs, has a minimum lethal dose of not less than 0.00,035 cc. and not more than 0.00,045 cc. for each Gm. of body weight of guinea pig.

Assay—Use guinea pigs weighing from 275 Gm. to 325 Gm. each and in good health. Dilute the Tincture with distilled water to make the dose about 1 cc., and inject into the guinea pig under the skin of the abdomen. The standard dose must kill within six hours at least two of every three guinea pigs injected.

The method for the assay of aconite, therefore, consists in determining the *minimum* dose per Gm. of body weight of guinea pig that will prove fatal within six hours, when the drug is subcutaneously injected. This is usually termed the *minimum lethal dose* or "M. L. D."

The usual practice is to inject a series of four guinea pigs with 0.0002, 0.0003, 0.0004, and 0.0005 cc., respectively, of the tincture, per Gm. of body weight of guinea pig. The animals are then placed in cages and allowed to remain six hours; at the end of this time they are examined and a note made of those living and those dead.

The results of this preliminary test, in which the range of dosage is quite wide, enables the investigator to form some idea of the strength of the preparation. Basing the dosage upon these results, other series of guinea pigs are injected with progressively increasing or decreasing doses, as the case may be, still further diminishing the variation between doses, until the smallest amount is found which will prove fatal within six hours. The probable minimum lethal (toxic) dose of the preparation, unless it deviates considerably from that of the standard, is generally obtained by one or two series of injections. In order to determine whether or not this is the true minimum lethal dose, this result is checked by carefully injecting a new series of four pigs, two with the smallest dose that was found to kill, and two with the largest dose that did not kill. If, however, any of this last series show irregularities, further tests must be made.

After thus determining the M. L. D. of the unknown preparation, its percentage strength as compared with the standard is calculated by simple proportion as follows:

M. L. D. of unknown : Standard M. L. D. :: 100 : X

Type 2—Bio-Assay Methods

The official drugs and preparations which are assayed by Type 2 methods and the biologic assay processes and standards adopted by the Pharmacopœia are as follows:

CANNABIS

Cannabis, in the form of the fluidextract, administered by the mouth to dogs in doses not exceeding 0.1 cc. for each kilogram of body weight of dog, produces a degree of incoördination equivalent to that caused by the same dose of the standard fluidextract of cannabis, prepared as directed below. It contains not more than 10 per cent of its fruits, large foliage leaves, stems over 3 mm. in diameter, and not more than 2 per cent of other foreign organic matter. It yields not more than 5 per cent of acid-insoluble ash.

Assay—Use adult dogs which weigh less than 15 kilograms and which are susceptible to the action of Cannabis. The dogs must not be fed for twelve hours before being used and observations should be made within one hour after administration. The same animal must not be used for testing purposes at shorter intervals than three days. Administer the fluidextract in gelatin capsules by the mouth.

Standard Fluidextract of Cannabis

Prepare a composite fluidextract, representing at least ten different lots of Cannabis, conforming to the official botanical description, and administer this fluidextract in gelatin capsules to dogs by the mouth. This standard fluidextract must be so adjusted that it will produce incoördination in dogs which have been found to be susceptible to the action of Cannabis when administered in doses of 0.03 cc. for each kilogram of body weight of dog.

Extract of Cannabis, administered by the mouth to dogs, in doses not exceeding 0.004 Gm. for each kilogram of body weight of dog, produces a degree of incoördination equivalent to that caused by 0.03 cc., for each kilogram of body weight of dog, of the standard fluidextract of cannabis prepared as directed under *Cannabis.*

Assay—Administer the Extract in gelatin capsules, proceeding as directed under *Cannabis.*

Fluidextract of Cannabis, administered by the mouth to dogs in doses not exceeding 0.1 cc. for each kilogram of body weight of dog, produces the same degree of incoördination as that produced by an equivalent dose of the standard fluidextract of cannabis, prepared as directed under *Cannabis.*

Assay—Proceed as directed under *Cannabis.*

The assay of cannabis and its preparations is based upon the fact that this drug produces certain symptoms of muscular incoördination. Within one hour after receiving a dose of suitable size of cannabis the dog loses control of its legs and of the muscles supporting the head, so that, when standing, the feet are usually spread apart to maintain balance. When nothing occurs to attract attention the head droops and the body sways from side to side or anteroposteriorly. A distinct ataxia is present when walking, and, when severely affected, the animal will stagger and fall. If, however, it is spoken to sharply or attention is drawn to anything of interest it may momentarily recover and the typical effects of the drug disappear, but in a few minutes it again relapses into the former condition. As the action of the drug progresses, the muscular incoördination becomes greater and the animal passes into deep, undisturbed sleep. After several hours the effects of the drug slowly disappear and the normal condition returns.

The assay method consists of ascertaining the dose of the preparation to be tested which will produce these symptoms of incoördination in dogs and then adjusting its strength by comparison with a standard preparation.

Dogs—The animals differ considerably in susceptibility to the drug and therefore it is best to make preliminary tests with average-sized doses upon several dogs and select from among them the animals which react easily to the drug. As a rule, fox terriers serve very well for the purpose, but any dog may prove satisfactory. It is best to provide at least two dogs for each assay, but if many samples are to be examined, more dogs will be needed. The dogs should be at least one year old and in normal health and must be kept under

the best sanitary conditions. They may be used repeatedly for the purpose, but not at shorter intervals than three days. Each series of tests should be conducted by the same operator who should be perfectly familiar with the peculiarities of each animal that he may more certainly recognize deviations from the normal. While the tests are being made, the animals should be kept in a quiet room, free from disturbance, and separated so that they cannot see each other.

Preparation of the Drug—The drug may be given most conveniently in the form of the fluidextract which is administered in gelatin capsules. In order to hasten absorption, the animal should not be fed for twelve hours before administering the drug.

Method of Administration—The drug is administered internally by means of a small gelatin capsule. The animal's mouth is opened by forcing the thumb and index finger of the left hand between the jaws, back of the teeth. The capsule is then placed on the back of the tongue with the right hand and the mouth quickly closed; while still holding the mouth shut, the animal can be made to swallow the capsule immediately by slapping it on the throat.

Assay—An average dose of the known or standard preparation is given to one of the dogs and a like dose of the preparation to be standardized is given to the second dog. After one hour both dogs are observed very carefully for symptoms of muscular incoördination. The incoördination is manifested differently in different animals, but in small doses it shows itself most frequently in slight swaying, when the animal is standing quietly, or in some ataxia when it runs about.

The results obtained from the first test should be confirmed after an interval of not less than three days by repeating the administration but reversing the order, that is, giving the known strength drug to the dog which received that of unknown strength before and *vice versa*.

In subsequent tests, the dose of the preparation of unknown strength is modified so as to produce symptoms similar to those produced by the standard. If the preparation to be tested is below the standard in strength, its dose must be increased, or if it is above strength, its dose is lessened until equivalent doses of the two are found. Dogs may be used over long periods of time, even for some years, but occasionally they have to be discarded, as in some cases they seem to learn the effects of the drug and so refuse to stand up. A certain degree of tolerance is sometimes gained which necessitates larger doses.

ERGOT

Ergot produces stimulation of unstriped muscle, partly central, but mainly peripheral, the action being exerted in the ganglionic cells or preganglionic endings. This in turn produces contractions of the uterus, blood vessels, and intestines.

Endeavors to measure these various actions have resulted in the development of three methods of biologic standardization:

1. The blood pressure method.
2. The cock's comb method.
3. The uterine method—(a) in situ; (b) isolated.

The U. S. P. Revision Committee has adopted the *cock's comb method* as the official assay process.

This method consists in determining the minimum amount of fluidextract of ergot necessary to cause the same degree of bluing in the cock's comb and

wattles as that produced by a given amount of a standard preparation, when introduced into the crop or when intramuscularly injected.

The official standard and assay process are as follows:

Ergot, in the form of the fluidextract, administered by intramuscular injection to single-comb, white Leghorn cocks, in doses not exceeding 0.5 cc. for each kilogram of body weight of cock, produces a darkening of the comb, corresponding in intensity to that caused by the same dose of a standard fluidextract of ergot, prepared as directed below. It contains not more than five per cent of seeds, fruits or other foreign organic matter.

Assay—Use single-comb, white Leghorn cocks, which are less than eighteen months of age, and weigh approximately two kilograms. Injections are made deeply into the breast muscles, and the effects are observed within one hour to one hour and a half after the administration of the drug. The same cock must not be used for testing purposes at shorter intervals than two weeks.

Standard Fluidextract of Ergot

Prepare a composite fluidextract, representing at least ten different lots of Ergot, conforming to the official botanical description. This standard fluidextract, which must be aged for at least six months before being standardized by the method described in the preceding paragraph, and must be preserved in a vacuum, when administered by intramuscular injection in doses not exceeding 0.5 cc. per kilogram of body weight of cock, produces darkening of the comb of a single-comb, white Leghorn cock which is less than eighteen months of age, and which weighs approximately two kilograms.

Fluidextract of Ergot, administered by intramuscular injection to single-comb, white Leghorn cocks, in doses not exceeding 0.5 cc. for each kilogram of body weight of cock, produces a darkening of the comb, corresponding in intensity to that caused by the same dose of the standard fluidextract of ergot prepared as directed under *Ergota*.

Assay—Proceed as directed under *Ergota*.

The usual procedure is to inject one cock with a dose of the standard preparation and another with the same dose of the unknown preparation, and within one hour to one hour and a half after the injections have been given, compare the color of the two combs, as the maximum cyanosis seems to be reached in about that time. The color begins to fade soon after, so that at the end of two hours or more, depending on the amount of drug given, the comb will usually appear to be nearly normal. Judging from the results obtained from the first two injections, the dose of the unknown preparation is increased or diminished until that amount is found which will give approximately the same intensity of action as was shown by the color of the comb of the cock injected with the standard. The same cocks may be used for several tests, but the injections should be made at intervals of two weeks to allow sufficient time for complete recovery from the effects of previous administrations of the drug. It should not be considered sufficiently accurate if the first injections of the standard and of the unknown preparations produce the same degree of activity, because it is believed that individual variation in different birds might be sufficiently great to interfere. This variation can be reduced to a minimum, if the order of injection on the succeeding tests is reversed until each preparation has been given to each of several birds in turn. The results are then based on the average of the several injections. The final comparisons demand careful selection of the birds to be injected. A choice of two birds of about the same size and which had previously reacted well to the drug is advisable. With a little practice it is easy to compare the intensity of the discoloration in the two cocks' combs and to so regulate the dose of the drug given as to produce approximately the same degree of reaction. The doses thus obtained will give the relative strength of the two drugs.

Variations may further be avoided by using only such cocks as react alike to a standard preparation, and also by constantly changing the order of injections so that the same cock shall not receive the same specimen of the drug twice in succession.

SOLUTION OF EPINEPHRINE HYDROCHLORIDE

Epinephrine acts peripherally on a variety of structures probably by stimulating the sympathetic nerve endings. Its most important therapeutic action consists in a constriction of the blood vessels with consequent high rise

in blood pressure, a slowing of the heart, due to stimulation of the vagus center, and a direct stimulant and tonic effect on the heart muscle. Of these actions the effect upon the blood pressure presents the best means of biologic standardization.

The official assay, therefore, depends upon the characteristic, transitory, quantitative rise in blood pressure in dogs, produced by the intravenous injection of *submaximal doses* properly diluted.

The official standard and assay process are as follows:

Solution of Epinephrine Hydrochloride, diluted with physiological solution of sodium chloride in the proportion of one part of the Solution of Epinephrine Hydrochloride to 99 parts of the salt solution, and injected intravenously into dogs by the method described below, produces a rise in the systolic blood pressure of the dog corresponding to that produced by an equal amount of the standard solution of epinephrine hydrochloride prepared as directed below.

Assay—Prepare a standard solution of epinephrine hydrochloride from the standard epinephrine by dissolving 0.050 Gm. of epinephrine in 5 cc. of tenth-normal hydrochloric acid, and dilute this to 50 cc. by the addition of distilled water, thus making a 1 in 1000 solution. For the assay, add 1 cc. of this 1 in 1000 solution to 99 cc. of physiological solution of sodium chloride. This dilute solution (1 in 100,000) must be freshly prepared when needed. On account of the possibility of deterioration, the 1 in 1000 solution must have been recently prepared. It will keep for a short time if preserved in amber-colored bottles in a refrigerator, but it must be discarded if any signs of deterioration, such as discoloration, are observed.

Add 1 cc. of the Solution of Epinephrine Hydrochloride to be tested to 99 cc. of physiological solution of sodium chloride, and thoroughly mix.

For the purpose of the assay, the dog to be used should be of medium size and be anesthetized with a suitable anesthetic. It is prepared for blood pressure estimations by inserting a cannula into the carotid artery and connecting the same with a mercury manometer. The trachea may also be exposed and a cannula inserted so that the animal may receive artificial respiration during the course of the experiment if necessary. The injections are made into the exposed femoral vein. Before the test is made, in case any muscular movement such as twitching is present, the dog should receive by intravenous injection a sufficient dose of curare (page 1533), but if the animal is deeply anesthetized, this is not necessary. The dog should also receive a sufficient dose of atropine sulphate (from 0.001 Gm. to 0.002 Gm.) to paralyze the vagi, this paralysis being proved by electrical stimulation. The blood pressure tracing is recorded on a kymograph. Injections must be made at regular intervals of approximately five minutes. Determine the amount of standard solution necessary to cause a rise in blood pressure of from 30 to 60 mm. by injecting intravenously varying doses of the solution and after a satisfactory dose has been ascertained, the uniformity of reaction should be tested by the injection of two or more doses of equal size. If these injections produce approximately equal increases in blood pressure, alternate injections of the solution to be tested and of the standard are made, varying the amount of the unknown until two or more successive injections raise the blood pressure to the same height, indicating that the amount of active agent is the same in the doses used. From the results thus obtained, the strength of the unknown solution may be determined and adjusted.

Type 3—Bio-Assay Method

Solution of pituitary is the only official preparation assayed by the Type 3 method.

SOLUTION OF PITUITARY

Physiologic experiments and clinical experience have *demonstrated that solution of pituitary accelerates diuresis, raises the blood pressure by arterial constriction,* excites marked *uterine contractions* and has a rather marked *galactagogue action.*

Of these actions, three present themselves as possible means of biologic standardization, *i.e.*, the action on the blood pressure, the uterus, and the kidneys.

It has been shown by Dale and Laidlaw that methods of standardization based on the diuretic action are unsatisfactory because of the tolerance produced by the first injection.

The blood-pressure method, although strongly advocated by some workers, has been proved by most experimenters to be less accurate than the isolated uterus method.

It will be noted, therefore, that the official method is based upon the effect of a pituitary extract on the isolated uterus of the virgin guinea pig.

The value of the preparation depends upon the amount required to produce submaximal contractions of the uterus equal to those produced by given amounts of the standard substance.

The official biologic assay process and standard for solution of pituitary are as follows:

Solution of Pituitary contains the water-soluble principle or principles from the fresh posterior lobe of the pituitary body of cattle, 1 cc. having an activity upon the isolated uterus of the virgin guinea pig, corresponding to not less than 80 per cent and not more than 120 per cent of that produced by 0.005 Gm. of the Standard Powdered Pituitary, prepared as directed below. The Solution should be sterile.

Assay—Prepare a solution as follows: Carefully weigh a suitable amount of the dried Standard Powdered Pituitary, place this weighed powder in a small agate mortar and moisten with a few drops of distilled water containing 0.25 per cent of acetic acid. Triturate the moistened powder thoroughly until the whole is of an impalpable frothy consistence. Add a few cc. of the 0.25 per cent acetic acid solution and stir the mixture thoroughly. Transfer to a hard glass test tube or beaker; rinse the small agate mortar with the acetic acid solution and add the rinsings to the pituitary mixture; then add enough 0.25 per cent acetic acid to make the final volume of the mixture of the same number of cc. as the number of milligrams of dried pituitary powder originally taken. Heat this mixture to the boiling point for not more than one minute and filter. The filtrate contains in each cc. the active principle of 0.001 Gm. of the dried standard powder. Place this solution in hard glass ampuls and sterilize by fractional sterilization for twenty minutes on three successive days at a temperature not exceeding 100° C. Preserve in a cool place (from 5° to 20° C.). This standard solution should not be kept more than six months.

The apparatus used for making the test may be any modification of the general type for studying the activity of the isolated smooth muscle of mammals. It must be provided with an accurate temperature-regulating device. The chamber in which the uterus is suspended should have a capacity of not less than 100 cc.

Use healthy guinea pigs weighing between 175 Gm. and 350 Gm. They should not have been pregnant and should not be in heat. It is recommended that young female pigs be segregated at the time of weaning and kept thereafter out of sight and smell of the males.

Kill a guinea pig by a blow on the head, or by decapitation, and immediately remove the entire uterus from the body. Suspend a part or all of one horn of the uterus in a chamber containing oxygenated Locke-Ringer solution (page 1547), one end of the uterus being attached to a muscle lever which is weighted as necessary. The temperature of the bath should be between 37° and 38° C. but should not vary more than one-tenth of a degree throughout the whole assay. When the uterus is completely relaxed, which is generally in from fifteen to thirty minutes, it is ready to begin the test. This is done by adding alternately varying doses of the standard extract and of the solution to be tested to the bath in the muscle chamber until quantities of the two solutions are found which give equal, submaximal contractions in at least two successive pairs of contractions. The strengths of the two solutions are in inverse ratio to the quantities necessary to produce these equal contractions.

Standard Powdered Pituitary

Select a number, not less than 25, of fresh posterior lobes of the pituitary body of cattle, removed within thirty minutes of the death of the animal and carefully free them from all extraneous tissue, immediately after their removal. As soon as they are so prepared, drop them into a flask containing a quantity of acetone corresponding to not less than 4 cc. of acetone for each pituitary body. Allow them to remain in the acetone for three hours, and then remove them and immediately cut them into small pieces with scissors and place the material in fresh acetone equal in quantity to that first employed. Leave the material in the acetone overnight, and then remove it and dry it in a vacuum desiccator over calcium chloride, at a temperature not above 50° C., for five hours. At the end of this time remove the material and grind it in a mortar until it will pass through a No. 40 sieve. Dry this powder for at least twelve hours in a vacuum desiccator over calcium chloride at a temperature not over 50° C. Extract this dried powder in a small Soxhlet continuous extraction apparatus with acetone for three hours and again dry it in a desiccator over calcium chloride for twelve hours. This dried powder should be preserved in a cool, dark place, in sealed ampuls *in vacuo*, or in vacuum desiccators over calcium chloride until used for the preparation of the standard solution.

CHAPTER XC

GENERAL TESTS OF THE U.S.P. AND N.F.

Acid Number

The acid number is the number of milligrams of potassium hydroxide required to neutralize the free acid in 1 Gm. of oils, fats, waxes, resins, balsams, and similar organic substances of complex composition. It is determined as follows: Shake about 2 Gm. of the substance, accurately weighed, with from 30 to 50 cc. of neutral alcohol or with a neutral mixture of equal volumes of alcohol and ether, and titrate with half-normal potassium hydroxide, using 1 cc. of phenolphthalein T.S. as indicator.

When the quantity of free acid is small, tenth-normal potassium hydroxide should be used. In place of potassium hydroxide, half-normal or tenth-normal sodium hydroxide may be used for this test, but should be calculated to the equivalent of potassium hydroxide.

Arsenic Test

Test Apparatus—Prepare several generators, equipped with tubes, etc., as described below. Select as a generator a bottle of about 50 cc. capacity, having a mouth about 2.5 cm. in diameter and provide a well-fitting rubber stopper, suitably perforated. Through the perforation insert a vertical exit tube about 13 cm. in total length and 1 cm. in diameter throughout the upper portion (for about 10 cm.) and constricted at its lower extremity to a tube of about 3 cm. in length and about 5 mm. in diameter. This latter tube should extend but slightly below the stopper. In the lower part of the wider exit tube insert a small pledget of dry glass wool (page 1534) and then a strip of freshly prepared but dry lead acetate test paper (page 1547) rolled into a coil, and above this a plug of moist (not wet) lead acetate glass wool (page 1547). In the upper extremity of this tube insert through a perforated cork stopper, a glass tube 12 cm. in length, having an internal diameter of about 3 mm. Place a strip of mercuric bromide test paper (page 1547) in this tube, bending or creasing the upper portion of the strip so that it will retain its position. The strip should extend within about 2 cm. of the perforated cork stopper and must not be introduced into the tube until the test is ready to start. This tube should be thoroughly cleaned and dried each time it is used.

Fig. 541

Arsenic test apparatus

Standard Arsenic Test Solution—Dissolve 0.1 Gm. of arsenic trioxide (page 1530) which has been finely pulverized, dried over sulphuric acid, and accurately weighed, in about 5 cc. of a 20 per cent solution of sodium hydroxide (free from arsenic). Neutralize the solution with diluted sulphuric acid (free from arsenic), add 10 cc. of the same acid and sufficient recently boiled distilled water to bring the volume of the solution to exactly 1000 cc. at 25° C. Accurately measure 10 cc. of this solution, transfer it to a 1000 cc. flask, add 10 cc. of diluted sulphuric acid (free from arsenic) and make up the volume with recently boiled distilled water to exactly 1000 cc. at 25° C. Employ this solution, which contains 0.001 milligram of arsenic trioxide in each cc. (at 25° C.), in preparing the standard stain. Keep this solution in a glass-stoppered bottle. It is advisable to make fresh solutions when new standard stains are to be prepared.

Preparation of the Chemical to be Tested—Add 1 cc. of a mixture of equal volumes of concentrated sulphuric acid (page 1542) and distilled water, to 5 cc. of an aqueous solution of the chemical (1 in 25) or to a solution in 5 cc. of distilled water of the residue remaining after any special treatment that may be directed. This acidulation is not necessary in the case of inorganic acids. Now, unless specially directed, add 10 cc. of sulphurous acid (page 1543). Evaporate this liquid in a small beaker, on a water bath, until it is free from sulphurous acid and has been reduced to about 2 cc. in volume. Dilute this evaporated liquid to about 5 cc. with distilled water.

The Test

Preparation of the Standard Stain—Introduce into the generator from 8 to 10 Gm. of reagent zinc (page 1543) followed by 25 cc. of dilute sulphuric acid, prepared by mixing 1 part of concentrated sulphuric acid, free from arsenic (page 1542), with 4 parts of distilled

water, and 5 drops of acid stannous chloride T.S. (page 1550). Add at once 2 cc. (accurately measured at 25° C.) of the standard arsenic T.S. (page 1512), and immediately insert the stopper containing the exit tube, into which have been placed the glass wool pledget, the dry lead acetate test paper, the moist lead acetate glass wool, and the mercuric bromide test paper, as described under *Test Apparatus* (page 1512). Should the evolution of the gas be violent at first, check the reaction by immersing the bottle in cold water. Should the reaction subside, increase it by placing the bottle in warm water. If the reaction is too violent, the stain will spread and not form a distinctive band, thus making the comparisons of color intensity difficult. After the test has continued for forty-five minutes, remove the mercuric bromide test paper and place it in a clean, dry tube for comparison. This stain represents 0.002 milligram of arsenic trioxide in addition to any stain produced by the reagents. The stain produced by the reagents in a blank test should be scarcely perceptible. Since light, heat, and moisture cause the stain to fade rapidly, comparison should be made as soon as possible. The stained test papers may be preserved by dipping in hot, melted paraffin or by keeping them over phosphoric anhydride, protected from light.

Testing the Chemical—Introduce into another generator from 8 to 10 Gm. of the zinc followed by 25 cc. of the dilute sulphuric acid (1 to 4) and 5 drops of acid stannous chloride T.S. Insert the stopper containing the exit tube in which have been placed the test papers and glass wool, as just described. Then add 5 cc. of the solution to be tested, previously treated as directed under *Preparation of the Chemical to be Tested*, and immediately insert the stopper containing the exit tube. When the evolution of hydrogen has proceeded actively for forty-five minutes, remove the mercuric bromide test paper and carefully compare it with the standard stain prepared as described above. The stain produced by the chemicals tested does not exceed in length or intensity of color that prepared as the standard, indicating not more than 1 part of arsenic trioxide in 100,000 parts of the substance tested.

Interfering Chemicals—Antimony, if present in the substance tested, will produce a gray stain. *Sulphites, sulphides, thiosulphates*, and other compounds which liberate hydrogen sulphide or sulphurous acid when treated with sulphuric acid, must be oxidized by means of nitric acid and then reduced by means of sulphurous acid as directed under *Preparation of the Chemical to be Tested* (page 1512), before introducing them into the apparatus. *Sulphur compounds* as well as *hydrogen phosphide* give a bright yellow band on the test paper. If sulphur compounds are present, a simultaneous darkening of the lead acetate test paper and glass wool will occur. If such is the case, the operation as directed under *Preparation of the Chemical to be Tested* (page 1512) must be repeated upon a fresh portion of the solution being tested, using greater care in effecting the complete removal of the sulphurous acid. In testing hypophosphites special care should be observed to oxidize completely the solution being tested as directed, otherwise a yellow stain may be produced through the evolution of hydrogen phosphide, which might be confused with the orange-yellow color produced by arsenic. The stain produced by hydrogen phosphide is differentiated from that given by arsenic by moistening it with ammonia T.S. A stain caused by arsenic will become dark, but if produced by hydrogen phosphide it will not materially change in color. The test apparatus should be thoroughly cleaned and dried immediately before and after use.

Compounds containing salts of bismuth and antimony should be tested for arsenic by Bettendorf's Test (see below).

Arsenic Test, Bettendorf's

This test for the presence of *arsenic* is employed only in testing salts of bismuth and compounds containing antimony.

To a solution of the prescribed quantity of the substance to be tested in 5 cc. of concentrated hydrochloric acid (page 1534) contained in a clean test tube, add 10 cc. of acid stannous chloride T.S. (page 1550) which has been freshly prepared, and set it aside for thirty minutes. If arsenic is present in non-permissible amounts, a brownish tint or precipitate will be seen when the tube is placed over a white surface and the solution viewed from above, comparison being made with a mixture of 5 cc. of concentrated hydrochloric acid (page 1534 and 10 cc. of concentrated stannous chloride T.S., prepared as directed above.

NOTE—It is absolutely necessary that for this test the solution of stannous chloride be freshly prepared, and that nitrates, sulphates, sulphites, sulphides, and compounds of mercury, gold, and selenium be absent from the reagents, and the chemicals being tested.

Ash or Non-volatile Matter in Chemicals

Weigh accurately from 1 to 2 Gm., or the amount of the chemical directed in the text, and place it in a tared platinum or porcelain crucible. Ignite it, at first very gently, then gradually raise the temperature until any carbon which may be formed is completely burned off. Conduct the ignition in a place protected from air currents and use as low a temperature as possible to effect the combustion of the carbon. When the carbon has

completely disappeared, transfer the crucible while still hot to a desiccator and weigh it when cold. In the case of substances which increase in volume on ignition, or where it is very difficult to burn off the carbon, the determination is facilitated by using a platinum dish of suitable size, or by igniting the weighed quantity of the substance, in the manner described above, in several separate portions.

To test for non-volatile matter in volatile inorganic chemicals, proceed as directed above, using as low a temperature as possible.

Assay for Acids (Alkalimetric)

In assaying acids the quantity of acid to be taken should be such that about 30 to 40 cc. of the alkali solution will be consumed. As a general principle it is recommended that the normality of the acid to be titrated should be approximately the same as that of the titrating medium. Except when otherwise directed, the liquid to be titrated is to be brought to room temperature before titration, as many indicators give different values at different temperatures. For most of the inorganic acids, methyl orange, methyl red, phenolphthalein, or litmus can be used as indicators, but the alkali must be standardized with the particular indicator used. For organic acids, phenolphthalein is always used.

Tare a glass-stoppered flask of about 150 to 200 cc. capacity, pour into it approximately the quantity of acid directed in the text, stopper immediately, and reweigh: the difference represents the quantity of acid taken. Dilute with distilled water to about 40 cc. and titrate with normal sodium hydroxide, using the indicator specified in the text.

In assaying acids which evolve fumes on exposure to air, such as hydrochloric, nitric, and glacial acetic acids, the flask is tared with 10 cc. of distilled water, then the specified quantity of acid is added, the flask immediately stoppered, allowed to cool, and reweighed.

Solid acids are weighed either in a tared glass-stoppered flask or in another suitable container, dissolved in about 40 cc. of distilled water, and titrated.

Assay for Alkali Benzoates and Salicylates

Dry about 2 Gm. of the salt to constant weight at from 100° to 110° C., weigh accurately in a platinum or porcelain crucible, and heat at first gently, then gradually raise the temperature until the salt is thoroughly carbonized. The final temperature must not exceed a dull red heat and the flame of the burner must not come in contact with the carbonized mass. Allow the carbonized mass to cool, disintegrate it well with a stout glass rod or powder carefully, and transfer with the crucible to a beaker or casserole. Add 50 cc. of distilled water and 50 cc. of half-normal sulphuric acid, cover the beaker or casserole with a watch glass, and boil for thirty minutes. Filter and wash the residue with hot distilled water until the washings cease to redden blue litmus paper. Dry the residue and filter paper, and ignite as described above. Transfer the ignited residue to the filtrate, and determine the excess of acid in the cooled filtrate by titration with half-normal sodium hydroxide, using methyl orange T.S. as indicator. The volume of half-normal sulphuric acid consumed, multiplied by the proper equivalent of the salt, represents the amount of the salt present in the quantity taken.

Assay for Alkali Salts of Organic Acids

Heat about 2 Gm. of the salt, accurately weighed, in a platinum or porcelain crucible, heating at first very gently, then gradually raising the temperature until the salt is thoroughly carbonized. (*Caution—Do not use platinum crucibles for lithium salts.*) The final temperature must not exceed a dull red heat and the flame of the burner must not come in contact with the carbonized mass. After allowing the carbonized mass to cool, moisten with distilled water, ignite again, and repeat the moistening and igniting until a white residue is obtained. Then disintegrate the ignited mass with the aid of a stout glass rod and transfer the mass and crucible to a beaker. Add 50 cc. of distilled water and titrate with half-normal sulphuric acid, using methyl orange T.S. as indicator. The number of cc. of half-normal sulphuric acid used, multiplied by the proper equivalent of the salt, represents the amount of salt present in the quantity taken.

Assay for Chlorides, Bromides, and Iodides

Chlorides—Dissolve about 0.2 Gm. of the salt to be assayed, accurately weighed, (corresponding to from 30 to 40 cc. of tenth-normal silver nitrate), in 25 cc. of distilled water in a 200 cc. graduated flask. Add 50 cc. of tenth-normal silver nitrate to the solution, and 5 cc. of nitric acid, then add sufficient distilled water to make 200 cc., and mix well. Filter the mixture through a dry filter into a dry flask, and reject the first 20 cc. of the

filtrate. To 100 cc. of the filtrate add 2 cc. of ferric ammonium sulphate T.S. and titrate with tenth normal potassium thiocyanate until the supernatant liquid remains reddish after it is well shaken. Multiply by 2 the number of cc. of tenth-normal potassium thiocyanate required, and subtract this figure from the number of cc. of tenth-normal silver nitrate added. The difference, multiplied by the equivalent of the respective chloride, represents the amount of chloride present in the weight of the salt or solution taken.

Bromides and Iodides—Dissolve about 0.4 Gm. of the salt if a bromide, or 0.5 Gm. of the salt if an iodide, accurately weighed, in 25 cc. of distilled water in a glass-stoppered flask. Add 50 cc. of tenth-normal silver nitrate to the solution, then 2 cc. of ferric ammonium sulphate T.S. and 2 cc. of nitric acid, and determine the excess of silver nitrate by titrating with tenth-normal potassium thiocyanate until the supernatant liquid remains reddish after it is well shaken. The difference between the number of cc. of tenth-normal silver nitrate added and the number of cc. of tenth-normal potassium thiocyanate used, multiplied by the equivalent of the respective bromide or iodide being assayed, represents the amount of the bromide or iodide present in the weight of the salt taken. This difference, divided by the weight of the salt taken, represents the number of cc. of tenth-normal silver nitrate required by 1 Gm. of the salt.

Electrolytic Determinations

Copper, Mercury, Silver, and Zinc—The electrolytic apparatus consists principally of an ammeter, voltmeter, and rheostat, properly connected with the source of the current, a platinum spiral or disk anode, and a device for rotating the anode. Other suitable apparatus adapted to the use of rotating electrodes may also be employed.

The source of the current may be either storage batteries or any other system of direct current which permits regulation of the voltage and amperage.

Copper and silver are determined in a platinum dish of about 100 cc. capacity which serves as the cathode.

Mercury is determined in a mercury cathode cup, or in a platinum dish which serves as the cathode. The mercury cathode cup consists of a glass cylinder about 6.5 cm. in height and 3.5 cm. in diameter, into which is fused a platinum wire near the bottom, and containing from 50 to 60 Gm. of mercury. The platinum wire must be in contact with the mercury.

For the determination of zinc, a nickel dish of about 175 cc. capacity is used. A platinum dish upon which a thin layer of silver or copper has been previously deposited may also be used.

Cupric Sulphate—Dissolve from 0.75 to 1.0 Gm. of the salt, accurately weighed, in about 100 cc. of distilled water in a weighed platinum dish, add 1 cc. of diluted sulphuric acid, rotate the anode about 500 revolutions per minute and pass the current, gradually increasing it to 2.5 amperes and from 5 to 7 volts. Occasionally add a little distilled water to the electrolyte to keep the deposit of copper covered. When the copper is all deposited (usually in about twenty minutes, to be ascertained by withdrawing a little of the electrolyte and testing it with hydrogen sulphide T.S.), stop the rotation, and wash the deposit with distilled water by means of a siphon without interrupting the current, until the current drops to nearly zero. Remove the dish, wash again with distilled water by decantation, followed by a little alcohol and ether, successively, dry for a few minutes only, at from 80° to 100° C., and weigh.

One gram of Copper is the equivalent of:	Gram
Cupric Sulphate, $CuSO_4 . 5H_2O$	3.9281
Cupric Sulphate, anhydrous, $CuSO_4$	2.5112

Corrosive Mercuric Chloride—Dissolve from 0.3 to 0.4 Gm. of the salt, accurately weighed, in 10 cc. of distilled water and transfer the solution to the cathode cup, which has been previously weighed with its metallic mercury. Dilute the liquid to about 20 cc. with distilled water, add 1 cc. of nitric acid, which has been diluted with an equal volume of distilled water, and 10 cc. of toluene, and pass through the solution a current of from 1 to 3 amperes and from 8 to 12 volts, stirring the solution by rotating the anode from 500 to 600 revolutions per minute. After twenty minutes, when the mercury is all removed from solution (to be ascertained by removing a few drops of the solution and testing with hydrogen sulphide T.S.), wash with distilled water, with the aid of a siphon and without interrupting the current, until the current drops to nearly zero. Remove the cathode cup, wash the mercury with alcohol, then with ether, remove most of the remaining ether with filter paper, dry over sulphuric acid, and weigh. The increase in weight of the cathode cup represents the amount of mercury present in the quantity of the salt taken.

Mercury (Metallic), Mercuric Oxide (Red or Yellow), Mercury with Chalk, and Solution of Mercuric Nitrate—Dissolve an accurately weighed quantity of the substance in a mixture

of equal volumes of nitric acid and distilled water (metallic mercury or mercuric oxide from 0.2 to 0.3 Gm. in 1 cc.; mercury with chalk from 0.6 to 0.8 Gm. in 2.5 cc.), transfer the solution to the cathode cup, which has previously been weighed with its metallic mercury, and dilute with distilled water to about 30 cc. Electrolyze the solution and proceed further as described under *Corrosive Mercuric Chloride*, using a current of from 1.5 to 2 amperes and from 7 to 10 volts.

Ammoniated Mercury, Mild Mercurous Chloride, Mercuric Salicylate, Red Mercuric Iodide, Yellow Mercurous Iodide—Introduce the accurately weighed substance (from 0.5 to 0.6 Gm. of ammoniated mercury or mild mercurous chloride; from 0.7 to 0.8 Gm. of mercuric salicylate or yellow mercurous iodide; from 1.0 to 1.2 Gm. of red mercuric iodide) into the cathode cup, previously weighed with its metallic mercury, add 10 cc. of solution of sodium sulphide (made by dissolving 50 Gm. of crystallized sodium sulphide in sufficient distilled water to measure 100 cc.) and dissolve as completely as possible by agitation. Dilute the mixture to about 30 cc. with distilled water and pass through the solution a current of from 2 to 3 amperes and from 7 to 10 volts for thirty minutes (or until a few drops of the liquid do not give a black precipitate or coloration when gently warmed with a few drops of concentrated ammonium chloride solution), stirring the solution by rotating the anode about 500 revolutions per minute. Wash the mercury, and proceed as described under *Corrosive Mercuric Chloride*, except that before washing with alcohol allow it to stand with about 20 cc. of dilute acetic acid (from 2 to 3 per cent) until bubbles cease to be evolved.

One gram of Mercury is the equivalent of:	Gram
Ammoniated Mercury, $HgNH_2Cl$	1.2566
Mercuric Chloride, Corrosive, $HgCl_2$	1.3535
Mercurous Chloride, Mild, $HgCl$	1.1768
Mercuric Iodide, Red, HgI_2	2.2654
Mercurous Iodide, Yellow, HgI	1.6327
Mercuric Nitrate, $Hg(NO_3)_2$	1.6182
Mercuric Oxide (Red or Yellow), HgO	1.0798
Mercuric Salicylate, $HgC_7H_4O_3$	1.1798

Silver Nitrate—Powder the salt, dry it to constant weight over sulphuric acid in the dark, dissolve from 0.3 to 0.5 Gm., accurately weighed, in about 35 cc. of distilled water in a tared platinum dish, add a solution of 2 Gm. of sodium cyanide in 10 cc. of distilled water, rotate the anode about 500 revolutions per minute, and pass a current, gradually increased to 2.5 amperes and from 5 to 7 volts. After the silver is all deposited (usually from twenty to thirty minutes, to be ascertained by withdrawing a small quantity of the electrolyte and testing it with hydrochloric acid), interrupt the current, wash the deposit of silver several times with distilled water, rinse with a little alcohol, then with ether, dry the dish at from 80° to 100° C. for a few minutes, and weigh.

Molded Silver Nitrate—Dissolve from 0.3 to 0.5 Gm., accurately weighed, in 10 cc. of distilled water, filter through a small filter paper, wash the paper with distilled water until free from silver nitrate, bring the combined filtrate and washings to a volume of about 35 cc. in a tared platinum dish, add a solution of 2 Gm. of sodium cyanide in 10 cc. of distilled water, and proceed with the determination as under *Silver Nitrate*.

One gram of Silver is the equivalent of:	Gram
Silver Nitrate, $AgNO_3$	1.5748
Silver Oxide, Ag_2O	1.0742

Zinc (Metallic), Zinc Acetate, Zinc Carbonate, Zinc Chloride, Zinc Oxide, Zinc Phenolsulphonate, Zinc Sulphate—Introduce into a tared nickel dish, an accurately weighed quantity of the salt, equivalent to about 0.15 Gm. of metallic zinc (zinc acetate, 0.5 Gm., zinc carbonate, 0.25 Gm.; zinc chloride, 0.3 Gm., zinc oxide, 0.2 Gm.; zinc phenolsulphonate, 1.2 Gm.; zinc sulphate, 0.6 Gm.); dissolve it in distilled water or in 10 cc. of diluted sulphuric acid (zinc carbonate, zinc oxide), add from 30 to 35 cc. of sodium hydroxide solution (20 per cent), and dilute with distilled water to about 120 cc. Heat the mixture nearly to boiling and electrolyze for thirty minutes with a current of from 4 to 5 amperes and from 5 to 6 volts, stirring the solution by rotating the anode from 500 to 600 revolutions per minute. Without interrupting the current, wash the deposited zinc with distilled water with the aid of a siphon until the current drops to zero or nearly so. Remove the dish, wash the zinc first with alcohol, then with ether, dry over sulphuric acid, and weigh. The increase in weight of the dish represents the amount of zinc present in the weight of the salt taken.

To determine zinc in metallic zinc, weigh accurately about 1.5 Gm. of the metal, dissolve

it by warming with 40 cc. of diluted sulphuric acid, filter the solution, if necessary, wash the filter well with distilled water, and make up the volume of the solution and washings to 100 cc. Measure 10 cc. of this liquid into the weighed dish and proceed as directed above.

One gram of Zinc is the equivalent of:	Gram
Zinc Acetate, $Zn(C_2H_3O_2)_2.2H_2O$	3.3570
Zinc Chloride, $ZnCl_2$	2.0849
Zinc Oxide, ZnO	1.2448
Zinc Phenolsulphonate, $Zn(C_6H_5SO_4)_2.8H_2O$	8.5011
Zinc Sulphate, $ZnSO_4.7H_2O$	4.3988
Zinc Sulphate, anhydrous, $ZnSO_4$	2.4695

Ester Number

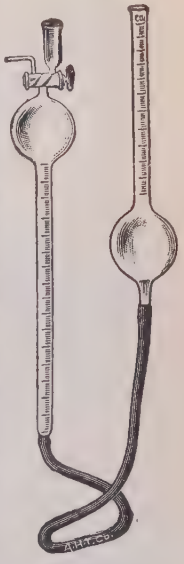
The ester number is the number of milligrams of potassium hydroxide required to saponify the esters in 1 Gm. of oils, fats, waxes, resins, balsams, and similar organic substances of complex composition. If the saponification value and the acid number have been determined, the difference between these two represents the ester number.

The ester number is also determined directly as follows: Shake from 1.5 to 2 Gm. of the substance, accurately weighed, in a 200 to 250 cc. tared flask, with from 20 to 30 cc. of alcohol, add 1 cc. of phenolphthalein T.S., and titrate with half-normal alcoholic potassium hydroxide until the free acid is neutralized. Add exactly 25 cc. of half-normal alcoholic potassium hydroxide, and proceed as directed under *Saponification Value*, beginning with "Insert in the neck of the flask" and omitting the further addition of phenolphthalein T.S. The difference in the number of cc. of half-normal hydrochloric acid consumed in the actual test and in the blank, multiplied by 28.06 and divided by the weight of the substance taken, gives the ester number.

Gasometric Estimations

In certain cases the Pharmacopœia directs the strength of a product or chemical substance to be determined by the volume of gas (nitrogen dioxide) given off during a definite reaction. This volume is to be determined by the use of a nitrometer (see Fig. 542) in the following manner:

Fig. 542



Nitrometer

By means of clamps attached to a stand, arrange a nitrometer consisting of a measuring tube (having a capacity of at least 50 cc. and graduated into one-tenth cc.) connected by stout rubber tubing with an open equilibrium tube (both tubes, preferably, provided with a globular expansion near the lower end) in such a manner, that either tube may be readily adjusted and quickly clamped at a higher or lower level. The stopcock of the measuring tube having been opened, and the open equilibrium tube having been raised to a higher level, pour into the latter a saturated aqueous solution of sodium choride, until the measuring tube, including the bore of the stopcock, is completely filled. Then close the latter and adjust the equilibrium tube at a low level. Having ascertained that the stopcock is closed and is air-tight, and having, if necessary, wiped out the graduated tube of the nitrometer, introduce into it the prescribed quantity of the liquid to be tested, and allow this to flow slowly into the measuring tube, being careful not to admit any air. Follow it successively with the prescribed quantities of potassium iodide T.S. and normal sulphuric acid. When the reaction moderates, remove the measuring tube from its clamp, and, being careful to hold it constantly so that the liquid contained in it stands at a higher level than that in the equilibrium tube, shake its contents without permitting any gas to pass into the open tube. When the reaction has completely ceased and the volume of gas has become constant, which usually requires from thirty to sixty minutes, restore the tube to its fastening, and allow the apparatus and contents to acquire the ordinary temperature of the room, which is assumed to be close to 25° C. Then adjust the two tubes so that the liquid columns are at exactly the same level, and read the volume of gas in the measuring tube. Multiply this figure by the weight of the liquid being assayed which is the equivalent of 1 cc. of nitrogen dioxide (page 1518). The result will be the weight of the absolute substance (ethyl, amyl, or sodium nitrite) contained in the quantity taken for the assay.

For pharmacopœial purposes, the determination will be sufficiently exact if the evolved gas is measured within 3° above or below 25° C.

Since temperature and barometric pressure affect the volume of the gas, the following correction factors must be used to obtain exact results when the temperature and pressure vary from the normal. The barometric correction is important at any locality more than 250 meters above sea level:

FACTORS FOR TEMPERATURE CORRECTIONS

(Normal Temperature, 25° C.)

Temperature	Factor	Temperature	Factor	Temperature	Factor
15° C.	1.035	22° C.	1.010	29° C.	0.987
16° C.	1.031	23° C.	1.007	30° C.	0.983
17° C.	1.028	24° C.	1.003	31° C.	0.980
18° C.	1.024	25° C.	1.000	32° C.	0.977
19° C.	1.021	26° C.	0.997	33° C.	0.974
20° C.	1.017	27° C.	0.993	34° C.	0.971
21° C.	1.014	28° C.	0.990	35° C.	0.968

Example: Assuming that the volume of gas read off was 44.5 cc. at 32° C., and it is desired to ascertain the corresponding volume at 25° C., barometric pressure not being taken into consideration, then the 44.5 cc. must be reduced in the proportion of 1 to 0.977 (see temperature correction factors above), or 44.5 must be multiplied by 0.977. The result will be 43.48 cc. as the equivalent volume of gas at 25° C.

FACTORS FOR CORRECTION FOR BAROMETRIC PRESSURE

(Normal Barometer, 760 mm.)

Barometer Reading		Factor	Barometer Reading		Factor
Millimeters	Inches		Millimeters	Inches	
790	31.10	1.039	660	25.98	0.868
780	30.71	1.026	650	25.59	0.855
770	30.31	1.013	640	25.20	0.842
760	29.92	1.000	630	24.80	0.829
750	29.53	0.987	620	24.41	0.816
740	29.13	0.974	610	24.02	0.803
730	28.74	0.961	600	23.62	0.789
720	28.35	0.947	590	23.23	0.776
710	27.95	0.934	580	22.83	0.763
700	27.56	0.921	570	22.44	0.750
690	27.17	0.908	560	22.05	0.737
680	26.77	0.895	550	21.65	0.724
670	26.38	0.882	540	21.26	0.711

Example: Assuming that the volume of gas read off was 43.48 cc. at 590 mm. barometric pressure, and it is desired to ascertain the corresponding volume at normal barometric pressure (760 mm.), temperature not being taken into consideration, then the 43.48 cc. must be reduced in the proportion of 1 to 0.776 (see barometric correction factors above), or 43.48 must be multiplied by 0.776. The result will be 33.74 cc. as the equivalent volume of gas at normal barometric pressure.

FACTORS FOR DETERMINING NITRITES

NO = 30.01; 1 Liter { at 0° C. and 760 mm. = 1.3406 Gm.
at 25° C. and 760 mm. = 1.2281 Gm.

One cubic centimeter of Nitrogen Dioxide is the equivalent of:

		At 0° C. and 760 mm. Gram	At 25° C. and 760 mm. Gram
Nitrogen Dioxide, NO =	30.01	0.0013406	0.0012281
Amyl Nitrite, $C_5H_{11}NO_2$ =	117.10	0.0052310	0.0047920
Ethyl Nitrite, $C_2H_5NO_2$ =	75.05	0.0033528	0.0030713
Sodium Nitrite, $NaNO_2$ =	69.01	0.0030828	0.0028241

Heavy Metals Test

Chemicals—This test is to be used to detect the presence of undesirable metallic impurities in official chemical substances or their solutions. Acidulate 10 cc. of a solution of the substance in distilled water (1 in 50), contained in a test tube of about 25 cc. capacity and about 2 cm. in diameter, with 1 cc. of diluted hydrochloric acid (unless otherwise directed),[1] warm it to about 50° C., add an equal volume of freshly prepared hydrogen sulphide T.S., stopper, and allow the mixture to stand at 35° C. for half an hour. At the end of this time the mixture should still possess the odor of hydrogen sulphide; if not, it should be thoroughly saturated with the gas and again set aside for half an hour. The color produced, if any, is not greater than that observed in a blank test made in the same manner and with the same quantities of the reagents (omitting the solution to be tested), the solutions being viewed crosswise by reflected light while held against a white surface. A slight turbidity due to separation of sulphur from the hydrogen sulphide may occur. Filter the solution if necessary and render it alkaline by the addition of ammonia T.S.: a greenish color may be produced but no precipitate is formed within one minute. The addition of ammonia T.S. is omitted in testing salts which produce precipitates when ammonia is added to their solutions.

Volatile Oils—Shake 10 cc. of the oil with an equal volume of distilled water to which a drop of hydrochloric acid has been added, and pass hydrogen sulphide through the mixture until it is saturated: no darkening in color is produced in either the oil or the water (*lead or copper*).

Iodine Value

The iodine value or number of a fat or oil indicates the proportion of iodine absorbed under specified conditions. It is determined as follows: Introduce about 0.8 Gm. of a solid fat or about 0.3 Gm. of an oil, accurately weighed, into a glass-stoppered bottle of 250 cc. capacity, dissolve it in 10 cc. of chloroform, add 25 cc. of iodobromide T.S. (page 1546) accurately measured from a burette or pipette, stopper the bottle securely, and allow the mixture to stand for half an hour in a cool place protected from light. After this time it must still retain a brown color; if the color is not brown, a new test should be started, using a smaller quantity of the fat or oil. Then add in the order named 30 cc. of potassium iodide T.S., 100 cc. of distilled water, and tenth-normal sodium thiosulphate in small successive portions, shaking thoroughly after each addition, until the color of the mixture becomes quite pale. Now add a few drops of starch T.S. and continue the addition of tenth-normal sodium thiosulphate until the blue color is discharged. While this test is being carried out, make a blank test by mixing exactly the same quantities of reagents and titrate the free iodine with tenth-normal sodium thiosulphate as directed above. The difference in the number of cc. of tenth-normal sodium thiosulphate consumed by the blank test and the actual test, multiplied by 1.269 and divided by the weight of the fat or oil taken, gives the iodine value.

Rosin Test

For testing for rosin as an adulterant in resins, gum resins, and balsams, place in a small mortar 1 Gm. of the substance, powdered or crushed if necessary, and add 10 cc. of purified petroleum benzin unless the substance contains free cinnamic or benzoic acid, in which cases the petroleum benzin should be replaced by xylene. Triturate well for one or two minutes, filter into a test tube, and add to the filtrate 10 cc. of a fresh aqueous solution of copper acetate (1 in 200). Shake well and allow the liquids to separate: the benzin or xylene layer should not show a green color (*rosin*).

Saponification Value

The saponification value is the number of milligrams of potassium hydroxide required to neutralize the free fatty acids and saponify the esters of 1 Gm. of a fat, oil, wax, etc. It is determined as follows: Place from 1.5 to 2 Gm. of the filtered fat or oil, accurately weighed, in a flask of from 200 to 250 cc. capacity and add to it exactly 25 cc. of alcoholic half-normal potassium hydroxide (page 1558). Insert into the neck of the flask, by means of a perforated stopper, a glass tube from 70 to 80 cm. in length and from 5 to 8 mm. in diameter, and heat the flask on a water bath for half an hour, frequently rotating the contents. Then add 1 cc. of phenolphthalein T.S. and titrate the excess of potassium hydroxide with half-normal hydrochloric acid. Make a blank test at the same time, using exactly the same amount of alcoholic half-normal potassium hydroxide. The difference in

[1] Acids are first carefully neutralized by the addition of ammonia T.S. and then acidified as directed above.

the number of cc. of half-normal hydrochloric acid consumed in the actual test and in the blank, multiplied by 28.06 and divided by the weight of the fat or oil taken, gives the saponification value.

Turbidimetric Tests

These tests are applied to certain official chemicals, to insure the absence of excessive amounts of chloride or sulphate.

In carrying out these turbidimetric tests, the following points are to be observed: The same quantities of the same reagents must be used in the test of the substance under examination and in the control test. The glass cylinders in which the tests are made must be of the same diameter and match in all other respects as closely as possible. The precipitating reagent must be added to both in immediate sequence.

Chloride—The prescribed quantity of the substance to be tested is dissolved in from 30 to 40 cc. of distilled water, and the solution neutralized, if necessary, with nitric acid, using litmus paper as indicator. One cc. of nitric acid and 1 cc. of silver nitrate T.S. are added and then sufficient distilled water to make 50 cc. After mixing well and allowing to stand five minutes protected from direct sunlight, the turbidity, if any, is compared with that produced in a control test made with the specified volume of fiftieth-normal hydrochloric acid.

Bismuth Salts are first dissolved in a few cc. of distilled water and 2 cc. of nitric acid, then diluted with distilled water to 50 cc.

Sulphate—The specified quantity of the substance to be tested is dissolved in from 30 to 40 cc. of distilled water, and the solution neutralized, if necessary, with hydrochloric acid, using litmus paper as indicator. One cc. of diluted hydrochloric acid and 1 cc. of barium chloride T.S. are added and then sufficient distilled water to make 50 cc. After mixing well, it is allowed to stand for ten minutes and the turbidity, if any, is compared with that produced in a control test made with the specified volume of fiftieth-normal sulphuric acid.

If the solution, after the addition of acid, is not perfectly clear, it is filtered through a filter paper free from chloride or sulphate, then the silver nitrate or the barium chloride is added.

In applying the turbidimetric tests to salts of heavy metals, which normally show an acid reaction, their aqueous solutions prepared for the test are not to be neutralized.

When the tests for chloride or sulphate are to be applied to a specified volume of a solution of a substance prepared as directed in the text, and the permissible limit for these impurities corresponds to 0.2 cc. or less of fiftieth-normal hydrochloric or sulphuric acid, the solution is not to be further diluted. The control test is also made with the same volume of water (or other specified solvent) as in the test.

Unsaponifiable Matter

The term "unsaponifiable matter" is understood to mean substances present in oils or fats that are not saponifiable by caustic alkali and are insoluble in water. It is determined as follows: Heat 5 Gm. of the oil or fat under a reflux condenser with a solution of about 2 Gm. of potassium hydroxide in 40 cc. of alcohol for an hour or until completely saponified. Evaporate most of the alcohol, dissolve the residue in 50 cc. of hot distilled water, and transfer the solution to a separator, rinsing the flask with 25 or 50 cc. of hot distilled water. Cool, and shake with two successive portions of 50 cc. each of ether, adding a few cc. of alcohol to facilitate the separation of the two liquids. Wash the combined ether extract with small portions of distilled water until the water is not reddened by phenolphthalein T.S. Transfer the ether solution to a tared dish or beaker, evaporate the ether on a water bath, dry the residue at a temperature not exceeding 100° C., and weigh.

Vegetable Drugs, Sampling and Analysis

Sampling from Original Containers

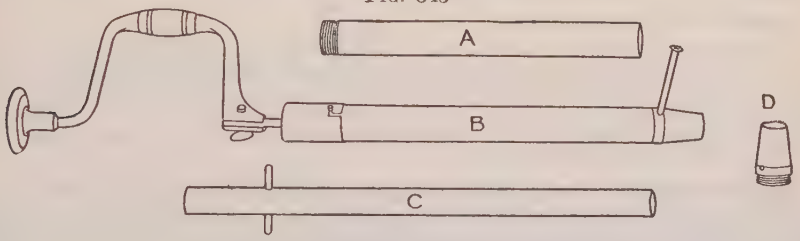
I. It is recommended that gross samples of vegetable drugs in which the component parts are 1 cm. or less in any dimension, and all powdered or ground drugs, be taken by means of a sampler which removes a core from the top to the bottom of the container, not less than two cores being taken in opposite directions; that when the total weight of the drug to be sampled is less than 100 kilos (200 pounds), at least 250 Gm. shall constitute an *official sample;* that when the total weight of the drug to be sampled is in excess of 100 kilos, repeated samples shall be taken by the above method, and according to the schedule given below, mixed and quartered, two of the diagonal quarters being rejected, the remaining two quarters being combined and carefully mixed, and again subjected to a quartering

process in the same manner until two of the quarters weigh at least 250 Gm., which latter shall constitute an *official sample.*

The apparatus illustrated in Fig. 543 was proposed by L. J. Schwarz and has been used at the New York Food and Drug Inspection Station of the Bureau of Chemistry. The sampling procedure is very simple and resolves itself into cutting out the desired number of cores from the drug to be sampled. As each core is cut, the end cap is released and the drug column in the sampler is forced into a suitable receiver by means of the wooden plunger (*C*). The work is not difficult. Even a novice at sampling is capable of doing the work properly, and, moreover, the bag or bale from which the sample has been taken will suffer no damage. Another point of interest in this connection is that the sample taken does not make the identification of the drug more difficult because the material is not mangled and the diameter of the drill insures pieces of sufficient size. Some drugs require the cutter fitted with a saw edge (*D*).

II. It is recommended that gross samples of vegetable drugs in which the component parts are over 1 cm. in any dimension be taken by hand; that when the total weight of the drug to be sampled is less than 100 kilos, at least 500 Gm. shall constitute an *official sample,* and this shall be taken from different parts of the container or containers; that when the total weight of the drug to be sampled is in excess of 100 kilos, repeated samples shall be taken by the above method and according to the schedule below, mixed and quartered, two of the diagonal quarters being rejected, and the remaining two quarters being combined

FIG. 543



Sampler for drugs in bales

and carefully mixed, and again subjected to a quartering process in the same manner until two of the quarters weigh not less than 500 Gm., which latter quarters shall constitute an *official sample.*

SCHEDULE RECOMMENDED FOR SAMPLING

Number of packages in shipment	Number of packages to be sampled
1 to 10	1 to 3
10 to 25	2 to 4
25 to 50	3 to 6
50 to 75	6 to 8
75 to 100	8 to 10

When over 100, the total number sampled should not be less than 10.

III. When the total weight of a drug to be sampled is less than 10 kilos, it is recommended that the above methods be followed but that somewhat smaller quantities be withdrawn, and in no case should the final *official sample* weigh less than 125 Gm.

IV. In addition to the withdrawing of *official samples* according to methods I, II, and III, the *official sample* may consist of the total amount of a direct purchase made by Federal, State, or Municipal Food and Drugs Act enforcement officials.

Foreign Organic Matter in Whole Vegetable Drugs.

V. Withdraw from 25 to 500 Gm. from the *official sample,* spread out in a thin layer, and separate the foreign organic matter by hand as completely as possible. Weigh and determine the per cent of foreign organic matter, calculated upon the weight of drug taken. The maximum quantity should be used for coarse or bulky drugs.

Preparation of Vegetable Drugs for Analysis.

VI. The following method is to be used where specific directions are not otherwise given in the text: Withdraw as much as may be necessary of the *official sample* by quartering, taking pains to see that the portion is representative of the gross sample. In the case of

unground or unpowdered drugs, grind the withdrawn sample so that it will pass through a No. 20 standard-mesh sieve. If the sample cannot be ground, reduce it to as fine a state as possible. Mix by rolling it on paper or sampling cloth, spread it out in a thin layer and withdraw the portion for analysis.

Total Ash in Vegetable Drugs.

VII. Accurately weigh a quantity of the ground drug, representing from 2 to 4 Gm. of the air-dried material, in a tared crucible, and incinerate at a low temperature, not to exceed very dull redness, until free from carbon, and determine the weight of the ash. If a carbon-free ash cannot be obtained in this way, exhaust the charred mass with hot distilled water, collect the insoluble residue on an ashless filter paper, incinerate the residue and filter paper until the ash is white or nearly so, then add the filtrate, evaporate it to dryness; and heat the whole to a low redness. If a carbon-free ash cannot be obtained in this way, cool the crucible, add 15 cc. of alcohol, break up the ash with a glass rod, burn off the alcohol, and again heat the whole to a low redness. Finally determine the weight of the ash. Calculate the percentage of total ash from the weight of the drug taken.

Acid-insoluble Ash in Vegetable Drugs.

VIII. Boil the ash obtained under paragraph VII with 25 cc. of diluted hydrochloric acid for five minutes, collect the insoluble matter in a Gooch crucible or on an ashless filter, wash with hot distilled water, ignite, and weigh. Determine the per cent of acid-insoluble ash calculated from the weight of drug taken.

Moisture in Vegetable Drugs.

IX. *Preparation of Sample*—In the case of unground or unpowdered drugs, prepare about 10 Gm. of the *official sample* by cutting, granulating, or shredding, so that the parts are about 3 mm. in thickness. Seeds or fruits smaller than 3 mm. should be cracked. High-speed mills should not be used for preparing the sample and care should be taken that no appreciable amount of moisture is lost during the preparation, and that the portion taken is representative of the *official sample.*

Moisture Method for Drugs Containing no Constituents Volatile at 100° C.

X. Accurately weigh about 10 Gm. of the drug as prepared under paragraph IX in a tared evaporating dish. Dry at a temperature of 100° C. for five hours and weigh. Continue the drying and weighing at one hour intervals until the loss is not more than 0.25 per cent in one hour's drying.

Moisture Method for Drugs Containing Ether-soluble Constituents Volatile at 100° C.

XI. Proceed as under paragraph X. Determine the volatile ether-soluble extractive (paragraph XIII) and subtract the percentage of volatile ether-soluble extractive from the percentage lost during drying. The difference represents the percentage of moisture.

Crude Fiber.

XII. Exhaust a weighed quantity of the prepared drug (paragraph VI), representing about 2 Gm. of the drug, with ether or use the residue from the determination of the volatile ether-soluble extractive (paragraph XIII). Add 200 cc. of boiling sulphuric acid solution adjusted to exactly 1.25 per cent by titration, to the ether-exhausted drug, in a 500 cc. flask, and connect the flask with a reflux condenser, the tube of which passes only a short distance below the rubber stopper, into the flask. Heat the mixture to boiling and continue the boiling exactly thirty minutes. Then filter the mixture through a filter and wash the residue on the filter with boiling distilled water until the washings are no longer acid. Rinse the residue back into the flask with 200 cc. of boiling sodium hydroxide solution, adjusted to exactly 1.25 per cent by titration and free from sodium carbonate. Again heat the mixture to boiling and continue the boiling exactly thirty minutes under the reflux condenser as described under the treatment with acid, then rapidly filter through a tared filter, wash the residue with boiling distilled water until the washings are neutral, dry it at 110° C. until of constant weight, and note the weight. Now completely incinerate the dried residue and weigh the ash: the loss of weight is considered to be the weight of the crude fiber.

NOTE—The boiling with acid and alkali should continue *exactly* thirty minutes from the time that the liquid (which is cooled below the boiling point by adding it to the cold flask) again boils. After the solution has been brought to boiling, the flame should be turned low enough just to maintain boiling. During the boiling the flask should be gently rotated from time to time to catch any particles which may adhere to the walls of the flask. A slow current of air introduced into the flask during the boiling operation will be very helpful to keep down excessive frothing.

Volatile Ether-soluble Extractive.

XIII. Extract completely 2 Gm. of the prepared drug (paragraph VI), dried over sulphuric acid for not less than twelve hours, by subjecting it, during twenty hours, to the action of dehydrated ether (page 1533) in continuous extraction apparatus. Transfer the ethereal solution to a tared porcelain dish and allow it to evaporate spontaneously. Then dry it over sulphuric acid during eighteen hours and weigh the total ether extract. Now heat the extract gradually up to 110° C. until the weight becomes constant: the loss in weight during the heating represents the volatile portion of the extract.

Non-volatile Ether-soluble Extractive.

XIV. Proceed as directed under *Volatile Ether-soluble Extractive* (paragraph XIII). The weight of the extract after drying in a desiccator and then at 110° C. until of constant weight represents the non-volatile portion of the extract.

Alcohol-soluble Extractive.

XV. Macerate about 2 Gm. of the prepared drug (paragraph VI), accurately weighed, in about 70 cc. of alcohol in a suitable flask. Shake during eight hours at thirty minute intervals and allow to stand for sixteen hours without shaking. Filter and wash the flask and residue with small portions of alcohol until the filtrate measures 100 cc. Evaporate a 50 cc. aliquot portion to dryness in a suitable tared dish on a water bath and dry to constant weight at 110° C. Calculate the percentage of anhydrous extractive from the weight of drug taken.

Diluted Alcohol-soluble Extractive.

XVI. Proceed as directed under paragraph XV, using diluted alcohol instead of alcohol.

Water-soluble Extractive.

XVII. Proceed as directed under paragraph XV, using distilled water instead of alcohol.

Extractive, Soluble in Purified Petroleum Benzin.

XVIII. Extract completely about 2 Gm. of the prepared drug (paragraph VI), accurately weighed, by subjecting it during twenty hours to the action of purified petroleum benzin in a continuous extraction apparatus. Transfer the benzin solution to a tared porcelain dish and allow it to evaporate spontaneously. Then dry it over sulphuric acid for eighteen hours and weigh. Calculate the percentage of anhydrous extractive from the weight of drug taken.

CHAPTER XCI

PHYSICAL CONSTANTS

Boiling and Distilling Points

THESE are described on page 120.

Congealing Points

Unless otherwise directed, about 10 cc. of the liquid to be tested is introduced into a dry test tube of from 18 to 20 mm. internal diameter, which is then cooled in water or in a suitable freezing mixture, the temperature of which should be about 5° lower than the supposed congealing point of the liquid. To induce crystallization, rub the walls of the tube with a standard thermometer (page 106), or add a small crystal of the substance being tested. By alternated immersion of the tube in the bath, or removal from the bath and constant stirring with the thermometer, the temperature is so adjusted that the greater part of the liquid gradually congeals. The highest temperature remaining constant for a short time during the congelation is defined as the congealing point.

Melting Points

These are described on page 106.

Optical Rotation

In a ray of ordinary light the transverse vibrations take place indifferently in any plane about the line of propagation. When these waves are limited to a single plane, they are termed polarized and the phenomenon is known as polarization.

Many organic substances, either liquid or in solution in suitable solvents, when examined in a specially constructed optical apparatus called a polariscope, are capable of rotating the plane of polarization of a ray of light either to the right or to the left. Such substances are termed "optically active", and when rotating to the right, are designated as "dextrorotatory" and when rotating to the left, as "lævorotatory". Substances which do not possess this property of optical rotation are termed "optically inactive". Optical activity in many instances is intimately connected with the chemical constitution of a substance, frequently becoming a specific property, and its determination is of considerable value.

Among the substances recognized in the Pharmacopœia, there are a number, particularly certain essential or volatile oils and related bodies, for which the determination of the angle of rotation of a ray of polarized light, or, in some cases, the proof of their optical inactivity, affords the most simple and positive evidence of their identity or purity.

The instruments used for polariscopic tests, vary in their construction and are classified as polarimeters (measuring angular rotation) and saccharimeters (measuring percentage of sucrose). Those which are most generally adapted for the examination of the substances mentioned above are the penumbral or so-called "half-shadow" instruments of Laurent and of Schmidt and Hänsch in which the two sides of the field of vision are capable of becoming unequally illuminated. Polarimeters permit the angle of rotation to be read off in degrees or fractions of a degree of a circle. Saccharimeters, set to measure percentage of sucrose, give readings in terms of divisions of the sugar scale.

These determinations are best made in a dark room, and by means of monochromatic light, the latter being obtained by introducing into a non-luminous flame, on a loop of platinum wire, a small bead of fused sodium chloride. The light thus radiated corresponds with the line D of the solar spectrum.

The following factors are employed for converting readings of a saccharimeter into readings of a polarimeter.

1 division Laurent sugar scale equals 0.2167° angular rotation D.

1 division Schmidt and Hänsch sugar scale equals 0.346° angular rotation D.

Since the deviation of the plane of polarization either to the right or to the left of the zero point is directly proportional to the length of the column of liquid, it is essential that the observations should be made with tubes of a definite length, such as 200, 100, 50, or 25 mm. The selection of the length of the tube to be employed is, however, usually dependent upon the depth of color of the liquid and the magnitude of its optical rotation.

The rotatory power of an optically active, liquid substance, observed with sodium light, and referred to the ideal density 1, and in a tube having a length of 1 decimeter (100 mm.), is designated as its *specific rotatory power*. This is usually expressed by the term $[a]_D$. Since, however, not only the density of an optically active liquid, but also its rotation, is influenced by the temperature, the specific rotation varies with the latter. In stating the specific rotation it is, therefore, necessary to indicate at what temperature the rotation and the density of the liquid have been determined. But for the same temperature the specific rotation of a pure, optically active liquid is always a constant number. The temperature used in the text of the Pharmacopœia is 25° C., except when otherwise indicated. For saccharimeters the temperature is fixed at 20° C. by international agreement.

For calculating the specific rotatory power of an optically active liquid substance, or solution of an optically active solid, the following formulas are of general application:

$$\text{I. For liquid substances} \quad [a]_D = \frac{100 \times a}{L \times d}$$

$$\text{II. For solutions of solids} \begin{cases} [a]_D = \dfrac{10000 \times a}{L \times p \times d} \\ \text{or} \quad [a]_D = \dfrac{10000 \times a}{L \times c} \end{cases}$$

For calculating these formulas, the determination of the following factors is necessary:
a = the angle of rotation of the liquid or solid observed with sodium light.
L = the length of the tube in millimeters.
d = the density of the active liquid or solution.
p = the amount of active substance in 100 parts by weight of the solution.
c = the number of grams of active substance in 100 cc. of solution.

Refractive Index

When a ray of light passes from one transparent substance into another of different density, it is deflected, except when it enters perpendicularly to the surface of contact. The direction of the deviation is dependent upon the difference of density of the two substances; the extent is also influenced by this difference.

This deviation is termed "refraction". When the ray passes from a substance of given density to one of greater density (*e.g.*, from air into glass) the refraction is towards the perpendicular meeting the surface at the point of contact; when passing from a substance of greater density to one of less (*e.g.*, from water into air) the ray deviates from the perpendicular at the point of contact.

Quantitative measurements of refraction are expressed as "indices of refraction", the index being the figure obtained by dividing the sine of the angle that the incident ray makes with the perpendicular, by the sine of the angle that the refracted ray makes with the same perpendicular; that is, it is the ratio between these sines. Thus, the ratio for a ray of light passing from air into water at standard temperature is about 4 : 3 or, expressing it decimally and with greater exactness, 1.336. This is, therefore, the index of refraction of water. The determination of the refractive index is accomplished by means of optical instruments known generally as *refractometers*, which are of several types. Some of these give figures on an arbitrary scale, the actual refractive index being ascertained by consulting a table.

As the exact temperature at which the examination is made is of great importance, all of the instruments are provided with attachments for circulating water of the proper temperature about the prisms or about the vessel containing the liquid to be observed, and are also equipped with thermometers for observing the temperature very closely.

The principal instruments in use are as follows:

Pulfrich Refractometer—This instrument is used chiefly for purely scientific investigations. It is adapted for use with liquids and solids of all degrees of refractive power. When a liquid is to be examined, it is placed in a small cylindrical glass vessel immediately above the observation prism. When solids are to be examined, the glass cylinder is removed and the solid (previously polished) is placed in direct contact with the observation prism. The reading of this instrument is made by noting a boundary line between a light and a dark field in its position with reference to a graduated scale upon which the refractive index is directly expressed.

The Abbe Refractometer—This is an instrument of wide utility, designed primarily for the examination of liquids. Only a few drops of the liquid are required for an observation. This is spread in a thin film between the two observation prisms. The index of refraction

is also read off directly upon the scale of this instrument, in which, as in the Pulfrich refractometer, a boundary line between a light and a dark field is the observation line.

The Zeiss Butyro Refractometer—This instrument is especially designed for the examination of fixed oils and fats. It is not applicable to aqueous or alcoholic liquids. The distinctive line for observation in this instrument is the border line of total reflection which is a narrow line capable usually of being accurately read to within a tenth of a unit of the arbitrary scale used. Sometimes this observation line is accompanied by a blue or a red fringe or haze which interferes with the accuracy of the reading. Should a close reading be impossible on this account, it will be found necessary to use the monochromatic sodium flame for the observation (see under optical rotation).

Zeiss Immersion Refractometer—This is adapted for the examination of aqueous, oily, or alcoholic liquids. The distinctive line for observation is as described under the preceding instrument, the border line of total reflection in this case being much sharper and capable of being more accurately read.

For making observations of the entire range of pharmacopœial substances, the Abbe instrument is the one generally selected, the Pulfrich instrument not being in common use, and the Zeiss butyro- and immersion refractometers not covering the entire range necessary.

Solubility

This is described on page 182.

Specific Gravity

This is described on page 57.

Viscosity

Viscosity is a term used to denote the relative degree of fluidity of a liquid. Scientifically, viscosity may be defined as the force which will move a unit area of plane surface, with unit speed relative to another parallel plane surface, from which it is separated by a layer of the liquid of unit thickness. The viscosity of a liquid varies with the temperature, the higher the temperature the lower the viscosity and *vice versa*.

Several methods of expressing viscosity are in use. The method adopted in this Pharmacopœia is "kinematic viscosity" which is based on absolute viscosity. The kinematic viscosity is the ratio of the absolute viscosity expressed in poises over the density $\left(\frac{\mu}{\gamma}\right)$. The poise is the unit of absolute viscosity and is equivalent to the force of one "dyne-second per square centimeter".

As a poise is rather large, one-hundredth of a poise, or a centipoise (cp.), is now generally accepted as a more convenient unit for absolute viscosity. The centipoise is almost exactly the viscosity of water at 20° C.

Methods of determining absolute or kinematic viscosity are described in the U. S. Bureau of Standards papers S–298, T–100, and T–112. Instead of the direct determination of absolute or kinematic viscosity which is rather difficult, the viscosity may be determined with either the Engler or Saybolt viscosimeters and the results obtained with these instruments converted into the kinematic viscosity with the aid of the conversion tables given below.

In the Engler instrument, viscosity is expressed in "Engler degrees". These are obtained by dividing the time of discharge for the liquid being tested by the time of discharge for water at 20° C.

With the Saybolt Universal Viscosimeter, results are expressed as the time of discharge, in seconds, of the liquid being tested. In the United States the Saybolt Universal Viscosimeter is generally used for the determination of viscosity of lubricating oils. This instrument, in brief, consists of a metallic cylinder to contain the liquid under examination and having an outlet in the bottom closed with a cork stopper. It is surrounded with a jacket which serves as a bath to heat the liquid under examination to the specified temperature, the jacket being provided with facilities for stirring and heating the bath. Thermometers, a flask graduated at 60 cc., and a stop watch accompany the apparatus.

To determine the viscosity, the bath is first filled with a suitable liquid, and heated to a few degrees above the temperature at which the test is to be made, then the cylinder is filled with the liquid under examination, and when the liquid in the cylinder registers the specified temperature, adjust the volume, place the flask, graduated at 60 cc., under the outlet, and quickly remove the cork, immediately starting the stop watch. When the oil in the flask reaches the 60 cc. mark, stop the watch. The time, in seconds, required to fill the flask to the 60 cc. mark represents the viscosity of the liquid. A fuller description of the apparatus and the details of manipulation are given in the U. S. Bureau of Mines, Technical Paper, 323 A.

Table for Conversion of Saybolt or Engler Viscosity into Kinematic Viscosity

Column 1 = Viscosity, Saybolt Universal, sec.
Column 2 = Kinematic viscosity, poises divided by Gm. per cc.
Column 3 = Viscosity, Engler degrees.

1	2	3	1	2	3	1	2	3	1	2	3
50	0.074	1.59	128	0.273	3.86	196	0.429	5.85	274	0.601	8.09
52	0.080	1.65	130	0.278	3.93	198	0.433	5.90	276	0.605	8.14
54	0.086	1.71	132	0.282	3.98	200	0.437	5.96	278	0.609	8.18
56	0.092	1.77	134	0.287	4.04	202	0.442	6.02	280	0.614	8.25
58	0.097	1.82	136	0.292	4.10	204	0.446	6.08	282	0.618	8.29
60	0.103	1.88	138	0.297	4.16	206	0.450	6.13	284	0.622	8.35
62	0.109	1.94	140	0.301	4.22	208	0.455	6.19	286	0.627	8.42
64	0.114	2.00	142	0.306	4.27	210	0.460	6.26	288	0.631	8.48
66	0.120	2.05	144	0.310	4.32	212	0.464	6.31	290	0.636	8.55
68	0.125	2.11	146	0.315	4.39	214	0.468	6.36	292	0.640	8.61
70	0.130	2.17	148	0.320	4.45	216	0.473	6.42	294	0.645	8.68
72	0.136	2.23	150	0.324	4.50	218	0.477	6.47	296	0.649	8.72
74	0.141	2.29	152	0.328	4.55	220	0.482	6.54	298	0.654	8.78
76	0.146	2.35	154	0.333	4.61	222	0.487	6.60	300	0.659	8.85
78	0.151	2.40	156	0.338	4.68	224	0.491	6.66	302	0.663	8.90
80	0.156	2.46	158	0.342	4.74	226	0.495	6.71	304	0.667	8.95
82	0.161	2.52	160	0.347	4.81	228	0.499	6.76	306	0.672	9.02
84	0.166	2.58	162	0.352	4.87	230	0.503	6.81	308	0.676	9.07
86	0.171	2.64	164	0.356	4.92	232	0.508	6.87	310	0.680	9.12
88	0.176	2.70	166	0.361	4.98	234	0.512	6.93	312	0.685	9.19
90	0.182	2.76	168	0.365	5.03	236	0.517	6.99	314	0.689	9.24
92	0.186	2.81	169	0.368	5.06	238	0.521	7.04	316	0.693	9.30
94	0.191	2.87	**170**	**0.370**	**5.09**	240	0.526	7.10	318	0.698	9.36
96	0.196	2.93	171	0.372	5.12	242	0.530	7.16	320	0.702	9.41
98	0.201	2.98	172	0.374	5.14	244	0.535	7.21	322	0.707	9.48
100	0.206	3.04	173	0.376	5.17	246	0.539	7.27	324	0.711	9.54
102	0.211	3.10	174	0.379	5.20	248	0.543	7.32	326	0.716	9.59
104	0.215	3.16	**175**	**0.381**	**5.23**	250	0.548	7.38	328	0.720	9.64
106	0.221	3.22	176	0.383	5.26	252	0.552	7.44	330	0.724	9.70
108	0.225	3.27	177	0.385	5.28	254	0.557	7.50	332	0.729	9.77
110	0.230	3.33	178	0.388	5.31	256	0.561	7.56	334	0.733	9.82
112	0.235	3.39	180	0.392	5.37	258	0.566	7.62	336	0.738	9.89
114	0.240	3.45	182	0.397	5.43	260	0.570	7.68	338	0.742	9.94
116	0.244	3.51	184	0.402	5.49	262	0.574	7.73	340	0.746	10.00
118	0.249	3.57	186	0.406	5.55	264	0.579	7.79	342	0.751	10.05
120	0.254	3.63	188	0.410	5.61	266	0.584	7.86	344	0.755	10.10
122	0.259	3.69	190	0.415	5.66	268	0.588	7.91	346	0.759	10.16
124	0.263	3.74	192	0.420	5.73	270	0.592	7.96	348	0.764	10.22
126	0.268	3.80	194	0.424	5.79	272	0.597	8.03	350	0.768	10.28

CHAPTER XCII

REAGENTS AND TEST SOLUTIONS

Reagents, Test Solutions and Volumetric Solutions

Reagents are substances used in chemical testing or in microscopic examinations.

Test Solutions, abbreviated "T. S.," are solutions of prescribed strength of reagents in appropriate solvents for use in applying tests.

Indicators are reagents or test solutions employed for the purpose of determining the completion of reactions.

Volumetric Solutions are solutions of reagents of accurately determined strength. The strength is usually related to the molecular weight. These solutions are primarily intended for quantitative estimations.

Some official substances are satisfactory for use as reagents or test solutions if they comply with the tests for purity given in the monographs of the Pharmacopœia. Space is conserved by simply referring to these where such is the case.

When a substance is not official or when a greater degree of purity is required than is provided for in the monograph, the substance will be found in the following list, with such description and tests as will insure its suitability for the purpose intended.

Reagents, test solutions, volumetric solutions, and indicators should be preserved in bottles or other containers made of glass of a minimum solubility and low alkalinity, and approximately free from lead or arsenic. The bottles must be capable of being tightly closed with appropriate stoppers.

When ground glass stoppers are directed for bottles and apparatus which are to contain substances capable of attacking such surfaces, the ground glass surfaces are to be coated with a thin film of petrolatum. Certain reagents and their solutions are affected by light. In such cases, the direction to keep the substances in amber-colored glass bottles should be carefully observed.

Water, wherever mentioned in carrying out tests or as a solvent in preparing test solutions, etc., is always meant to be distilled water.

The chemical formulas when definitely known, immediately follow the titles of the reagents. This is for convenience and is not to be interpreted as meaning that the reagents are of absolute purity and strength.

Amounts of Substances to be Used in Applying Tests—When not otherwise stated, it is to be understood that a volume of 10 cc. of an aqueous solution of the designated strength is to be used for a test.

Reagents

Acetic Acid, $CH_3.COOH$—Use *Acidum Aceticum.*

Acetic Acid, Diluted—Use *Acidum Aceticum Dilutum.*

Acetic Acid, Glacial, $CH_3.COOH$—Use *Acidum Aceticum Glaciale*, page 13.

Acetic Anhydride, $(CH_3CO)_2O$—A colorless liquid having a pungent odor. Boiling point, about 137° C. Specific gravity, about 1.075 at 25° C. Non-volatile residue at 110° C. not over 0.005 per cent. An aqueous solution (1 in 50) gives no reaction for *chloride.* One Gm., when dissolved in 50 cc. of distilled water and allowed to stand for one hour in a stoppered flask, requires not less than 19.3 cc. of normal sodium hydroxide for neutralization, using phenolphthalein T.S. as indicator, corresponding to at least 90 per cent of $(CH_3CO)_2O$.

Preserve in glass-stoppered bottles in a cool, dry place. The stoppers should be sealed with paraffin.

Acetone CH_3COCH_3—Use *Acetonum.*

Alcohol, C_2H_5OH—Use *Alcohol.*

Alcohol, Dehydrated (*Absolute Alcohol*), C_2H_5OH—Use the official *Alcohol Dehydratum.*

Alcohol, Neutralized—To a suitable quantity of alcohol, add 2 or 3 drops of phenolphthalein T.S. and just sufficient fiftieth-normal or tenth-normal sodium hydroxide to produce a slight pink color. Neutralized alcohol should be prepared immediately before using.

Aluminum Metallic, Al—Aluminum in the form of wire.

Ammonium Carbonate, $NH_4HCO_3.NH_4NH_2CO_2$—In addition to the description and tests for *Ammonii Carbonas,* page 655, it must conform to the following tests: Residue upon incineration not over 0.01 per cent. An aqueous solution (1 in 10) gives no reaction for *chloride, phosphate, sulphate, thiocyanate, or heavy metals.*

Ammonium Chloride, NH_4Cl—In addition to the description and tests for *Ammonii Chloridum,* page 656, it must conform to the following tests: Residue upon incineration not over 0.03 per cent. An aqueous solution (1 in 10) gives no reaction for *phosphate, sulphate, thiocyanate, or heavy metals.* Ammonium chloride employed in the test for lead under citric and tartaric acids and their salts, must also comply with the following special test. Dissolve 3 Gm. in 10 cc. of distilled water, acidified with 1 drop of reagent hydrochloric acid, in a test tube having an internal diameter of about 20 mm., add 10 cc. of clear, colorless hydrogen sulphide T.S., and mix well. The liquid must show no color when viewed downward against a white background.

Ammonium Nitrate, NH_4NO_3—Colorless crystals, or white granules, very soluble in water, slightly soluble in alcohol. Residue upon incineration not over 0.03 per cent. An aqueous solution (1 in 10) gives no reaction for *chloride, phosphate, sulphate, thiocyanate, or heavy metals.* An aqueous solution (1 in 20) gives no reaction for *nitrite* when tested as follows: To a solution of 1 Gm. of ammonium nitrate in 20 cc. of distilled water add 2 cc. of diluted sulphuric acid and 1 cc. of metaphenylenediamine hydrochloride T.S.: no yellow or yellowish-brown color develops.

Ammonium Oxalate, $(NH_4)_2C_2O_4.H_2O$—Colorless crystals, soluble in water. Residue, upon incineration, not over 0.03 per cent. An aqueous solution (1 in 25) gives no reaction for *chloride, phosphate, sulphate, or heavy metals.*

Ammonium Sulphate, $(NH_4)_2SO_4$—Colorless crystals or white granules, very soluble in water. Residue upon incineration not over 0.05 per cent. An aqueous solution (1 in 10) gives no reaction for *chloride, phosphate, thiocyanate, or heavy metals.*

Ammonium Vanadate (*Ammonium Metavanadate*), NH_4VO_3—A white crystalline powder, slightly soluble in water. Easily decomposed upon heating either dry or in solution.

Amyl Alcohol, $C_5H_{11}OH$—Colorless, oily liquid. Boiling point, 128° to 132° C. Specific gravity, about 0.812 at 25° C. Miscible with alcohol, ether, chloroform, carbon disulphide, petroleum benzin, benzene, and fixed or volatile oils. Slightly soluble in water. Non-volatile residue at 100° C., not over 0.005 per cent.

Aniline, $C_6H_5NH_2$—A colorless or nearly colorless, strongly refractive, oily liquid. Boiling point, 182° to 184° C. Specific gravity, about 1.020 at 25° C. Soluble in water; miscible with alcohol, ether, and fixed or volatile oils. Five cc. of aniline dissolved in 10 cc. of hydrochloric acid, produces a clear solution. Upon diluting this solution with 15 cc. of distilled water and cooling to 15° C., the liquid does not become more than slightly cloudy.

Preserve in amber-colored bottles. Upon keeping, it often assumes a yellow or brown color, and should then be distilled before using.

Aniline Sulphate, $(C_6H_5NH_2)_2H_2SO_4$—White or nearly white crystals, very soluble in water, slightly soluble in alcohol.

Arsenic Trioxide, As_2O_3—Use *Arseni Trioxidum.*

Asbestos—The silky, well-matted variety of long-fiber asbestos. When moistened and rolled between the thumb and finger, it forms a compact mass. For use as a filtering medium for the Gooch crucible, boil the asbestos for one hour with diluted hydrochloric acid, and wash it with boiling distilled water until free from all acid.

Barium Chloride, $BaCl_2.2H_2O$—Colorless crystals, freely soluble in water, slightly soluble in alcohol and in concentrated hydrochloric acid. An aqueous solution (1 in 20) is neutral and gives no reaction for *nitrate, chlorate, or heavy metals.* Dissolve 2 Gm. of barium chloride in 100 cc. of distilled water, add a few drops of hydrochloric acid, heat to boiling, then add 20 cc. of diluted sulphuric acid, and set aside for at least twelve hours. Filter, evaporate the filtrate, and ignite. The weight of the residue does not exceed 0.002 Gm. (*other fixed bases*). Shake 1 Gm. of finely powdered barium chloride with 20 cc. of dehydrated alcohol during five minutes, filter, evaporate the filtrate, and ignite. The weight of the residue does not exceed 0.002 Gm. (*strontium and calcium*).

Barium Hydroxide, $Ba(OH)_2.8H_2O$—Colorless crystals, soluble in water, very soluble in boiling water. An aqueous solution (1 in 20) gives no reaction for *chloride or heavy metals.* Dissolve 2 Gm. of barium hydroxide in 100 cc. of distilled water, add 5 cc. of hydrochloric acid, heat to boiling, then add 15 cc. of diluted sulphuric acid, and set aside for at least twelve hours. Filter, evaporate the filtrate, and ignite. The weight of the residue does not exceed 0.003 Gm. (*other fixed bases*).

Assay—One Gm. dissolved in distilled water, and titrated with normal hydrochloric acid, using methyl orange T.S. as indicator, shows not less than 99 per cent of $Ba(OH)_2.8H_2O$.

Preserve in tightly-stoppered containers to prevent access of carbon dioxide.

Barium Nitrate, $Ba(NO_3)_2$—Colorless crystals, soluble in water, freely soluble in boiling water. An aqueous solution (1 in 20) gives no reaction for *heavy metals* and meets the requirements of the test for *other fixed bases* under *barium chloride.* Converted into chloride by twice evaporating to dryness with hydrochloric acid, it meets the requirements of the tests for *strontium and calcium* under *barium chloride.*

Benzene (*Benzol*), C_6H_6—A colorless, transparent, liquid. Boiling point, 79° to 81° C. Congealing point, about 5° C. Specific gravity, about 0.876 at 25° C. Insoluble in water, miscible with alcohol, ether, and with fixed or volatile oils. When equal volumes of benzene and sulphuric acid are shaken together in a glass cylinder during fifteen minutes, the acid upon separation is not colored. Add a few mgm. of isatin, shake well, and allow to stand for thirty minutes. The acid does not acquire a blue or green color (*thiophene*). Non-volatile residue at 100° C., not over 0.01 per cent.

Benzidine (*Paradiaminodiphenyl*), $(C_6H_4NH_2)_2$—A white or slightly reddish crystalline powder. Sparingly soluble in cold water, slightly soluble in boiling water, alcohol, and ether. Melting point, about 128° C. A solution (1 in 50) in 2 per cent hydrochloric acid gives no reaction for *sulphate.* Residue upon incineration not over 0.05 per cent.

Benzin, Petroleum—Use *Benzinum Purificatum.*

Betanaphthol, $C_{10}H_7OH$—Use *Betanaphthol.*

Bromine, Br—A dark reddish-brown fuming, corrosive volatile liquid containing not less than 99 per cent of Br and not more than 1 per cent of Cl. Specific gravity, about 3.1 at 25° C. Soluble in about 30 parts of water, soluble in alcohol and in ether (with gradual decomposition of the solvents). Dissolve about 1 cc. of bromine in 50 cc. of sodium hydroxide T.S. and allow to stand for six hours: the solution remains clear (*organic bromine compounds*). Agitate 10 cc. of a saturated aqueous solution of bromine with 1 Gm. of reduced iron until the solution is nearly colorless. Filter and add 1 cc. of starch T.S. and 1 cc. of ferric chloride T.S.: no blue color develops (*iodine*). Non-volatile residue at 100° C., not over 0.01 per cent.

Assay—Dissolve 10 Gm. of potassium iodide in 25 cc. of distilled water, introduce the solution into a 100 cc. measuring flask, stopper, and determine accurately the weight of the flask and its contents. Add about 1 Gm. of bromine to the contents of the flask, determine its exact weight, then fill the flask to the mark with distilled water, and titrate 25 cc. of this solution with tenth-normal sodium thiosulphate, using starch T.S. as indicator. Each Gm. of bromine (containing not more than 1 per cent of chlorine) corresponds to not more than 126.7 cc. of tenth-normal sodium thiosulphate. Preserve in glass-stoppered bottles, in a cool place, the bottles being enclosed in larger vessels with the space between filled with some substance, capable of absorbing bromine.

Cadmium and Potassium Iodide—A mixture of equal weights of cadmium iodide and potassium iodide. An aqueous solution (1 in 20) shows no *free iodine.*

Cadmium Chloride, $CdCl_2.2H_2O$—Small, colorless crystals, efflorescent in dry air. Very soluble in water, soluble in alcohol.

Cadmium Iodide, CdI_2—Colorless crystals, becoming yellow upon exposure to light and air. Very soluble in water and in alcohol, sparingly soluble in ether and acetone.

Calcium Carbonate, $CaCO_3$—Use *Calcii Carbonas Præcipitatus.*

Calcium Chloride, $CaCl_2.2H_2O$—In addition to the description and tests for *Calcii Chloridum,* page 676, it must conform to the following tests: One Gm. dissolves completely in 10 cc. of alcohol. An aqueous solution (1 in 20) is neutral to litmus paper, does not respond to the test for *heavy metals,* and yields no precipitate with an equal volume of calcium sulphate T.S. (*barium*). One Gm. of calcium chloride shows no *ammonia* when warmed with sodium hydroxide, and 0.5 Gm. meets the requirements of the test for *arsenic.* Precipitate the calcium from 1 Gm. of the salt dissolved in 50 cc. of distilled water by ammonium oxalate T.S., evaporate and ignite the filtrate: the residue does not exceed 0.3 per cent (*alkali and magnesium salts*).

Calcium Chloride, Fused, $CaCl_2$—Deliquescent lumps or granules. It complies with the test for identity and purity under *Calcii Chloridum,* page 676, and when assayed by the method given under that substance shows not less than 98 per cent of $CaCl_2$.

Calcium Sulphate, $CaSO_4.2H_2O$—Transparent crystals, crystalline masses or a white powder. Slightly soluble in water.

Canada Turpentine—A liquid oleoresin from *Abies balsamea* (Linné) Miller (Fam. *Pinaceæ*). A pale yellow or greenish, viscid, transparent liquid. Completely soluble in ether, chloroform, and benzene. When exposed to the air, Canada turpentine gradually dries and remains transparent. Canada turpentine solidifies when mixed with 20 per cent of its weight of magnesium oxide, previously moistened with water.

Carbon Disulphide, CS_2—A clear, colorless, very volatile, inflammable liquid. Boiling point, about 46° C. Specific gravity, about 1.26 at 25° C. Slightly soluble in water, very soluble in alcohol, ether, chloroform and fixed or volatile oils. Carbon disulphide does not affect the color of blue litmus paper moistened with water (*sulphur dioxide*). Agitate 10 cc. of carbon disulphide with 0.5 Gm. of lead carbonate: the latter should not acquire a brown color (*foreign sulphur compounds*). Non-volatile residue at 100° C., not over 0.004 per cent.

Carbon Tetrachloride, CCl_4—Use *Carbon Tetrachloridum.*

Casein—A white or slightly yellow, odorless, granular powder. Insoluble in water and other neutral solvents, but readily dissolved by ammonia T.S. and by solutions of alkali hydroxides, forming a cloudy solution. Ash: not more than 1 per cent. Loss on drying at 100° C., not more than 10 per cent. Shake 1 Gm. of casein with 20 cc. of distilled water for ten minutes and filter: the filtrate is not alkaline to litmus paper, and on evaporating to dryness and drying at 100° C., the residue does not exceed 0.1 per cent (*soluble substances*). Dissolve 1 Gm. of casein in 10 cc. of distilled water, with 5 cc. of alcoholic ammonia T.S., and shake out with two successive portions of 20 cc. each of purified petroleum benzin. Evaporate the benzin extract at a low temperature and dry at 70° C. The weight of the residue does not exceed 0.5 per cent (*fats*). Anhydrous casein contains from 15.2 to 16 per cent of nitrogen, using the Kjeldahl method.

Charcoal—Use *Carbo Ligni.*

Chloral Hydrate, $CCl_3CHO.H_2O$—Use *Chloralis Hydras.*

Chlorinated Lime—Use *Calx Chlorinata.*

Chloroform, $CHCl_3$—Use *Chloroformum.*

Chromium Trioxide, CrO_3—Use *Chromii Trioxidum.*

Cobaltous Chloride, (*Cobalt Chloride*) $CoCl_2.6H_2O$—Red crystals or a red, crystalline powder. Very soluble in water and in alcohol, soluble in acetone and in glycerin. Dissolve 2 Gm. of cobaltous chloride in 100 cc. of distilled water. Completely precipitate the cobalt by the addition of an excess of ammonia T.S., followed by ammonium sulphide T.S., and filter. The filtrate, after evaporation and ignition, leaves not more than 0.008 Gm. of residue (*salts of alkalies and alkali earths*). Dissolve 1 Gm. of cobaltous chloride in 20 cc. of distilled water, add 3 Gm. of sodium cyanide, and boil until the solution acquires a yellow color. Filter, add 1 cc. of bromine, and sufficient sodium hydroxide T.S. to render strongly alkaline: no brown color develops (*nickel*). A solution of cobaltous chloride (1 in 20) strongly acidulated with hydrochloric acid, yields no dark precipitate with hydrogen sulphide (*lead or copper*).

Copper, Cu—Copper in the form of wire, foil, turnings, filings, or granules. It should give no reaction for *antimony, lead, silver, or tin.* It should contain not more than 0.03 per cent of *iron* and not more than 0.0001 per cent of *arsenic.*

Cupric Acetate, $Cu(C_2H_3O_2)_2.H_2O$—Bluish-green crystals, or powder, having an acetous odor. Soluble in water, slightly soluble in alcohol. It should contain not more than 0.01 per cent of *sulphate or chloride.* Dissolve 1 Gm. of cupric acetate in 100 cc. of distilled water, add 1 cc. of hydrochloric acid, completely precipitate the copper with hydrogen sulphide, filter, evaporate the filtrate to dryness, and gently ignite: the residue does not exceed 0.5 per cent.

Cupric Sulphate, $CuSO_4.5H_2O$—Use *Cupri Sulphas.*

Cupric Sulphate, Anhydrous, $CuSO_4$—A white or grayish-white powder, free from a blue tinge. Upon adding a small quantity of water, it becomes blue. It is soluble in

water and responds to the reactions characteristic of copper and sulphates. An aqueous solution (1 in 50) yields no immediate reaction for *chloride*. Precipitate the copper from a solution of 2 Gm. in 100 cc. of distilled water, acidulated with 2 cc. of hydrochloric acid, with hydrogen sulphide, and filter. Evaporate the filtrate to dryness and gently ignite: the residue does not exceed 0.1 per cent.

Curare—The composition of curare is not definitely known, and different specimens vary, depending upon the special variety of plant used in its manufacture. The most important source of curare is the bark of several varieties of *Strychnos*, the species most commonly employed being *S. Castelnæi*, Wedd., *S. Toxifera* Benth., *or S. Crevauxii* G. Planch. (Fam. *Loganiaceæ*). Commercial curare is a brownish or black, shining resinoid mass. About 75 per cent is soluble in cold water and it is almost completely soluble in diluted alcohol.

Dextrose, $C_6H_{12}O_6.H_2O$—Use *Dextrosum*.

Dichloramine, $C_7H_7O_2NSCl_2$—Use *Dichloramina*.

Diphenylamine, $(C_6H_5)_2NH$—Grayish-white or colorless crystals. Melting point, about 54° C. Slightly soluble in water and in alcohol. A solution of 0.2 Gm. in 20 cc. of sulphuric acid, is colorless (*nitrates*). No violet color results when 1 Gm. of powdered diphenylamine is added to 20 cc. of a saturated aqueous solution of chlorinated lime (*aniline*).

Epinephrine, $C_9H_{13}O_3N$—Use *Epinephrina*.

Ether, Dehydrated, $(C_2H_5)_2O$—It conforms to the description and tests for *aldehyde and peroxide*, page 917, and to the following: Specific gravity, not over 0.711 at 25° C. Boiling point, from 34° to 36° C. To 10 cc. of ether, contained in a dry, clean, glass cylinder, add 0.1 Gm. of rosaniline acetate: no coloration results (*water or alcohol*). Non-volatile residue at 100° C., not more than 0.002 per cent.

Ethyl Acetate, $CH_3COOC_2H_5$—A transparent, colorless, inflammable liquid. Soluble in water, miscible with alcohol, ether, and fixed or volatile oils. Boiling point, 75° to 77° C. Specific gravity: 0.893 to 0.898 at 25° C. Ethyl acetate does not redden moistened blue litmus paper. Evaporate 5 cc. of ethyl acetate from clean, odorless, unsized paper. The final odor is not different in character from that observed at the beginning of the test. Superimpose 5 cc. of ethyl acetate upon 5 cc. of sulphuric acid: no dark coloration is produced at the zone of contact (*readily carbonizable substances*). Non-volatile residue at 100° C., not more than 0.005 per cent.

Ferric Ammonium Sulphate, $FeNH_4(SO_4)_2.12H_2O$—Pale violet crystals. Efflorescent on exposure to air. Very soluble in water, insoluble in alcohol. An aqueous solution (1 in 20) gives no reaction for *chloride or ferrous salts*.

Ferric Chloride, $FeCl_3.6H_2O$—Use *Ferri Chloridum*.

Ferrous Sulphate, $FeSO_4.7H_2O$—Use *Ferri Sulphas*.

Ferrous Sulphide, FeS—Dark gray or grayish-black lumps, fragments, sticks, granules, or globules. It is insoluble in water but is dissolved by diluted sulphuric or diluted hydrochloric acid with copious evolution of hydrogen sulphide.

Filter Paper, Quantitative—For the Mercuric Bromide Test Paper of the Arsenic Test, use Schleicher and Schüll's No. 589 (Blue Ribbon), or Swedish O. filter paper, or other makes of like surface, quality and ash (see Arsenic Test.

Fluorescein (*Resorcinolphthalein*), $C_{20}H_{12}O_5$—A yellowish-red to dark red powder. Sparingly soluble in water and in ether, soluble in alcohol. Fluorescein dissolves in solutions of the alkali hydroxides or carbonates, forming a solution which has a bright green fluorescence. Ash, not over 0.25 per cent. Agitate about 1 Gm. of

fluorescein with 20 cc. of distilled water and filter. One drop of tenth-normal sodium hydroxide imparts to 10 cc. of the filtrate a bright green fluorescence. The addition of a drop of ferric chloride T.S. to the remaining portion of the filtrate does not produce a bluish coloration (*resorcinol or other phenolic compounds*).

Fuchsin, Basic (*Basic Fuchsin, Rosaniline, Rosaniline Acetate, Rosaniline Hydrochloride*)—Crystals or crystalline fragments with a glossy, greenish-bronze luster. Soluble in water, alcohol, and amyl alcohol. An aqueous solution (1 in 500) yields a red precipitate upon the addition of tannic acid T.S. To 10 cc. of an aqueous solution (1 in 500), add 10 cc. of ammonia T.S. and 0.5 Gm. of zinc dust, and agitate. Decolorization of the solution results. Place a few drops of this decolorized solution upon filter paper, then place near by, on the paper, a few drops of hydrochloric acid. The zone of contact assumes a red color. Ash: not over 0.25 per cent.

Gallic Acid, $HC_7H_5O_5.H_2O$—White or nearly white crystals. A cold, saturated aqueous solution of gallic acid neither colors nor precipitates solutions of pure ferrous salts, and does not produce a precipitate with gelatin T.S. (*tannic acid*).

Gelatin—Use *Gelatinum*.

Glass Wool—Fine threads of glass. Glass wool should yield not more than 0.5 per cent of soluble matter when boiled for one-half hour with diluted hydrochloric acid. Boil 1 Gm. of glass wool for five minutes with a mixture of 25 cc. each of diluted nitric acid and distilled water, filter, evaporate the filtrate to dryness, treat the residue with 10 cc. of distilled water, and again filter. This latter filtrate is not colored by the addition of an equal volume of hydrogen sulphide T.S. (*lead*).

Gold Chloride (*Chlorauric Acid*), $HAuCl_4.4H_2O$—Yellow, hygroscopic crystals. Very soluble in water, soluble in alcohol and in ether. An accurately weighed portion of about 0.1 Gm., when moistened with a slight excess of ammonium oxalate T.S., evaporated to dryness, ignited, and weighed, yields a residue of about 48 per cent of metallic gold. Heat the metallic gold thus obtained with diluted hydrochloric acid and filter. The filtrate gives no appreciable coloration with either hydrogen sulphide T.S. or ammonium sulphide T.S. (*other metals*).

Hematein, $C_{16}H_{12}O_6$—A product of the oxidation of hematoxylin. Reddish-brown crystalline plates of a greenish metallic luster. Sparingly soluble in water, alcohol and in ether, insoluble in chloroform. It is dissolved by ammonia T.S. with a brownish-violet color and by dilute solutions of caustic alkalies with a bright red color.

Hydrochloric Acid, HCl—Use *Acidum Hydrochloricum*.

Hydrochloric Acid, Concentrated, HCl—In addition to the description and identity tests for *Acidum Hydrochloricum*, page 553, it must conform to the following tests: Specific gravity, between 1.170 and 1.184 at 25° C., corresponding to from 35 to 38 per cent of HCl. Non-volatile residue, upon evaporation and ignition with a drop of sulphuric acid, not more than 0.002 per cent. Evaporate 100 cc. of concentrated hydrochloric acid to about 5 cc., dilute with 10 cc. of distilled water, and add 5 drops of barium chloride T.S.: no precipitate occurs within twelve hours (*sulphate*). Add 5 cc. of concentrated hydrochloric acid, diluted with 50 cc. of distilled water, to a solution of 1 drop of tenth-normal iodine in 50 cc. of distilled water to which a few drops of starch T.S. have been added: no decolorization occurs (*sulphur dioxide*). Dilute 10 cc. of the acid with about 100 cc. of distilled water at a temperature of about 50° C. and thoroughly saturate it with hydrogen sulphide: no dark coloration or precipitate forms either before or after rendering alkaline with ammonia T.S. and adding 5 drops of ammonium sulphide T.S. (*heavy metals*). Two cc. of concentrated

hydrochloric acid, diluted with 10 cc. of distilled water, when subjected to the arsenic test, page 1512, produces a stain not greater than that produced by the zinc alone.

Hydrochloric Acid, Diluted—Use *Acidum Hydrochloricum Dilutum.*

Hydrogen Sulphide, H_2S—A gas generated by treating ferrous sulphide with diluted sulphuric or hydrochloric acid.

Indicators—See page

Indigo Carmine, $C_{16}H_8O_2N_2(SO_3Na)_2$—Use *Sodii Indigotindisulphonas.*

Iodine, Purified, I—Prepared from *Iodum*, page 575, as follows: Powder a suitable quantity of iodine and place it in a porcelain dish. Heat it over a water bath for twenty minutes, stirring constantly with a glass rod to vaporize moisture and other impurities. Then transfer the iodine to a glass, porcelain, or wedgwood mortar and triturate with about 5 per cent of its weight of potassium iodide. Return the mixture to the dish, cover it with a glass funnel, and heat carefully on a sand bath to sublime the iodine. When the operation is completed, detach the sublimed iodine, powder it, and dry it over calcium chloride in a desiccator for twenty-four hours: the ash from 2 Gm. is negligible.

Preserve in well-closed, glass-stoppered bottles, in a cool place.

Iron, Fe—Bright, clean iron in the form of wire, sheet, filings, or powder. In the test for copper, use bright pieces of sheet iron or steel knitting needles.

Preserve iron in well-closed glass containers to protect it from moist air, acid fumes, etc.

Isatin, $C_8H_5NO_2$—Small yellowish-red crystals; slightly soluble in water, soluble in alcohol, and in ether. Melting point about 200° C. Aqueous, alcoholic or ethereal solutions of isatin are reddish-brown in color.

When isatin is dissolved in a solution of an alkali hydroxide, it yields a violet colored solution which upon heating or upon long standing becomes yellow.

Kerosene—A mixture of hydrocarbons, chiefly of the methane and naphthene series. It is a clear, colorless or only slightly colored liquid, having a characteristic but not disagreeable odor. Specific gravity about 0.80 at 25° C. Boils between 180° and 300° C. Prepare purified kerosene by shaking a convenient volume of kerosene twice with about one-tenth its volume of 15 per cent sodium hydroxide solution, then wash with distilled water until free from alkali.

Lead Acetate, $Pb(C_2H_3O_2)_2.3H_2O$—Use *Plumbi Acetas.*

Lead Carbonate, $(PbCO_3)_2.Pb(OH)_2$—A white, heavy powder. Insoluble in water and in alcohol. It is dissolved by acetic or diluted nitric acid with effervescence, the resulting solutions responding to the identity tests for lead.

Lead Monoxide, PbO—Use *Plumbi Monoxidum.*

Lead Nitrate, $Pb(NO_3)_2$—Colorless or white crystals or a white crystalline powder. Very soluble in water, almost insoluble in alcohol. Lead nitrate responds to the identity tests for lead, page 737, and nitrates, page 551, and meets the requirements of the tests for *foreign metals* under *Plumbi Acetas.*

Lead Peroxide (*Lead Dioxide*), PbO_2—A dark brown powder containing not less than 90 per cent of PbO_2. Insoluble in water and in alcohol. It is unaffected by nitric acid, but is decomposed by hydrochloric acid with the evolution of chlorine, and by hot sulphuric acid with the evolution of oxygen. It is dissolved by concentrated solutions of alkali hydroxides. Boil 2 Gm. of lead peroxide with 50 cc. of distilled water for fifteen minutes, filter, evaporate the filtrate to dryness and ignite. The residue does not exceed 0.5 per cent (*soluble salts*).

Assay—Dissolve about 0.5 Gm. of finely powdered lead peroxide, previously dried to constant weight at 100° C. and accurately weighed, in a solution made by mixing 1.5 Gm. of potassium iodide, 12 Gm. of sodium acetate, 8 cc. of glacial acetic acid, and 8 cc. of distilled water. Clear the solution if necessary by the further addition of sodium acetate, and then determine the liberated iodine by titration with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.01195 Gm. of PbO_2.

Lime, Freshly Slaked, $Ca(OH)_2$—To prepare freshly slaked lime, drop upon a convenient quantity of lime, page 671, one-third of its weight of water, cover, and allow it to stand until it has been converted to a pulverulent mass and is cool. Freshly slaked lime, after drying and igniting, yields not more than 0.1 per cent of residue insoluble in hydrochloric acid and should show practically no effervescence when dissolved.

Magnesium Chloride, $MgCl_2.6H_2O$—White, deliquescent crystals, very soluble in water. An aqueous solution is neutral to litmus paper. Two Gm. of magnesium chloride should completely dissolve in 10 cc. of 85 per cent alcohol. Magnesium chloride also complies with the tests for *barium, calcium, heavy metals, and sulphate,* under reagent sodium chloride.

Magnesium Oxide, MgO—Use *Magnesii Oxidum.*

Magnesium Sulphate, $MgSO_4.7H_2O$—Use *Magnesii Sulphas.*

Manganese Dioxide, MnO_2—A fine heavy black powder, containing not less than 85 per cent of MnO_2. It is insoluble in water, but is dissolved by hydrochloric acid with the evolution of chlorine.

Assay—Dissolve about 0.2 Gm. of manganese dioxide, accurately weighed, in a mixture of 50 cc. of tenth-normal oxalic acid and 3 cc. of sulphuric acid, heat to about 80° C., and titrate the excess of oxalic acid with tenth-normal potassium permanganate. Each cc. of tenth-normal oxalic acid represents 0.0043465 Gm. of MnO_2.

Manganese Sulphate, $MnSO_4.4H_2O$ or $MnSO_4.5H_2O$—Pink crystals. Very soluble in water, insoluble in alcohol. An aqueous solution (1 in 50) gives no reaction for *chloride or iron.* Dissolve 1 Gm. of manganese sulphate in 50 cc. of distilled water, add 10 cc. of ammonium chloride T.S., heat to boiling, and precipitate the manganese with a slight excess of ammonium sulphide T.S. Continue the heating until the precipitate assumes a greenish color, then filter, evaporate the filtrate to dryness, and ignite: not more than 0.5 per cent of residue remains (*salts of foreign metals*).

Mercuric Bromide, $HgBr_2$—White needles, prisms, lustrous scales, or a granular, crystalline powder. Slightly soluble in cold water, soluble in boiling water and in alcohol. Mercuric bromide should be completely soluble in hot water. Residue upon incineration, not more than 0.05 per cent.

Mercuric Chloride, $HgCl_2$—Use *Hydrargyri Chloridum Corrosivum.*

Mercuric Oxide, Red, HgO—An orange-red, crystalline powder. Insoluble in water but dissolved by dilute nitric or dilute hydrochloric acid. A solution (1 in 50) in diluted nitric acid gives no reaction for *chloride or sulphate.* One Gm. mixed with 10 cc. of diluted sulphuric acid should give no reaction for nitrate with ferrous sulphate. Residue upon incineration, not more than 0.2 per cent. When dried to constant weight at 100 ° C. and assayed electrolytically or by titration with tenth-normal potassium thiocyanate, it should show not less than 99.5 per cent of HgO.

Mercurous Chloride, Mild, HgCl—Use *Hydrargyri Chloridum Mite.*

Mercury, Hg—Use *Hydrargyrum.*

Metaphenylenediamine Hydrochloride, $C_6H_4(NH_2)_2.2HCl$—A white, or slightly

reddish-white, crystalline powder, easily soluble in water. An aqueous solution (1 in 200) should be colorless.

Molybdic Acid—A white or yellowish-white powder of somewhat variable composition, containing, when assayed by the lead molybdate method, not less than 83 per cent of MoO_3. It is insoluble in water, soluble in solutions of alkali hydroxides. No insoluble residue should remain when 1 Gm. of molybdic acid is dissolved in 10 cc. of ammonia T.S. The addition of 10 cc. of hydrogen sulphide T.S. produces a greenish-yellow color but no brownish-yellow color or precipitate (*heavy metals*). Dissolve 10 Gm. of molybdic acid in 25 cc. of ammonia T.S., pour this solution gradually and with constant stirring into a mixture of 75 cc. of nitric acid and 75 cc. of distilled water, and set the solution aside for at least twelve hours at 40° C.: no yellow precipitate should appear (*phosphate*).

Naphthylamine (Alpha) Hydrochloride, $C_{10}H_7NH_2.HCl$—A white, crystalline powder which turns bluish upon exposure to light and air. Insoluble in water, soluble in alcohol and in ether. An aqueous solution (1 in 100) in diluted acetic acid gives a violet color with 5 drops of ferric chloride T.S. An aqueous solution (1 in 40) in diluted acetic acid should be colorless and not more than slightly opalescent from undissolved matter. Non-volatile residue upon incineration, not more than 0.05 per cent.

Naphthylamine (Beta) Acetate, $C_{10}H_7NH_2.C_2H_4O_2$—White to yellowish-white, crystalline scales or flakes. Slightly soluble in water, soluble in alcohol. An aqueous solution (1 in 100) does not give a violet color with 5 drops of ferric chloride T.S. (*alpha naphthylamine*).

Nitric Acid, HNO_3—Use *Acidum Nitricum*.

Nitric Acid, Diluted—Use a 10 per cent aqueous solution of HNO_3.

Nitric Acid, Fuming—A yellowish-red to brownish-red fuming liquid. Specific gravity, about 1.50 at 25° C. It conforms to the tests for purity under *Acidum Nitricum*, page 557, omitting the assay.

Preserve carefully in glass-stoppered bottles, in a cool place.

Oil of Cedar Wood—For clearing microscopic sections, a selected commercial distilled oil from the wood of the red cedar, *Juniperus virginiana*, Linné (Fam. *Pinaceæ*), should be used. Refractive index, about 1.504 at 20° C. For use with homogeneous immersion lenses, a specially prepared oil is required, having a refractive index of exactly 1.515 at 18° C.

Ouabain, $C_{30}H_{46}O_{12}.xH_2O$—Ouabain, crystallized from a mixture of alcohol and ether, contains approximately 12½ per cent of water, and requires a temperature of 130° C. for rapid and complete dehydration. The optical properties are as follows: In ordinary light—colorless rods. In parallel polarized light with crossed nicols extinction is parallel. The double refraction is strong. The sign of elongation is +

Refractive indices $\left(\begin{smallmatrix}20^\circ\\D\end{smallmatrix}\right)$: $\alpha = 1.540$ (crosswise), $\gamma = 1.580$ (lengthwise), both ± 0.002.

The specific rotation of anhydrous ouabain: $\left(\alpha\right)\begin{smallmatrix}20\\D\end{smallmatrix} = -31.3°$ to $-31.9°$.

Ouabain is stable at 130° C. Anhydrous ouabain, whether originally crystallized from alcohol and ether or from water at room temperature, begins to soften at about 180° C.

Oxalic Acid, $H_2C_2O_4.2H_2O$—Colorless, uneffloresced crystals. Soluble in water, very soluble in boiling water and in alcohol. Dissolve 2 Gm. of oxalic acid in 30 cc. of

distilled water, add 2 Gm. of sodium hydroxide, and treat with 1 cc. of Nessler's reagent: it shows no darker coloration than a blank test from which the oxalic acid has been omitted (*ammonium compounds*). An aqueous solution (1 in 20) gives no reaction for *chloride, sulphate, nitrate, or heavy metals*. Residue upon incineration, not over 0.05 per cent. Preserve in well-stoppered bottles.

Palladous Chloride, $PdCl_2$—A dark brown, hygroscopic powder, yielding a turbid solution with water, in consequence of the formation of a basic salt.

Phenol, C_6H_5OH—Use *Phenol*.

Phenylhydrazine, $C_6H_5.NH.NH_2$—A colorless or slightly yellowish, highly refractive liquid. Boiling point, about 242° C., congealing when cold to crystalline plates which melt at 19° C. Slightly soluble in water, soluble in alcohol and in ether. Its aqueous solution soon becomes dark from oxidation. Shake 2 cc. of phenylhydrazine with 20 cc. of 5 per cent acetic acid: a clear liquid results.

Phloroglucinol, $C_6H_3(OH)_3.2H_2O$—White or yellowish-white crystals or a crystalline powder. Slightly soluble in water, soluble in alcohol and in ether. When rapidly heated, it melts between 217° and 219° C. When slowly heated, it melts at a much lower temperature. Add 0.1 Gm. of phloroglucinol to 1 cc. of acetic anhydride and 1 cc. of sulphuric acid in a test tube, and heat in a bath of boiling water for ten minutes: no blue color develops (*diresorcinol*).

Phosphoric Acid, H_3PO_4—Use *Acidum Phosphoricum*.

Phosphotungstic Acid, approximately $P_2O_5.24WO_3.xH_2O$—White or yellowish-green crystals or a crystalline powder. Soluble in water and in alcohol. Slightly soluble in ether. To a solution of 1 Gm. of phosphotungstic acid in 10 cc. of distilled water, add 0.1 Gm. of sodium chloride and 3 drops of indigo carmine T.S., then cautiously add 10 cc. of sulphuric acid, and allow the liquid to stand for ten minutes: the blue color does not disappear (*nitrate*). An aqueous solution (1 in 10) gives no reaction for *ammonium salts*.

Picric Acid, $C_6H_2(OH)(NO_2)_3$—Use *Trinitrophenol*.

Platinic Chloride (*Chloroplatinic Acid*), $H_2PtCl_6.6H_2O$—A brownish-red, very hygroscopic, crystalline mass. Very soluble in water, soluble in alcohol and in ether. It dissolves completely in 10 parts of water or alcohol, forming yellow solutions. The residue, upon incineration in a porcelain crucible, is not less than 37.6 per cent. When this residue is treated with 50 times its weight of diluted nitric acid for fifteen minutes on a water bath, the acid solution, upon filtration, evaporation to dryness and incineration, yields a residue not exceeding 0.15 per cent of the platinic chloride taken.

Potassium and Sodium Tartrate, $KNaC_4H_4O_6.4H_2O$ — Use *Potassii et Sodii Tartras*, page 301.

Potassium Acetate, $KC_2H_3O_2$—Use *Potassii Acetas*.

Potassium Bicarbonate, $KHCO_3$—Use *Potassii Bicarbonas*.

Potassium Bisulphate, $KHSO_4$—Fused white, deliquescent masses or granules. Reaction acid. Freely soluble in water. It responds to the identity tests for potassium, page 596, and for sulphates, page 581.

Potassium Bitartrate, $KHC_4H_4O_6$—In addition to the tests described under *Potassii Bitartras*, page 602, it gives no reaction for *chloride, sulphate, calcium, ammonium compounds, or heavy metals*. Heat 5 Gm. of potassium bitartrate at 100° C. for thirty minutes: no loss of weight should result. Dissolve 5 Gm. of potassium bitartrate, accurately weighed, in 250 cc. of hot distilled water, heat to boiling, and titrate

with normal sodium hydroxide, phenolphthalein T.S. being used as indicator: it shows not less than 99.9 per cent and not more than 100 per cent of $KHC_4H_4O_6$.

Potassium Bromate, $KBrO_3$—White crystals or a granular powder. Soluble in water, slightly soluble in alcohol. An aqueous solution (1 in 20) is neutral and should not at once acquire a yellow color upon the addition of 3 drops of diluted sulphuric acid (*bromide*).

Assay—When dried to constant weight at 100° C. and assayed by titration with tenth-normal sodium thiosulphate, after adding potassium iodide and hydrochloric acid, it shows not less than 99.8 per cent of $KBrO_3$. Each cc. of tenth-normal sodium thiosulphate corresponds to 0.002784 Gm. of $KBrO_3$.

Potassium Carbonate, $K_2CO_3.xH_2O$—Use *Potassii Carbonas.*

Potassium Carbonate, Anhydrous, K_2CO_3—White granules or powder, very hygroscopic. Very soluble in water with the evolution of heat. When heated to redness, it should not lose more than 1 per cent of its weight (*water*). It meets the requirements of the tests for identity and purity under *Potassii Carbonas*, making allowance for the difference in water content.

Potassium Chlorate, $KClO_3$—Use *Potassii Chloras.*

Potassium Chloride, KCl—Colorless crystals or a white, granular powder. It is odorless. Freely soluble in water, slightly soluble in alcohol. Its aqueous solution (1 in 10) is neutral to litmus paper, and imparts to a non-luminous flame not more than a slight transient yellow color (*sodium*). To a solution of 1 Gm. of the salt in 5 cc. of distilled water, add an equal volume of sulphuric acid and 1 drop of indigo T.S.: the blue color does not disappear (*nitrate*). Potassium chloride also complies with the tests for *barium, sulphate, magnesium, calcium, heavy metals, and ammonia* under *Reagent Sodium Chloride.*

Potassium Chromate, K_2CrO_4—Yellow crystals, very soluble in water, insoluble in alcohol. An aqueous solution (1 in 20) is not reddened by phenolphthalein T.S. An aqueous solution (1 in 20) gives no reaction for *aluminum or calcium.* Ten cc. portions of an aqueous solution (1 in 20), acidulated respectively with 5 cc. of nitric acid and 3 cc. of hydrochloric acid, give no reaction for *chloride or sulphate.*

Potassium Citrate, $K_3C_6H_5O_7.H_2O$—Use *Potassii Citras.*

Potassium Dichromate, $K_2Cr_2O_7$—Dark yellowish-red crystals or crystalline granules. Soluble in water. An aqueous solution (1 in 20) should give no reaction for *aluminum or calcium.* Twenty cc. portions of an aqueous solution (1 in 20), treated respectively with 5 cc. of nitric acid and 2 cc. of hydrochloric acid, should give no reaction for *chloride* and no reaction for *sulphate* within eighteen hours after adding 1 cc. of barium chloride T.S.

Assay—When dried to constant weight at 100° C. and assayed by titration with tenth-normal sodium thiosulphate, after adding potassium iodide, and diluted sulphuric acid, it shows not less than 99.9 per cent of $K_2Cr_2O_7$.

Potassium Ferricyanide, $K_3Fe(CN)_6$—Dark red crystals. Very soluble in water. An aqueous solution (1 in 20) gives no reaction for sulphate. An aqueous solution (1 in 50), to which 2 drops of ferric chloride T.S. have been added, forms a clear, brown solution free from any green or blue coloration (*ferrocyanide*).

Potassium Ferrocyanide, $K_4Fe(CN)_6.3H_2O$ —Yellow, transparent, soft crystals very soluble in water. An aqueous solution (1 in 20) is neutral to litmus paper and gives no reaction for *sulphate.*

Potassium Hydroxide, KOH—Use *Potassii Hydroxidum.*

Potassium Iodide, KI—Use *Potassii Iodidum.*

Potassium Nitrate, KNO_3—In addition to the description and tests given under *Potassii Nitras,* page 612, it should conform to the following tests: An aqueous solution (1 in 20) gives no reaction for *sulphate.* Gently ignite 1 Gm. of potassium nitrate and dissolve the residue in 10 cc. of distilled water: it gives no reaction for *chloride.*

Potassium Nitrite, KNO_2—White or nearly white, deliquescent sticks. It responds to the identity tests for potassium, page 596, and for nitrites, page 551.

Potassium Permanganate, $KMnO_4$—Use *Potassii Permanganas.*

Potassium Sulphate, K_2SO_4—Hard, colorless crystals or a white powder, soluble in water. An aqueous solution (1 in 20) is neutral to litmus paper, and gives no reaction for *heavy metals, chloride, iron, calcium, magnesium, ammonia, or nitrate.* An aqueous solution (1 in 30) meets the requirements of the test for *arsenic.*

Potassium Thiocyanate (*Potassium Sulphocyanate*), KSCN—Colorless, hygroscopic crystals. Very soluble in water, completely soluble in 8 parts of warm alcohol without coloration. An aqueous solution (1 in 20) gives no reaction for *sulphate, heavy metals, or ammonia.*

Pyrogallol, $C_6H_3(OH)_3$—Use *Pyrogallol.*

Resorcinol, $C_6H_4(OH)_2$—Use *Resorcinol.*

Salicylic Acid, $HC_7H_5O_3$—Use *Acidum Salicylicum.*

Selenous Acid, H_2SeO_3—Colorless crystals. Efflorescent in dry air and hygroscopic in moist air. Soluble in water and in alcohol.

Silver, Ag—Silver in foil or wire containing not more than 0.025 per cent of *foreign metals.*

Silver Nitrate, $AgNO_3$—Use *Argenti Nitras.*

Silver Sulphate, Ag_2SO_4—Small, white, lustrous crystals or a white powder. Slightly soluble in water and dissolved by nitric acid, or by ammonia T.S.

Preserve in amber-colored bottles.

Sodium Acetate, $NaC_2H_3O_2.3H_2O$—Use *Sodii Acetas.*

Sodium Acetate, Anhydrous, $NaC_2H_3O_2$—Made from sodium acetate by heating it carefully until all water of crystallization is driven off and a dry powder results. It contains not more than 3 per cent of *water.*

Sodium Bicarbonate, $NaHCO_3$—Use *Sodii Bicarbonas.*

Sodium Bisulphite (*Sodium Acid Sulphite*), $NaHSO_3$—White crystals or a white granular powder, having the odor of sulphur dioxide. Freely soluble in water, slightly soluble in alcohol. An aqueous solution (1 in 50), boiled with a slight excess of hydrochloric acid to expel sulphur dioxide, gives no reaction for *heavy metals* and 0.2 Gm., oxidized with nitric acid, meets the requirements of the test for *arsenic.*

Assay—Dissolve a weighed amount of sodium bisulphite in distilled water, add a measured excess of tenth-normal iodine, and titrate the excess of iodine with tenth-normal sodium thiosulphate. Each cc. of tenth-normal iodine corresponds to 0.005204 Gm. of $NaHSO_3$. It shows not less than 90 per cent of $NaHSO_3$. Preserve in well-filled, well-stoppered bottles, in a cool place.

Sodium Bitartrate, $NaHC_4H_4O_6.H_2O$ — White crystals or crystalline powder. Soluble in cold water. An aqueous solution (1 in 10) is clear and colorless and gives no reaction for *sulphate or heavy metals.* An aqueous solution (1 in 40) gives no reaction for *chloride.*

Sodium Borate, $Na_2B_4O_7.10H_2O$—Use *Sodii Boras.*

Sodium Bromide, NaBr—Use *Sodii Bromidum.*

Sodium Carbonate, Anhydrous, Na_2CO_3—A white, hygroscopic powder, soluble in water. An aqueous solution (1 in 10) should be clear and colorless and gives no reaction for *sulphate, silicate, nitrate, phosphate, calcium, magnesium, iron, ammonia, heavy metals,* contains not more than 0.005 per cent of *chloride* and meets the requirements of the test for *arsenic.* Not more than traces of potassium should be shown by the flame test, using cobalt glass. Titrate about 1.5 Gm. of anhydrous sodium carbonate, accurately weighed, with normal sulphuric acid, methyl orange T.S. being used as indicator. It shows not less than 99 per cent of Na_2CO_3.

Sodium Carbonate, Monohydrated, $Na_2CO_3.H_2O$—Use *Sodii Carbonas Monohydratus.*

Sodium Chloride, NaCl—In addition to the requirements and the tests prescribed under *Sodii Chloridum,* it is required to conform to the following additional tests. An aqueous solution of sodium chloride (1 in 20) shows no turbidity or precipitation on the addition of dilute sulphuric acid (*barium*). To a solution of 3 Gm. of sodium chloride in 80 cc. of distilled water, add 1 cc. of concentrated hydrochloric acid (page 1534), heat to boiling, and add about 5 cc. of barium chloride T.S. No precipitation takes place within twenty-four hours (*sulphate*). To a solution of 3 Gm. of sodium chloride in about 10 cc. of distilled water, add 5 cc. of ammonia T.S., and 5 cc. of sodium phosphate T.S.: no precipitation takes place within twelve hours (*magnesium salts*). Dissolve 5 Gm. of the salt in 80 cc. of distilled water, heat the solution to boiling, and add 5 cc. of ammonium oxalate T.S.: no precipitate is produced within twelve hours (*calcium*); nor is this solution affected by the addition of sodium carbonate T.S.; nor is a freshly prepared solution of the same concentration affected by the addition of ammonium sulphide T.S. (*alkali earths and heavy metals*). To a solution of 1 Gm. of sodium chloride in 10 cc. of distilled water, add 5 cc. of sodium cobaltic nitrite T.S.: no precipitation occurs after twenty-four hours (*potassium*). The addition of Nessler's Reagent (page 1548) to a solution of 3 Gm. of sodium chloride produces no yellow coloration (*ammonium salts*).

Sodium Cyanide, NaCN—White, opaque, amorphous fragments, or a white, granular powder. Very soluble in water. An aqueous solution (1 in 10) gives no reaction for *ferrocyanides or thiocyanates.*

Assay—Dissolve about 0.45 Gm. of sodium cyanide, accurately weighed, in 25 cc. of distilled water, add 4 cc. of ammonia T.S., 3 drops of potassium iodide T.S., and titrate with tenth-normal silver nitrate to the production of a permanent turbidity: it shows not less than 95 per cent of NaCN. Each cc. of tenth-normal silver nitrate represents 0.009802 Gm. of NaCN.

Sodium Hydroxide, NaOH—Use *Sodii Hydroxidum.*

Sodium Nitrite, $NaNO_2$—Use *Sodii Nitris.*

Sodium Nitroprusside (*Sodium Nitroferricyanide*), $Na_2Fe(NO)(CN)_5.2H_2O$—Transparent, dark-red crystals, very soluble in water. An aqueous solution (1 in 50) gives no reaction for *sulphate.*

Sodium Oxalate, $Na_2C_2O_4$—A white, crystalline powder, slightly soluble in water. The loss on drying at 105° C. does not exceed 0.01 per cent. The residue insoluble in water does not exceed 0.01 per cent. *Sulphate,* not over 0.001 per cent. *Chloride,* not over 0.002 per cent. *Iron,* not over 0.002 per cent. *Sodium bicarbonate,* not over 0.03 per cent. *Sodium binoxalate,* not over 0.02 per cent.

Sodium Phosphate, $Na_2HPO_4.12H_2O$—Use *Sodii Phosphas.*

Sodium Sulphide, $Na_2S.9H_2O$—Clear, colorless, deliquescent crystals. Very

soluble in water. An aqueous solution (1 in 10) is alkaline to litmus paper and has an odor of hydrogen sulphide.

Assay—Transfer about 0.3 Gm. of sodium sulphide, accurately weighed, to a flask containing 40 cc. of tenth-normal iodine. Allow it to stand until the sulphide is completely decomposed, add 2 cc. of hydrochloric acid and titrate with tenth-normal sodium thiosulphate. It shows not less than 95 per cent of $Na_2S.9H_2O$. Each cc. of tenth-normal iodine represents 0.01201 Gm. of $Na_2S.9H_2O$.

Sodium Sulphite, Exsiccated, Na_2SO_3—A white powder, freely soluble in water, slightly soluble in alcohol. An aqueous solution (1 in 50), boiled with a slight excess of hydrochloric acid to expel sulphur dioxide, gives no reaction for *heavy metals.*

Assay—Dissolve 0.5 Gm. of exsiccated sodium sulphite in sufficient freshly boiled distilled water to make 100 cc. Run this solution gradually from a burette into a mixture of 30 cc. of tenth-normal iodine and 5 cc. of hydrochloric acid, until complete decolorization results, using starch T.S. as indicator. It shows not less than 85 per cent of Na_2SO_3. Each cc. of tenth-normal iodine represents 0.006308 Gm. of Na_2SO_3.

Sodium Tartrate, Neutral, $Na_2C_4H_4O_6.2H_2O$—Transparent crystals, very soluble in water, insoluble in alcohol. An aqueous solution (1 in 20) gives no reaction for *ammonia, sulphate, or heavy metals.* An aqueous solution (1 in 40) gives no reaction for *chloride.*

Sodium Thiosulphate, $Na_2S_2O_3.5H_2O$—Use *Sodii Thiosulphas.*

Sodium Tungstate, $Na_2WO_4.2H_2O$—Colorless crystals or crystalline lumps, or a white, crystalline powder. An aqueous solution (1 in 40) gives no reaction for *chloride or sulphate.* The loss in weight after gentle ignition does not exceed 12 per cent.

Stannous Chloride, $SnCl_2.2H_2O$—Colorless crystals, very soluble in water, the aqueous solutions requiring a slight excess of hydrochloric acid to prevent the formation of basic chloride. An aqueous solution (1 in 50) gives no reaction for *sulphate.* When tested for *arsenic* (page 1512), 0.3 Gm. of stannous chloride produces no stain. A solution of 0.2 Gm. in 1 cc. of distilled water and 0.5 cc. of hydrochloric acid does not become opalescent upon diluting with 20 cc. of distilled water (*lead*).

Starch, Potato—The starch separated from the tubers of *Solanum tuberosum* Linné (Fam. *Solanaceæ*). A more or less finely granular powder, consisting of starch grains of characteristic shape and appearance when examined microscopically.

Sucrose, $C_{12}H_{22}O_{11}$—Use *Sucrosum.*

Sulphanilic Acid, $C_6H_4NH_2(SO_3H)2H_2O$—Colorless, acicular, efflorescent crystals. Slightly soluble in water. Residue upon incineration, not over 0.05 per cent. A hot, aqueous solution (1 in 25) gives no reaction for *sulphate.*

Sulphosalicylic Acid, $C_6H_3(OH)(SO_3H).COOH$—Colorless needles, soluble in water and in alcohol. Melting point, about 120° C.

Sulphur, S—Use *Sulphur Præcipitatum.*

Sulphuric Acid, H_2SO_4—Use *Acidum Sulphuricum.*

Sulphuric Acid, Concentrated, H_2SO_4—In addition to the description and tests under *Acidum Sulphuricum,* page 560, it complies with the following tests: It contains not less than 94 per cent and not more than 97 per cent of H_2SO_4. Residue upon ignition not to exceed 0.001 per cent. Dilute 1 volume of the acid with 4 volumes of distilled water: no stain is produced by 25 cc. of this dilute acid when subjected to the test for *arsenic,* page 1512. An aqueous solution (1 in 10) gives no reaction for *nitrate* when tested with diphenylamine.

Sulphuric Acid, Diluted—Use *Acidum Sulphuricum Dilutum.*

Sulphuric Acid, Fuming, $H_2SO_4.SO_3$—A heavy, fuming, colorless, oily liquid. It contains at least 84.5 per cent of total SO_3, corresponding to about 15 per cent of free SO_3. Specific gravity about 1.870 at 25° C. Residue upon ignition, not over 0.01 per cent. An aqueous solution (1 in 10) gives no reaction for *nitrate.*

Assay—Cautiously add about 1 cc. of fuming sulphuric acid, accurately weighed, to 100 cc. of distilled water, and titrate with normal sodium hydroxide, methyl orange T.S. being used as indicator. Each cc. of normal sodium hydroxide corresponds to 0.040035 Gm. of SO_3.

Sulphurous Acid, H_2SO_3—An aqueous solution having the odor of sulphur dioxide. A 10 cc. portion of sulphurous acid gives no reaction when subjected to the test for *arsenic.*

Assay—Add about 2 Gm. of sulphurous acid, accurately weighed, to 50 cc. of tenth-normal iodine and allow it to stand for five minutes. Then titrate with tenth-normal sodium thiosulphate, starch T.S. being used as indicator. Each cc. of tenth-normal iodine corresponds to 0.003203 Gm. of SO_2. It shows not less than 6 per cent of SO_2.

Tannic Acid—Use *Acidum Tannicum.*

Tartaric Acid, $C_2H_2(OH)_2(COOH)_2$—Use *Acidum Tartaricum.*

Tin, Sn—Tin, in the form of granules or irregular fragments. Digest 5 Gm. of tin with 40 cc. of nitric acid until entirely converted into the oxide, then evaporate to dryness. Stir the residue with 25 cc. of distilled water and filter. To the filtrate add 1 cc. of diluted sulphuric acid, evaporate on a water bath as completely as possible, and add 10 cc. of distilled water. No weighable residue remains undissolved (*lead*). When converted into stannous chloride by the action of hydrochloric acid, it complies with the tests under that salt.

Toluene (*Toluol*), $C_6H_5.CH_3$—A colorless, highly refractive, inflammable liquid. Insoluble in water, miscible with alcohol, ether, chloroform, carbon disulphide, and petroleum benzin. Specific gravity about 0.865 at 25° C. Boiling point, about 111° C.

Trinitrophenol, $C_6H_2(OH)(NO_2)_3$—Use *Trinitrophenol.*

Turmeric—The dried root of *Curcuma longa,* Linné, Fam. *Scitaminaceæ,* reduced to a fine powder.

Xylene, C_8H_{10}—A colorless, transparent liquid. Boiling point, 137° to 140° C. Specific gravity, about 0.85 at 25° C.

Yeast, Compressed—The moist, living cells of *Saccharomyces cerevisiæ* Meyen (Fam. *Saccharomycetaceæ*) or of other species of *Saccharomyces,* combined with a starchy or absorbent base. White or yellowish-white, soft and easily broken masses, having a characteristic, slightly sour odor, and not more than a faintly acid reaction to litmus paper. When examined under the microscope, numerous saccharomyces, and also oidium and mycoderma cells and starch grains are visible. Compressed yeast must not be used unless fresh, and free from mildew and musty or foul odors.

Zinc, Zn—Zinc in the form of globules, irregular fragments, granules, or a fine powder, the latter being known as zinc dust. The stain from 10 Gm. of zinc when determined by a blank experiment as directed under the test for *arsenic,* page 1512, is barely perceptible. It contains not more than 0.08 per cent of *iron.*

Zinc Oxide, ZnO—In addition to the description and tests under *Zinci Oxidum,* page 694, it should contain not more than 0.003 per cent of *chloride.*

Test Solutions

Wherever convenient or possible the strength of the following test solutions has been adjusted approximately to normality basis, which signifies that 1 liter of the solution contains a quantity of the reacting substance chemically equivalent to 1 Gm. of hydrogen. It is indicated by the symbol **N.** or **1 N.** Multiples or subdivisions of this ratio are expressed by appropriate numerals, fractions or decimals as **4 N., N/10, 0.5 N.,** etc. Reagents are usually stored in small glass-stoppered bottles (see Fig. 544).

FIG. 544

Reagent bottle

Albumin Test Solution—Carefully separate the white from the yolk of a hen's egg, strictly fresh, having a specific gravity of not less than 1.07. Shake the white thoroughly with 100 cc. of distilled water until thoroughly mixed and all but the chalaza has undergone solution; then filter. This solution must be freshly made when required.

Ammonia Test Solution—Use *Aqua Ammoniæ.*

Ammonia Test Solution, Alcoholic—A solution of ammonia gas in alcohol. A clear, colorless liquid having a strong odor of ammonia. Specific gravity, about 0.80 at 25° C. When assayed by the method directed under *Aqua Ammoniæ,* it shows not less than 9 per cent and not more than 11 per cent by weight of NH_3.

Preserve in glass-stoppered bottles in a cool place.

Ammonia Test Solution, Stronger—Use *Aqua Ammoniæ Fortior.*

Ammonium Carbonate Test Solution—Dissolve 20 Gm. of reagent ammonium carbonate and 20 cc. of ammonia T.S. in sufficient distilled water to make 100 cc.

Ammonium Chloride Test Solution (2 N.)—Dissolve 10.5 Gm. of reagent ammonium chloride, in sufficient distilled water to make 100 cc.

Ammonium Molybdate Test Solution—Dissolve 6.5 Gm. of finely powdered molybdic acid in a mixture of 14 cc. of distilled water and 14.5 cc. of stronger ammonia T.S. Cool the solution and add it slowly to a well-cooled mixture of 32 cc. of nitric acid, and 40 cc. of distilled water. Allow the solution to stand for twenty-four hours and then filter through asbestos. The reagent deteriorates upon standing and it must be rejected if, upon the addition of 2 cc. of sodium phosphate T.S. to 5 cc. of the solution, an abundant yellow precipitate does not form at once or after slight warming. Preserve in the dark; if a precipitate forms, use only the clear decanted solution.

Ammonium Oxalate Test Solution (0.5 N.)—Dissolve 3.5 Gm. of ammonium oxalate in sufficient distilled water to make 100 cc.

Ammonium Polysulphide Test Solution—A yellow liquid, made by saturating ammonium sulphide T.S. with sulphur.

Ammonium Sulphide Test Solution—Saturate 3 volumes of ammonia T.S. with hydrogen sulphide and add to it 2 additional volumes of ammonia T.S. Residue upon ignition, not over 0.05 per cent. The solution is not rendered turbid by either magnesium sulphate T.S. (*free ammonia*) or by calcium chloride T.S. (*carbonate.*) It must be rejected when it shows an abundant precipitate of sulphur. Sodium sulphide T.S. may be used when ammonium sulphide T.S. is directed.

Preserve in small, well-filled, dark amber-colored bottles, in a cool, dark place.

Aniline Sulphate Test Solution—Dissolve 5 cc. of aniline sulphate in 51 cc. of diluted alcohol and add sufficient distilled water to make 100 cc.

Barium Chloride Test Solution (1 N.)—Dissolve 12 Gm. of barium chloride in sufficient distilled water to make 100 cc.

Barium Hydroxide Test Solution (0.5 N.)—A saturated solution (about 8 per cent) of barium hydroxide in recently boiled distilled water. This solution must be freshly made when required for use.

Barium Nitrate Test Solution (0.5 N.)—Dissolve 6.5 Gm. of barium nitrate in sufficient distilled water to make 100 cc.

Bromine Test Solution (*Bromine Water*)—An approximately saturated aqueous solution of bromine, prepared by agitating 2 cc. of bromine with 100 cc. of cold distilled water in a glass-stoppered bottle, the stopper of which should be lubricated with petrolatum. Preserve in a cool place, protected from light.

Cadmium Chloride Test Solution (1 N.)—Dissolve 11 Gm. of cadmium chloride in sufficient distilled water to make 100 cc.

Calcium Chloride Test Solution (1 N.)—Dissolve 7.5 Gm of calcium chloride in sufficient distilled water to make 100 cc.

Calcium Hydroxide Test Solution (0.04 N.)—Use the official *Liquor Calcii Hydroxidi.*

Calcium Sulphate Test Solution (0.03 N.)—A saturated solution (about 0.25 per cent) of calcium sulphate in distilled water.

Chloral Test Solution—Dissolve 50 Gm. of chloral hydrate in 15 cc. of distilled water and 10 cc. of glycerin.

Chlorinated Soda Test Solution—Use *Liquor Sodæ Chlorinatæ.*

Chlorine Test Solution (*Chlorine Water*)—Place 10 Gm. of manganese dioxide in a 500 cc. flask connected by a suitable tube with a small wash bottle containing 50 cc. of distilled water, and connect this by a delivery tube leading to the bottom of a bottle having a capacity of 1000 cc. and containing 400 cc. of distilled water, which has previously been boiled and allowed to cool. Add to the dioxide in the generating flask 25 cc. of hydrochloric acid, previously diluted with 25 cc. of distilled water, stopper the generating flask, and apply a gentle heat by means of a sand bath. Conduct the generated chlorine through the water contained in the wash bottle into the bottle containing the water, which should be loosely stoppered with purified cotton and kept, during the operation, at a temperature of about 10° C. When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, shake the bottle, loosening the stopper from time to time, until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus, and continue passing the gas and agitating, until the water is saturated. Finally, pour the chlorine water into small, dark amber-colored, glass-stoppered bottles, which should be completely filled. Chlorine T.S., even when kept from light and air, is apt to deteriorate. When required of full strength, it must be freshly prepared.

Preserve in a dark, cool place.

Cobaltous Chloride Test Solution (0.16 N.)—Dissolve 2 Gm. of cobaltous chloride in 1 cc. of hydrochloric acid and sufficient distilled water to make 100 cc.

Cupric Acetate Test Solution—Dissolve 0.1 Gm. of cupric acetate in sufficient distilled water to make 100 cc, adding a few drops of acetic acid, if necessary, to make a clear solution.

Cupric Ammonium Sulphate Test Solution—To cupric sulphate T.S. add ammonia T.S., drop by drop, until the precipitate at first formed is nearly but not completely redissolved, then allow to settle and decant the clear solution. This solution must be freshly made when required.

Cupric Oxide, Test Solution, Ammoniated (*Schweitzer's Reagent*)—Dissolve 10 Gm. of cupric sulphate, in 100 cc. of distilled water, add just sufficient 20 per cent sodium hydroxide solution to precipitate the copper hydroxide, collect the latter on a filter, and wash free from sulphate. Then dissolve the purified, moist precipitate in the minimum quantity of ammonia T.S. necessary for complete solution.

Cupric Sulphate Test Solution (1 N.)—Dissolve 12.5 Gm. of cupric sulphate in sufficient distilled water to make 100 cc.

Denigè's Reagent—Use *Mercuric Sulphate, T.S.*.

Diphenylamine Test Solution—Dissolve 0.5 Gm. of diphenylamine in 100 cc. of reagent sulphuric acid, diluted with 20 cc. of distilled water. The solution should be colorless.

Ferric Ammonium Sulphate Test Solution (0.5 N.)—Dissolve 8 Gm. of reagent ferric ammonium sulphate in sufficient distilled water to make 100 cc.

Ferric Chloride Test Solution (1 N.)—Dissolve 9 Gm. of ferric chloride in sufficient distilled water to make 100 cc.

Ferrous Sulphate Test Solution—Dissolve 8 Gm. of clear crystals of ferrous sulphate in about 100 cc. of distilled water, which has been freshly boiled. This solution must be freshly prepared when required.

Ferrous Sulphate Test Solution, Acid (0.5 N.)—Dissolve 7 Gm. of ferrous sulphate in crystals in 90 cc. of distilled water, which has been freshly boiled and cooled, and then add sufficient sulphuric acid to make 100 cc. This solution must be freshly prepared when required.

Formaldehyde Test Solution—Use *Liquor Formaldehydi.*

Fuchsin-Sulphurous Acid Test Solution—Dissolve 0.2 Gm. of fuchsin in 120 cc. of hot distilled water, cool the solution, add a solution of 2 Gm. of anhydrous sodium sulphite in 20 cc. of distilled water, and follow by 2 cc. of concentrated hydrochloric acid. Then dilute the solution with distilled water to 200 cc. and allow to stand for one hour before use. This solution must be frequently prepared.

Gelatin Test Solution—Dissolve 1 Gm. of gelatin in 50 cc. of distilled water, with the aid of gentle heat, and filter, if necessary. Prepare freshly when required.

Gold Chloride Test Solution (0.2 N.)—Dissolve 1 Gm. of reagent gold chloride in 35 cc. of distilled water.

Hydrogen Dioxide Test Solution—Use *Liquor Hydrogenii Dioxidi.* This reagent must contain at least 3 per cent, by weight, of H_2O_2 when used.

Hydrogen Sulphide Test Solution—A saturated aqueous solution of hydrogen sulphide, made by passing H_2S into cold distilled water. Keep the solution in small, dark amber-colored bottles, filled nearly to the top. Do not use unless it retains a strong odor of H_2S, and, when added to an equal volume of ferric chloride T.S., it produces at once a copious precipitate of sulphur. Preserve in a cool, dark place.

Hypophosphorous Acid Test Solution—Use *Acidum Hypophosphorosum.*

Indigo Carmine Test Solution—Dissolve 1 Gm. of sodium indigotindisulphonate in 150 cc. of distilled water.

Iodine and Potassium Iodide Test Solution—Dissolve 0.5 Gm. of iodine and 1.5 Gm. of potassium iodide in 25 cc. of distilled water.

Iodine Test Solution—Use the tenth-normal iodine volumetric solution, page 1556.

Iodobromide Test Solution—(For use in determining iodine absorption value). Dissolve 13.2 Gm. of reagent iodine in 1000 cc. of glacial acetic acid, with the aid of

a gentle heat if necessary. Cool the solution to 25° C. and determine the iodine content in 20 cc. by titration with tenth-normal sodium thiosulphate, then add to the remainder of the solution a quantity of bromine chemically equivalent to that of the iodine present. Preserve in glass-stoppered bottles, protected from light.

Lead Acetate Glass Wool—Immerse glass wool in a mixture of equal parts of lead acetate T.S. and distilled water, and remove the excess of liquid by pressing it between folds of filter paper. It should be freshly prepared when required for a test.

Lead Acetate Test Paper—Immerse strips of heavy white filter paper, 6 mm. in width and 8 cm. in length, in a mixture of equal parts of lead acetate T.S. and distilled water, drain off the excess of liquid and dry the paper on glass in an oven at 100° C., avoiding contact with metal.

Lead Acetate Test Solution (0.5 N.)—Dissolve 9.5 Gm. of clear, transparent crystals of lead acetate, in sufficient freshly boiled distilled water to make 100 cc. Preserve in well-stoppered bottles.

Lead Acetate Test Solution, Alcoholic (0.1 N.)—Dissolve 2 Gm. of clear, transparent crystals of lead acetate in sufficient alcohol to measure 100 cc.

Preserve in well-stoppered bottles.

Lead Acetate Test Solution, Basic—Dilute 4 Gm. of solution of lead subacetate (page 738) with enough distilled water, previously boiled and cooled, to make the product weigh 100 Gm. Preserve in small, well filled, and tightly-stoppered bottles.

Locke-Ringer's Solution:

Reagent Sodium Chloride	9.000 Gm.
Reagent Potassium Chloride	0.420 Gm.
Reagent Calcium Chloride, crystals	0.240 Gm.
Reagent Magnesium Chloride	0.005 Gm.
Sodium Bicarbonate	0.500 Gm.
Dextrose	0.500 Gm.
Water, freshly distilled from a hard glass flask	
To make	1000 cc.

The solution must be made up each day. The constituents (except the dextrose) may be made up in more concentrated stock solutions and diluted as needed.

Magnesia Mixture Test Solution—Dissolve 5.5 Gm. of magnesium chloride and 7 Gm. of reagent ammonium chloride in 65 cc. of distilled water, add 35 cc. of ammonia T.S., set the mixture aside for a few days in a well-stoppered bottle, and then filter. If not perfectly clear, filter the solution before using.

Magnesium Sulphate Test Solution (1 N.)—Dissolve 12 Gm. of magnesium sulphate in sufficient distilled water to make 100 cc.

Manganese Sulphate Test Solution (1 N.)—Dissolve 11 Gm. of manganese sulphate in 50 cc. of distilled water and add sufficient sulphuric acid to make 100 cc.

Mayer's Reagent—See *Mercuric Potassium Iodide T.S.*.

Mercuric Bromide Test Paper—Cut stiff, heavy quantitative filter paper (see Filter Paper, Quantitative, page 1533) into strips 3 mm. in width and about 12 cm. in length. Immerse these strips for five minutes in alcoholic mercuric bromide T.S. (see below). Remove the excess of solution by pressing the strips between filter paper and then dry them quickly on glass in an oven heated to 100° C. Place at once in a glass-stoppered, wide-mouthed bottle, and protect from light.

Mercuric Bromide Test Solution, Alcoholic (0.3 N.)—Dissolve 5 Gm. of mercuric bromide in 100 cc. of alcohol, employing a gentle heat to facilitate solution.

Preserve in glass-stoppered bottles, and protect from light.

Mercuric Chloride Test Solution (0.5 N.)—Dissolve 6.5 Gm. of mercuric chloride in sufficient distilled water to make 100 cc.

Mercuric Nitrate Test Solution (4 N.)—Dissolve 40 Gm. of red mercuric oxide in a mixture of 32 cc. of nitric acid and 15 cc. of distilled water.

Preserve in glass-stoppered bottles, protected from light.

Mercuric Potassium Iodide Test Solution (*Mayer's Reagent*)—Dissolve 1.358 Gm. of mercuric chloride in 60 cc. of distilled water, and 5 Gm. of potassium iodide in 10 cc. of distilled water. Mix the two solutions and then add sufficient distilled water to make 100 cc.

Mercuric Potassium Iodide Test Solution, Alkaline (*Nessler's Reagent*)—Dissolve 10 Gm. of potassium iodide in 10 cc. of distilled water, and add gradually, in portions, a saturated aqueous solution of mercuric chloride, with constant agitation until a slight red precipitate remains undissolved. To this mixture add 30 Gm. of potassium hydroxide, and, after solution has taken place, add 1 cc. additional of the saturated aqueous solution of mercuric chloride. Dilute this solution with distilled water until it measures 200 cc. Allow the precipitate to subside and draw off the clear liquid. A 2 cc. portion of this reagent when added to 50 cc. of distilled water containing 0.05 mgm. of ammonia, produces at once a yellowish-brown coloration.

Mercuric Sulphate Test Solution (*Denigè's Reagent*)—Mix 5 Gm. of yellow mercuric oxide with 40 cc. of distilled water and while stirring add 20 cc. of sulphuric acid, then add 40 cc. additional distilled water, and stir until completely dissolved.

Mercurous Nitrate Test Solution (0.5 N.)—Mix 20 Gm. of mercury with 10 cc. of nitric acid and 10 cc. of distilled water, in a porcelain dish and set it aside for twenty-four hours in a cool, dark place. Separate and drain the crystals of mercurous nitrate and dissolve 15 Gm. of the crystals in a mixture of 90 cc. of distilled water and 10 cc. of diluted nitric acid.

Preserve in a dark amber-colored bottle in which a small globule of mercury is placed.

Metaphenylenediamine Hydrochloride Test Solution—Dissolve 1 Gm. of metaphenylenediamine hydrochloride in 200 cc. of distilled water: the solution is colorless. If necessary, decolorize by heating with freshly carbonized animal charcoal.

Naphthylamine Acetate Test Solution—Dissolve 0.5 Gm. of reagent naphthylamine acetate in 100 cc. of 30 per cent acetic acid and filter quickly through purified cotton.

Preserve in well-stoppered bottles, protected from light.

Nessler's Reagent—Use *Mercuric Potassium Iodide T. S., Alkaline* (see above).

Oxalic Acid Test Solution (1 N.)—Dissolve 6.8 Gm. of oxalic acid in sufficient distilled water to measure 100 cc.

Palladous Chloride Test Solution—Dissolve 0.5 Gm. of palladous chloride in sufficient distilled water to measure 10 cc.

Preserve in glass-stoppered bottles.

Phenol Disulphonic Acid Test Solution—Dissolve 2.5 Gm. of colorless phenol in 15 cc. of reagent concentrated sulphuric acid in a flask of suitable capacity. Add 7.5 cc. of fuming sulphuric acid, stir well, and heat for two hours at 100° C. Transfer the product, while still fluid, to a glass-stoppered bottle, and, when desired for use, warm in a water bath until liquefied.

Phloroglucinol Test Solution—Dissolve 0.5 Gm. of phloroglucinol in 25 cc. of alcohol.

Preserve in a tightly-stoppered bottle, protected from light.

Picric Acid Test Solution (*Trinitrophenol Test Solution*)—Dissolve 1 Gm. of picric acid in 100 cc. of hot distilled water. Cool the solution and filter, if necessary.

Platinic Chloride Test Solution (0.5 N.)—Dissolve 2.6 Gm. of platinic chloride in sufficient distilled water to make 20 cc.

Potassium Acetate Test Solution—Dissolve 10 Gm. of potassium acetate in sufficient distilled water to make 100 cc.

Potassium Carbonate Test Solution (1 N.)—Dissolve 7 Gm. of reagent anhydrous potassium carbonate in sufficient distilled water to make 100 cc.

Potassium Chromate Test Solution—Dissolve 10 Gm. of potassium chromate in sufficient distilled water to make 100 cc.

Potassium Dichromate Test Solution (1 N., based on the basicity of CrO_3.)—Dissolve 7.5 Gm. of potassium dichromate in sufficient distilled water to make 100 cc.

Potassium Ferricyanide Test Solution (1 N.)—Dissolve 1 Gm. of potassium ferricyanide in 10 cc. of distilled water. The solution must be freshly prepared when required.

Potassium Ferrocyanide Test Solution (1 N.)—Dissolve 10 Gm. of potassium ferrocyanide in sufficient distilled water to make 100 cc.

Potassium Hydroxide Test Solution (1 N.)—Dissolve 6.5 Gm. of potassium hydroxide in sufficient distilled water to make 100 cc.

Potassium Hydroxide Test Solution, Alcoholic—Use half-normal alcoholic potassium hydroxide.

Potassium Iodide Test Solution (1 N.)—Dissolve 16.5 Gm. of potassium iodide in sufficient distilled water to make 100 cc.

Preserve in dark amber-colored, well-stoppered bottles.

Potassium Permanganate Test Solution—Use tenth-normal potassium permanganate.

Potassium Sulphate Test Solution—Dissolve 1 Gm. of potassium sulphate in sufficient distilled water to make 100 cc.

Potassium Thiocyanate Test Solution (*Potassium Sulphocyanate Test Solution*)—Use tenth-normal potassium thiocyanate.

Pyrogallol Test Solution, Alkaline—Dissolve 0.5 Gm. of pyrogallol in 2 cc. of distilled water, and 12 Gm. of potassium hydroxide in 8 cc. of distilled water. The solutions should be freshly prepared and mixed immediately before using.

Resorcinol Test Solution—Dissolve 1 Gm. of resorcinol in sufficient reagent concentrated hydrochloric acid to make 100 cc.

Silver Ammonium Nitrate Test Solution—Dissolve 1 Gm. of silver nitrate in 20 cc. of distilled water and add ammonia T.S., drop by drop, agitating the mixture until the precipitate at first produced is almost but not entirely redissolved, and filter.

Preserve in dark amber-colored, well-stoppered bottles.

Silver Nitrate Test Solution—Use tenth-normal silver nitrate.

Silver Sulphate Test Solution—Mix 1 Gm. of silver sulphate with 100 cc. of distilled water in a glass-stoppered bottle and shake the mixture thoroughly. Decant the clear solution when required for use.

Sodium Acetate Test Solution (1 N.)—Dissolve 13.6 Gm. of sodium acetate in sufficient distilled water to make 100 cc.

Sodium Bisulphite Test Solution—Dissolve 30 Gm. of sodium bisulphite in sufficient distilled water to make 100 cc. Should the solution possess a strong odor of

sulphur dioxide, add sodium hydroxide T.S., drop by drop, until the odor becomes barely perceptible. The solution must be freshly prepared when required.

Sodium Bitartrate Test Solution (1 N.)—Dissolve 9 Gm. of sodium bitartrate in 100 cc. of distilled water. The solution must be freshly prepared when required.

Sodium Carbonate Test Solution (2 N.)—Dissolve 12.5 Gm. of monohydrated sodium carbonate in sufficient distilled water to make 100 cc.

Sodium Cobaltic Nitrite Test Solution—Dissolve 4 Gm. of cobaltous chloride and 10 Gm. of sodium nitrite in about 50 cc. of distilled water, add 2 cc. of acetic acid, and dilute with sufficient distilled water to make 100 cc. This reagent must not be kept longer than three months. It may be preserved for this length of time by the occasional addition of a few drops of acetic acid.

Sodium Cyanide Test Solution (2 N.)—Dissolve 1 Gm. of sodium cyanide in sufficient distilled water to make 10 cc. The solution must be freshly prepared when required.

Sodium Hydroxide Test Solution (1 N.)—Dissolve 4.3 Gm. of sodium hydroxide in sufficient distilled water to make 100 cc.

Sodium Hydroxide Test Solution, Special—This solution is to be prepared of the same strength as *Liquor Sodii Hydroxidi*, page 618, employing sodium hydroxide, which, in addition to the tests prescribed under *Sodii Hydroxidum*, should show not more than 0.005 per cent of *chloride* determined by the turbidimetric test, page 1520.

Sodium Hypobromite Test Solution—To a solution of 40 Gm. of sodium hydroxide in 150 cc. of distilled water, add 10 cc. of bromine, and, after solution has taken place, add sufficient distilled water to make 200 cc. The solution must be freshly prepared when required.

Sodium Nitroprusside Test Solution—Dissolve 1 Gm. sodium nitroprusside in sufficient distilled water to make 20 cc. This solution must be freshly prepared when required.

Sodium Phosphate Test Solution (1 N.)—Dissolve 12 Gm. of clear crystals of sodium phosphate in sufficient distilled water to make 100 cc.

Sodium Phosphotungstate Test Solution—To a solution of 20 Gm. of sodium tungstate in 100 cc. of distilled water, add sufficient phosphoric acid to impart a strongly acid reaction to litmus paper, and filter. When required for use, decant the clear solution from any sediment that may be present.

Preserve the solution in amber-colored, glass-stoppered bottles.

Sodium Sulphide Test Solution (1 N.)—Dissolve 12 Gm. of sodium sulphide in sufficient distilled water to make 100 cc.

NOTE—Sodium sulphide T.S. may be used in all cases when ammonium sulphide T.S. is directed. The solution must be freshly prepared when required for use.

Sodium Tartrate Test Solution (1 N.)—Dissolve 11.5 Gm. of sodium tartrate in sufficient distilled water to make 100 cc.

Sodium Thiosulphate Test Solution—Use the official tenth-normal sodium thiosulphate.

Stannous Chloride Test Solution—Dissolve 1.5 Gm. of stannous chloride in 10 cc. of distilled water containing a few drops of hydrochloric acid.

Preserve the solution in a glass-stoppered bottle in which a fragment of reagent tin has been placed. The solution must be renewed at frequent intervals.

Stannous Chloride Test Solution, Acid—Dissolve 40 Gm. of stannous chloride in 60 cc. of reagent concentrated hydrochloric acid.

Preserve in a glass-stoppered bottle.

Starch Test Solution—Triturate 1 Gm. of reagent starch with 10 cc. of cold distilled water, add sufficient boiling distilled water, with constant stirring, to make 200 cc., then boil the mixture until a thin, translucent fluid is obtained. The solution must be freshly prepared and filtered, if necessary.

Starch-Potassium Iodide Test Solution—Dissolve 0.5 Gm. of potassium iodide in 100 cc. of freshly prepared starch T.S. This solution should be made not longer than twenty-four hours before use.

Sulphanilic Acid Test Solution—Dissolve 0.8 Gm. of sulphanilic acid in 100 cc. of a 30 per cent solution of acetic acid. Preserve in well-stoppered bottles.

Sulphuric Acid Test Solution—Use *Acidum Sulphuricum Dilutum.*

Tannic Acid Test Solution—Dissolve 1 Gm. of tannic acid in 1 cc. of alcohol, and add sufficient distilled water to measure 10 cc. This solution should be freshly prepared when required for use.

Tartaric Acid Test Solution (4 N.)—Dissolve 6 Gm. of tartaric acid in sufficient distilled water to measure 20 cc. This solution should be freshly prepared.

Trinitrophenol Test Solution—See *Picric Acid T.S.*

Turmeric Test Paper—Impregnate sheets of white filter paper with turmeric T.S., dry, and cut into strips of a suitable size. Preserve in well-stoppered bottles.

Turmeric Test Solution—Digest 20 Gm. of powdered turmeric with 4 successive portions of 100 cc. each of cold distilled water, decanting the clear liquid portion each time and discarding it. Then dry the residue at a temperature not over 100° C., and digest it with 100 cc. of alcohol for several days, and filter. Turmeric turns yellow with acids, and brown with alkalies. It is unsuitable for ordinary titrations, being used for special tests.

Volumetric Solutions

It is absolutely necessary that the measuring vessels employed in the operations of volumetric analysis (burettes, flasks, mixing cylinders, pipettes, etc.,) shall agree accurately among themselves in their graduation at the standard temperature selected. All volumetric solutions, if practicable, should be prepared at the standard temperature of 25° C. and used in titrations at that standard temperature. If a titration is made at a markedly different temperature, a volumetric solution should be used which has been standardized for such temperature. In case graduated apparatus calibrated at 25° C. is not procurable, volumetric solutions may be prepared at the temperature for which the apparatus in hand was graduated (*e.g.*, 15° C. or 20° C.), and all such volumetric solutions should be marked to indicate the temperature at which they have been standardized. Such solutions must be used as above stated at the temperature at which the apparatus is standardized, care being taken that all graduated apparatus used be standardized at the same temperature.

Units of Capacity—The units of volume employed by this Pharmacopœia must accord with its standard liter at 25°C., which represents the volume occupied by 996.04 Gm. of distilled water, weighed in air with brass weights, at a temperature of 25° C.* and barometer at 760 mm. To secure uniformity among the various forms of apparatus employed, the standard specifications of the U. S. Bureau of Standards should be adhered to as closely as possible, except that the temperature adopted is 25° C. The tables for calibrating graduated apparatus will be found in the U.S.P.X.

Measuring Flasks—Standard measuring flasks are calibrated to contain, when filled to the mark, 1000, 500, 250, 200, or 100 cc., at 25° C. The necks must be of uniform caliber, and measure in diameter not less than 14 mm. and not more than 20 mm. for 1000 cc. capacity; from 12 mm. to 18 mm. for 500 cc. capacity; from 10 mm. to 15 mm. for 250 cc. capacity, and from 8 mm. to 12 mm. for 100 cc. capacity. The capacity mark on any of these flasks should be not less than 6 cm. distant from the mouth and not less than 2 cm. from the base of the neck (see Fig. 545).

Fig. 545

Volumetric flask

Cylinders—These should be graduated to contain their respective volumes at the standard temperature. Their inside diameter must not be more than one-fifth the graduated length.

Transfer Pipettes—These should be graduated to deliver at standard temperature the exact volume of fluid indicated. The suction stem should be at least 16 cm. long, and the delivery tube not less than 3 cm. and not more than 25 cm. long. The inside diameter at the capacity mark must not be less than 2 mm. and must not exceed 4 mm. for those of 25 cc. capacity. The capacity mark should not be more than 6 cm. from the bulb. The outlet of any transfer pipette should be of such size that the free outflow for water shall last not more than one minute, and not less than fifteen seconds for 5 cc., twenty seconds for 10 cc., and thirty seconds for 50 cc. After filling, the fluid adhering to the outside should be wiped from the stem; then when draining the contents, the pipette should be held in a vertical position; finally, to complete the emptying, the tip of the pipette should be held against the side of the vessel, permitting the last portions of the fluid to flow out by gravity. Pipettes should never be drained by blowing into them, except the Ostwald pipettes, which are especially graduated for use in this way.

Burettes—These must be provided with glass stopcocks and be graduated for

*500 cc. would weigh 498.02 Gm.; 250 cc., 249.01 Gm.; 100 cc., 99.604 Gm.

use at the standard temperature. Burettes provided with rubber tubes and pinch-cocks in place of glass stop-cocks may be used for potassium and sodium hydroxide V.S. The tips should be gradually tapered from 2 to 3 cm. in length and slightly bent. The rate of outflow should be regulated so that not less than 2 seconds should be consumed for each cc. delivered. When completing titration, the tip of the delivery tube should be touched with the wet surface of the receiving vessel to complete the emptying.

General Directions—All bottles in which volumetric solutions are to be kept, as well as the burettes or pipettes in which they are to be measured, should be thoroughly cleaned prior to use, and rinsed first with distilled water, and then with two or three small portions of the solution that they are to contain. In all apparatus where the surface of the fluid is limited by a meniscus, the reading must be made from the lowest point of the meniscus unless the liquid is too opaque to permit exact observation of that point. It is of the utmost importance that the inner surface of all measuring apparatus shall be free from any suggestion of greasiness.

Normal Volumetric Solutions $\left(\frac{N}{1}\right)$ are those which contain in 1000 cc., in any stated reaction, the chemical equivalent of 1.008 Gm. of hydrogen. If the molecule of the reagent is univalent, one liter will contain a weight in grams equal to the molecular weight of the reagent; if bivalent, a weight in grams equal to one-half its molecular weight; if trivalent, a weight in grams equal to one-third its molecular weight. Thus, hydrochloric acid, $HCl = 36.47$, having but one H atom replaceable by a basic element, has 36.47 Gm. of HCl in 1000 cc. of the normal volumetric solution; while sulphuric acid, $H_2SO_4 = 98.09$, having two replaceable H atoms, contains only one-half this number, or 49.045 Gm. of H_2SO_4 in 1000 cc. of its normal solution. Potassium hydroxide, $KOH = 56.11$, has but one K to replace one H in acids, hence its normal solution contains 56.11 Gm. of KOH in one liter. Again, one molecule of potassium dichromate ($K_2Cr_2O_7 = 294.20$) in oxidation liberates three atoms of oxygen which are capable of combining with six atoms of hydrogen. Therefore, each molecule of the dichromate, yielding three atoms of oxygen, is equivalent to six atoms of hydrogen. Hence, the normal solution should contain $\frac{294.20}{6}$ or 49.0333 Gm. in 1000 cc. Two molecules of potassium permanganate, $2KMnO_4 = 316.06$, in oxidation, give off five atoms of O, which are equivalent to ten atoms of H; hence its normal solution should contain $\frac{316.06}{10}$ or 31.606 in 1000 cc. Solutions containing in 1000 cc. one-tenth of the quantity of the active reagent in the normal solution are called tenth-normal (decinormal) $\left(\frac{N}{10}\right)$ (normality = 0.1); those containing one one-hundredth, hundredth-normal (centinormal) $\left(\frac{N}{100}\right)$ (normality = 0.01); those containing one-fiftieth, fiftieth-normal $\left(\frac{N}{50}\right)$ (normality = 0.02); those containing twice the amount, double-normal $\left(\frac{2N}{1}\right)$ (normality = 2); half the amount half-normal $\left(\frac{N}{2}\right)$ (normality = 0.5). Solutions containing quantities of the active reagent having no simple relation to the molecular weight are called empirical. The general policy has been followed to limit the factors of volumetric solutions to four significant figures.

Use of Empirical Solutions—As it is difficult to maintain the theoretical standard strength with many volumetric solutions, it is not absolutely necessary that such standard strength be maintained, or even attained originally. A solution of approximately the desired normality is prepared and its strength accurately determined.

The correction factor of the normality is applied in all calculations where the empirical solution is employed. As many volumetric solutions are subject to alteration in strength on keeping, their strength should frequently be ascertained.

When the same kind of volumetric solution of several normalities is used, the details of the preparation and standardization are given for the strength most frequently required. Stronger or weaker solutions are prepared and standardized in the same manner as the solutions described, using proportionate amounts of material. Whenever convenient, it is preferable to prepare tenth or lower normality solutions by properly diluting the stronger volumetric solutions, but in preparing any alkali hydroxide volumetric solution by dilution, its exact strength must be ascertained by the same method of titration as described under the stronger solution.

Alkaline Cupric Tartrate Volumetric Solution

FEHLING'S SOLUTION

A. The Copper Solution—Dissolve 34.66 Gm. of carefully selected, small crystals of cupric sulphate, showing no trace of efflorescence or of adhering moisture, in a sufficient quantity of distilled water to make the solution measure exactly 500 cc. at standard temperature. Keep this solution in small, well-stoppered bottles.

B. The Alkaline Tartrate Solution—Dissolve 173 Gm. of crystallized potassium and sodium tartrate and 50 Gm. of sodium hydroxide in a sufficient quantity of distilled water to make the solution measure exactly 500 cc. at standard temperature. Keep the solution in small, rubber-stoppered bottles.

For use, mix exactly equal volumes of the two solutions at the time required.

NOTE: In this Pharmacopœia Fehling's Solution is not used as a volumetric reagent, but is used qualitatively. The correct formula is given for the volumetric solution, because of its extensive use in this manner. It must always be used under carefully standardized conditions in quantitative work, and in connection with tables which will be found in "Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists."

Barium Hydroxide, Tenth-Normal

$Ba(OH)_2.8H_2O = 315.51$ 15.776 Gm. in 1000 cc.

Dissolve about 18 Gm. of reagent barium hydroxide in 1000 cc. of recently boiled and cooled distilled water, and, if necessary, filter the solution quickly.

Ascertain the exact strength by titration against tenth-normal hydrochloric acid, phenolphthalein T.S. being used as indicator, and adjust to exact normality or to a known strength of approximate normality. This solution deteriorates rapidly and should be standardized before using.

Preserve the solution in rubber-stoppered bottles provided with a soda-lime tube as directed under normal sodium hydroxide.

One cubic centimeter of Tenth-Normal Barium Hydroxide is the equivalent of:

	Gram
Barium Hydroxide, $Ba(OH)_2.8H_2O$	0.01578
Ammonium Benzoate, $NH_4C_7H_5O_2$	0.01391
Ammonium Salicylate, $NH_4C_7H_5O_3$	0.01551

	Gram
Benzoic Acid, $HC_7H_5O_2$	0.01221
Hydrochloric Acid, HCl	0.03647
Salicylic Acid, $HC_7H_5O_3$	0.01381
Sodium Benzoate, $NaC_7H_5O_2$	0.01441
Sulphuric Acid, H_2SO_4	0.004904

Bromine, Tenth-Normal

KOPPESCHAAR'S SOLUTION

Br = 79.92 7.992 Gm. in 1000 cc.

Dissolve 3 Gm. of potassium bromate and 50 Gm. of potassium bromide in sufficient distilled water to make 1000 cc.

Ascertain its exact strength by titration against tenth-normal sodium thiosulphate after the addition of potassium iodide and a slight excess of hydrochloric acid, and adjust to exact normality or to a known strength of approximate normality.

Preserve in dark amber-colored, glass-stoppered bottles.

One cubic centimeter of Tenth-Normal Bromine is the equivalent of:	Gram
Bromine, Br	0.007992
Phenol, C_6H_5OH	0.001568
Resorcinol, $C_6H_4(OH)_2$	0.001835
Sodium Phenolsulphonate, anhydrous, $NaC_6H_5O_4S$	0.004903
Sodium Phenolsulphonate, crystallized, $NaC_6H_5O_4S.2H_2O$	0.005804

Hydrochloric Acid, Normal

HCl = 36.47 36.47 Gm. in 1000 cc.

Mix 95 cc. of hydrochloric acid with sufficient distilled water to measure 1000 cc.

Ascertain its exact strength by titration against freshly standardized sodium carbonate or normal sodium hydroxide, methyl orange T.S. being used as indicator; or gravimetrically by precipitation as silver chloride, and adjust to exact normality or to a known strength of approximate normality.

One cubic centimeter of Normal Hydrochloric Acid is the equivalent of:	Gram
Hydrochloric Acid, HCl	0.03647
Barium Hydroxide, $Ba(OH)_2.8H_2O$	0.1578
Calcium Carbonate, $CaCO_3$	0.05004
Calcium Hydroxide, $Ca(OH)_2$	0.03705
Calcium Oxide, CaO	0.02804
Potassium Hydroxide, KOH	0.05611
Sodium Borate, anhydrous, $Na_2B_4O_7$	0.1008
Sodium Borate, crystallized, $Na_2B_4O_7.10H_2O$	0.1909
Sodium Cacodylate, anhydrous, $Na(CH_3)_2.AsO_2$	0.16002
Sodium Hydroxide, NaOH	0.04001

NOTE: Normal hydrochloric acid is in every respect equivalent in neutralizing power to normal sulphuric acid (page 1565), and may be employed, except in special cases, for the same purposes.

Hydrochloric Acid, Half-Normal

HCl = 36.47 — 18.235 Gm. in 1000 cc.

One cubic centimeter of Half-Normal Hydrochloric Acid is the equivalent of:

	Gram
Hydrochloric Acid, HCl	0.01824

Other factors are identical with those under Half-normal Sulphuric Acid, page 509.

Hydrochloric Acid, Fiftieth-Normal

HCl = 36.47 — 0.7294 Gm. in 1000 cc.

One cubic centimeter of Fiftieth-Normal Hydrochloric Acid is the equivalent of:

	Gram
Hydrochloric Acid, HCl	0.0007294

This volumetric solution is not used officially for titration but is employed in connection with the special Turbidimetric Test, page 1520.

Iodine, Tenth-Normal

I = 126.92 — 12.692 Gm. in 1000 cc.

Method I. Dissolve 12.692 Gm. of reagent iodine in a solution of 18 Gm. of potassium iodide in 100 cc. of distilled water. Then add sufficient distilled water to make the solution measure exactly 1000 cc. at 25° C. Unless freshly prepared its normality should always be redetermined before use.

Preserve in glass-stoppered bottles.

Method II. Tenth-normal iodine may also be prepared as follows:

Dissolve about 14 Gm. of reagent iodine in a solution of 18 Gm. of potassium iodide in about 100 cc. of distilled water, diluting finally to 1000 cc. Carefully measure from a burette 25 cc. of this solution (which is too concentrated), into a flask, then add gradually and cautiously from a burette tenth-normal sodium thiosulphate, shaking constantly, until the color of the solution is but slightly yellow, then add a few drops of starch T.S. and continue the addition of the tenth-normal sodium thiosulphate until the blue color is just discharged. Note the number of cc. of the tenth-normal sodium thiosulphate consumed, and then dilute the iodine solution so that 25 cc. will require for decolorization exactly 25 cc. of the tenth-normal sodium thiosulphate at standard temperature.

One cubic centimeter of Tenth-Normal Iodine is the equivalent of:

	Gram
Iodine, I	0.01269
Acetone, $(CH_3)_2CO$	0.0009677
Antimony and Potassium Tartrate, crystallized, $K(SbO)C_4H_4O_6.\frac{1}{2}H_2O$	0.01662
Arsenic, in arsenous compounds, As	0.003748
Arsenous Iodide, AsI_3	0.02279
Arsenic Trioxide (Arsenous Acid), As_2O_3	0.004948
Calcium Sulphide, CaS	0.003607
Iron, Fe	0.002792
Mercurous Chloride, HgCl	0.02361
Mercurous Iodide, HgI	0.03275
Mercury (in mercurous compounds), Hg	0.02006

	Gram
Sodium Bisulphite, $NaHSO_3$	0.005204
Sodium Sulphite, anhydrous, Na_2SO_3	0.006303
Sodium Thiosulphate, anhydrous, $Na_2S_2O_3$	0.01581
Sodium Thiosulphate, crystallized, $Na_2S_2O_3.5H_2O$	0.02482
Sulphur Dioxide, SO_2	0.003203

Oxalic Acid, Tenth-Normal

$H_2C_2O_4.2H_2O = 126.06$ 6.303 Gm. in 1000 cc.

Dissolve 6.45 Gm. of reagent oxalic acid in sufficient distilled water to measure 1000 cc. Ascertain its exact strength by titration against freshly standardized tenth-normal sodium hydroxide, phenolphthalein T.S. being used as indicator, and adjust to exact normality or to a known strength of approximate normality.

One cubic centimeter of Tenth-Normal Oxalic Acid is the equivalent of:	Gram
Oxalic Acid, crystallized, $H_2C_2O_4.2H_2O$	0.006303
Ammonia Gas, NH_3	0.001703
Calcium Carbonate, $CaCO_3$	0.005004
Calcium Hydroxide, $Ca(OH)_2$	0.003705
Calcium Oxide, CaO	0.002804
Lead, Pb	0.01036
Lead Acetate, anhydrous, $Pb(C_2H_3O_2)_2$	0.01626
Lead Acetate, crystallized, $Pb(C_2H_3O_2)_2.3H_2O$	0.01897
Lead Oxide, PbO	0.01116
Lead Peroxide, PbO_2	0.01196
Lead Subacetate, approximately, $Pb_2O(C_2H_3O_2)_2$	0.01371
Manganese Dioxide, MnO_2	0.004347
Potassium Hydroxide, KOH	0.005611
Potassium Permanganate, $KMnO_4$	0.003161
Sodium Hydroxide, NaOH	0.004001

Potassium Dichromate, Tenth-Normal

$K_2Cr_2O_7 = 294.20$ 4.9033 Gm. in 1000 cc.

Method I. Dissolve 4.9033 Gm. of potassium dichromate, which has been pulverized and dried to constant weight at 120° C., in sufficient distilled water to measure exactly 1000 cc. at standard temperature.

Method II. Tenth-normal potassium dichromate may also be prepared as follows:

Dissolve about 5 Gm. of potassium dichromate in 1000 cc. of distilled water, transfer exactly 25 cc. of this solution to a 500 cc. glass-stoppered flask, add 2 Gm. of potassium iodide (free from iodate), dilute with 200 cc. of distilled water, add 5 cc. of hydrochloric acid, allow to stand for ten minutes in a dark place, and titrate the liberated iodine with tenth-normal sodium thiosulphate, using starch T.S. at the end of the titration as indicator. Adjust to exact normality or to a known strength of approximate normality.

For estimating ferrous iron, it is used in the following manner. Introduce an acidulated aqueous solution of the ferrous compound into a flask. Gradually add the tenth-normal potassium dichromate from a burette with agitation until a drop placed

upon a white porcelain surface no longer becomes blue when mixed with a drop of freshly prepared potassium ferricyanide T.S. Several closely agreeing determinations should be made before finally calculating the result.

One cubic centimeter of Tenth-Normal Potassium Dichromate is the equivalent of:

	Gram
Potassium Dichromate, $K_2Cr_2O_7$	0.004903
Ferrous Carbonate, $FeCO_3$	0.01159
Ferrous Sulphate, anhydrous, $FeSO_4$	0.01519
Ferrous Sulphate, crystallized, $FeSO_4.7H_2O$	0.02780
Iron, in ferrous compounds, Fe	0.005584
Sodium Thiosulphate, $Na_2S_2O_3.5H_2O$	0.02482

Potassium Hydroxide, Dekanormal

KOH = 56.11 561.1 Gm. in 1000 cc.

Prepare and preserve as directed under normal potassium hydroxide.

NOTE: This solution is intended specifically for the ready measurement of definite amounts of absolute potassium hydroxide, hence it is not necessary to adjust the solution to exact strength, but the factor of strength must be accurately known and the solution used accordingly. The use of barium hydroxide in this solution is unnecessary, provided the solution be allowed to settle before standardizing and only the clear liquid employed.

Potassium Hydroxide, Normal

KOH = 56.11 56.11 Gm. in 1000 cc.

Normal Potassium Hydroxide is used only as an alternative solution. It is prepared and standardized in exactly the same manner as normal sodium hydroxide, using an equivalent quantity of the base for preparing the solution.

The factors for this solution are the same as for normal sodium hydroxide which is preferred on account of its economy.

Potassium Hydroxide Alcoholic, Half-Normal

KOH = 56.11 28.055 Gm. in 1000 cc.

Dissolve 2.5 Gm. of silver nitrate in 5 cc. of distilled water and add the solution to 1200 cc. of alcohol in a glass-stoppered bottle, and mix thoroughly. Dissolve 5 Gm. of potassium hydroxide in 25 cc. of warm alcohol, cool the solution, and pour it slowly, without stirring, into the alcoholic solution of silver nitrate. Let the mixture stand until the precipitated silver oxide has settled, filter, and distil. Dissolve about 35 Gm. of potassium hydroxide in 20 cc. of distilled water and add sufficient alcohol, purified as above, to make 1000 cc. Allow the solution to stand in a tightly stoppered bottle (using either a glass or rubber stopper) for twenty-four hours, then quickly decant the clear supernatant liquid into a bottle provided with a well-fitting rubber stopper. Ascertain the strength by titration against a hot solution of reagent potassium bitartrate, phenolphthalein T.S. being used as indicator, and adjust to exact normality or to a known strength of approximate normality. The strength may also be ascertained and adjusted after titration against half-normal hydrochloric acid.

NOTE: This solution should be kept in bottles provided with well-fitting stoppers of rubber, or of cork which have been well coated with paraffin, and it should be protected from light. It should be restandardized whenever it is used. It is very important that this solution should be used at the same temperature at which it was standardized.

One cubic centimeter of Half-Normal Alcoholic Potassium Hydroxide is the equivalent of:

	Gram
Potassium Hydroxide, KOH	0.02806
Borneol, $C_{10}H_{17}OH$	0.07710
Bornyl Acetate, $C_{10}H_{17}.C_2H_3O_2$	0.09811
Linalyl Acetate, $C_{10}H_{17}.C_2H_3O_2$	0.09811
Menthol, $C_{10}H_{19}OH$	0.07811
Menthyl Acetate, $C_{10}H_{19}.C_2H_3O_2$	0.09912
Methyl Salicylate, $CH_3.C_7H_5O_3$	0.07605
Potassium Bitartrate, $KHC_4H_4O_6$	0.09408
Santalol, $C_{15}H_{24}O$	0.1101

Potassium Permanganate, Tenth-Normal

$KMnO_4 = 158.03$ 3.1606 Gm. in 1000 cc.

Dissolve about 3.3 Gm. of potassium permanganate in 1000 cc. of distilled water in a flask and boil for about five minutes. Close the flask with absorbent cotton and allow it to stand for at least two days, then pour off the clear portion of the solution or filter through asbestos. The water for preparing and diluting this solution should be freshly distilled after adding about 1 Gm. of potassium permanganate to each liter of water in the retort before beginning the distillation. Ascertain its exact strength by titration against reagent sodium oxalate, and adjust to exact normality or to a known strength of approximate normality.

The strength may also be determined and adjusted by titrating against tenth-normal sodium thiosulphate after the addition of diluted sulphuric acid and an excess of potassium iodide.

Burettes provided with glass stop-cocks must be employed when titrating with this solution. It should be frequently restandardized. Preserve in glass-stoppered bottles.

One cubic centimeter of Tenth-Normal Potassium Permanganate is the equivalent of:

	Gram
Potassium Permanganate, $KMnO_4$	0.003161
Calcium Oxide, CaO (as oxalate)	0.002804
Ferrous Carbonate, $FeCO_3$	0.01159
Ferrous Oxide, FeO	0.007184
Ferrous Sulphate, anhydrous, $FeSO_4$	0.01519
Ferrous Sulphate, crystals, $FeSO_4.7H_2O$	0.02780
Hydrogen Dioxide, H_2O_2	0.001701
Iron, in ferrous compounds, Fe	0.005584
Oxalic Acid, crystallized, $H_2C_2O_4.2H_2O$	0.006303
Oxygen, O	0.0008

	Gram
Potassium Chlorate, $KClO_3$	0.002043
Sodium Chlorate, $NaClO_3$	0.001774
Sodium Nitrite, $NaNO_2$	0.003451
Sodium Oxalate, $Na_2C_2O_4$	0.006701

Potassium Thiocyanate, Tenth-Normal

$KSCN = 97.173$ 9.7173 Gm. in 1000 cc.

Dissolve 11 Gm. of reagent potassium thiocyanate in 1000 cc. of distilled water. Ascertain its exact strength by titration against tenth-normal silver nitrate, and adjust to exact normality or to a known strength of approximate normality.

One cubic centimeter of Tenth-Normal Potassium Thiocyanate is the equivalent of:

	Gram
Potassium Thiocyanate, KSCN	0.009717
Mercuric Iodide, HgI_2	0.02272
Mercuric Nitrate, $Hg(NO_3)_2$	0.01623
Mercuric Oxide, HgO	0.01083
Mercury, Hg	0.01003
Silver, Ag	0.01079
Silver Nitrate, $AgNO_3$	0.01699
Silver Oxide, Ag_2O	0.01159

Silver Nitrate, Tenth-Normal

$AgNO_3 = 169.89$ 16.989 Gm. in 1000 cc.

Method I. In a flask containing 10.788 Gm. of silver and provided with a small funnel inserted into the neck to prevent loss by spurting, introduce gradually about 30 cc. of nitric acid, or sufficient for complete solution. After thoroughly rinsing the funnel, transfer the clear solution, with the rinsings, to a beaker or porcelain dish, and evaporate to dryness on a water bath, carefully protecting the vessel from dust. Then dry in an oven at about 120° C. for ten minutes, cool the residue, and dissolve it in 1000 cc. of distilled water at 25° C.

Method II. The solution may also be made by dissolving 17.006 Gm. of thoroughly dried silver nitrate in enough distilled water to make 1000 cc..

One cubic centimeter of Tenth-Normal Silver Nitrate is the equivalent of:

	Gram
Silver Nitrate, $AgNO_3$	0.01699
Allyl Iso-thiocyanate, C_3H_5NCS	0.004957
Ammonium Bromide, NH_4Br	0.009796
Ammonium Chloride, NH_4Cl	0.005350
Ammonium Iodide, NH_4I	0.01450
Arsenous Iodide, AsI_3	0.01519
Bromine, Br	0.007992
Calcium Bromide, anhydrous, $CaBr_2$	0.009996
Calcium Bromide, $CaBr_2.2H_2O$	0.01180

	Gram
Calcium Chloride, anhydrous, $CaCl_2$	0.005550
Calcium Chloride, $CaCl_2.2H_2O$	0.007351
Calcium Hypophosphite, $Ca(PH_2O_2)_2$	0.002836
Chlorine, Cl	0.003546
Ferrous Bromide, anhydrous, $FeBr_2$	0.01078
Ferrous Iodide, FeI_2	0.01548
Hydriodic Acid, HI	0.01279
Hydrobromic Acid, HBr	0.008093
Hydrochloric Acid, HCl	0.003647
Hydrocyanic Acid, HCN, to first formation of precipitate	0.005404
Hydrocyanic Acid, HCN, potassium chromate as indicator	0.002702
Iodine, I	0.01269
Lithium Bromide, LiBr	0.008686
Lithium Chloride, LiCl	0.004240
Phosphoric Acid, H_3PO_4	0.003269
Potassium Bromide, KBr	0.01190
Potassium Chloride, KCl	0.007456
Potassium Cyanide, KCN, to first formation of precipitate	0.01302
Potassium Hypophosphite, KPH_2O_2	0.003472
Potassium Iodide, KI	0.01660
Potassium Nitrate, KNO_3	0.01011
Potassium Thiocyanate, KSCN	0.009717
Sodium Biphosphate, $NaH_2PO_4.H_2O$	0.004602
Sodium Biphosphate, anhydrous, NaH_2PO_4	0.004002
Sodium Bromide, NaBr	0.01029
Sodium Chloride, NaCl	0.005846
Sodium Cyanide, NaCN, to first formation of precipitate	0.009802
Sodium Hypophosphite, $NaPH_2O_2.H_2O$	0.003536
Sodium Iodide, NaI	0.01499
Sodium Nitrate, $NaNO_3$	0.008501
Sodium Phosphate, anhydrous, Na_2HPO_4	0.004735
Sodium Phosphate, crystallized, $Na_2HPO_4.12H_2O$	0.01194
Strontium Bromide, anhydrous, $SrBr_2$	0.01237
Strontium Bromide, crystallized, $SrBr_2.6H_2O$	0.01778
Strontium Chloride, $SrCl_2.6H_2O$	0.01333
Strontium Iodide, anhydrous, SrI_2	0.01707
Strontium Iodide, crystallized, $SrI_2.6H_2O$	0.02248
Zinc Chloride, $ZnCl_2$	0.006815

Sodium Hydroxide, Dekanormal

NaOH = 40.01 400.1 Gm. in 1000 cc.

Prepare and preserve as directed under normal sodium hydroxide.

NOTE: This solution is intended specifically for the ready measurement of definite amounts of absolute sodium hydroxide, hence it is not necessary to adjust the solution to exact strength, but the factor of strength must be accurately known and the solution used accordingly. The use of barium hydroxide in this solution is unnecessary, provided the solution be allowed to settle before standardizing and only the clear liquid employed.

Sodium Hydroxide, Double-Normal

$NaOH = 40.01$ 80.02 Gm. in 1000 cc.

Preserve the solution as directed under normal sodium hydroxide (see below). This solution should be frequently restandardized.

Sodium Hydroxide, Normal

$NaOH = 40.01$ 40.01 Gm. in 1000 cc.

Dissolve 45 Gm. of sodium hydroxide in about 950 cc. of distilled water and add a freshly prepared saturated solution of reagent barium hydroxide until no more precipitate forms. Allow the precipitate to subside, decant the clear liquid or filter the solution, and determine its strength by titration against a hot solution of an accurately weighed quantity of reagent potassium bitartrate, or against normal hydrochloric or sulphuric acid, and adjust to exact normality or to a known strength of approximate normality.

NOTE: Solutions of alkali hydroxides absorb carbon dioxide when exposed to the atmosphere. They should therefore be preserved in bottles with well-fitting rubber stoppers, provided with tubes filled with a mixture of sodium hydroxide and lime (soda-lime tubes) so that air in entering the container must pass through such tubes which will absorb the carbon dioxide.

The solution should be frequently restandardized.

One cubic centimeter of Normal Sodium Hydroxide is the equivalent of:	Gram
Sodium Hydroxide, NaOH	0.04001
Acetic Acid, $HC_2H_3O_2$	0.06004
Acetic Anhydride, $(CH_3CO)_2O$	0.05104
Ammonia Gas, NH_3	0.01703
Boric Acid, H_3BO_3	0.06192
Chloral Hydrate, $CCl_3CHO.H_2O$	0.1654
Citric Acid, crystallized, $H_3C_6H_5O_7.H_2O$	0.07004
Formaldehyde, HCHO	0.03002
Hydriodic Acid, HI	0.1279
Hydrobromic Acid, HBr	0.08093
Hydrochloric Acid, HCl	0.03647
Hypophosphorous Acid, HPH_2O_2	0.06606
Lactic Acid, $HC_3H_5O_3$	0.09006
Nitric Acid, HNO_3	0.06302
Oxalic Acid, crystallized, $H_2C_2O_4.2H_2O$	0.06303
Paraformaldehyde, $(HCHO)_3$	0.03002
Phosphoric Acid, H_3PO_4 (to form Na_2HPO_4; with phenolphthalein)	0.04903
Potassium Bitartrate, $KHC_4H_4O_6$	0.1882
Potassium Hydroxide, KOH	0.05611
Sodium Biphosphate, $NaH_2PO_4.H_2O$	0.1381
Sodium Biphosphate, anhydrous, NaH_2PO_4	0.1201
Sodium Bitartrate, $NaHC_4H_4O_6.H_2O$	0.1901
Sulphuric Acid, H_2SO_4	0.04904
Sulphuric Anhydride, SO_3	0.04003
Tartaric Acid, $H_2C_4H_4O_6$	0.07504
Trichloracetic Acid, $CCl_3.COOH$	0.1634

Sodium Hydroxide, Half-Normal

$NaOH = 40.01$ 20.005 Gm. in 1000 cc.

Preserve as directed under normal sodium hydroxide, page 1562. This solution should be frequently restandardized.

One cubic centimeter of Half-Normal Sodium Hydroxide is the equivalent of:

	Gram
Sodium Hydroxide, $NaOH$	0.02001
Acetic Acid, $HC_2H_3O_2$	0.03002
Acetylsalicylic Acid, $C_6H_4.O(C_2H_3O).COOH$	0.04503
Benzyl Benzoate, $C_6H_5CO_2.CH_2C_6H_5$	0.1061
Boric Acid, H_3BO_3	0.03100
Citric Acid, crystallized, $H_3C_6H_5O_7.H_2O$	0.03502
Hydriodic Acid, HI	0.06397
Hydrobromic Acid, HBr	0.04047
Hydrochloric Acid, HCl	0.01824
Hypophosphorous Acid, HPH_2O_2	0.03303
Lactic Acid, $HC_3H_5O_3$	0.04503
Nitric Acid, HNO_3	0.03151
Oxalic Acid, crystallized, $H_2C_2O_4.2H_2O$	0.03152
Phosphoric Acid, H_3PO_4 (to form Na_2HPO_4; with phenolphthalein)	0.02452
Potassium Bitartrate, $KHC_4H_4O_6$	0.09408
Potassium Hydroxide, KOH	0.02806
Sodium Bitartrate, $NaHC_4H_4O_6.H_2O$	0.09504
Sulphuric Acid, H_2SO_4	0.02452
Sulphuric Anhydride, SO_3	0.02002
Tartaric Acid, crystallized, $H_2C_4H_4O_6$	0.03752
Trichloracetic Acid, $CCl_3.COOH$	0.08170

Sodium Hydroxide, Tenth-Normal

$NaOH = 40.01$ 4.001 Gm. in 1000 cc.

Preserve as directed under normal sodium hydroxide, page 1562. This solution should be frequently restandardized.

One cubic centimeter of Tenth-Normal Sodium Hydroxide is the equivalent of:

	Gram
Sodium Hydroxide, $NaOH$	0.004001
Cinchophen, $C_6H_5.C_9H_5N.COOH$	0.02492
Eucaine Hydrochloride, $C_{15}H_{21}O_2N.HCl$	0.02837
Lactic Acid, $HC_3H_5O_3$	0.009006
Potassium Bitartrate, $KHC_4H_4O_6$	0.01882
Potassium Hydroxide, KOH	0.005611
Sulphuric Acid, H_2SO_4	0.004904

Sodium Hydroxide, Fiftieth-Normal

$NaOH = 40.01$ 0.800 Gm. in 1000 cc.

Preserve as directed under normal sodium hydroxide, page 1562. This solution should be frequently restandardized.

One cubic centimeter of Fiftieth-Normal Sodium Hydroxide is the equivalent of:

	Gram
Sodium Hydroxide, NaOH	0.0008002
Potassium Bitartrate, $KHC_4H_4O_6$	0.003763
Sulphuric Acid, H_2SO_4	0.0009808

Sodium Hydroxide, Hundredth-Normal

$NaOH = 40.01$ 0.400 Gm. in 1000 cc.

Preserve as directed under normal sodium hydroxide. This solution should be frequently restandardized.

One cubic centimeter of Hundredth-Normal Sodium Hydroxide is the equivalent of:

	Gram
Sodium Hydroxide, NaOH	0.0004001
Potassium Bitartrate, $KHC_4H_4O_6$	0.001882
Sulphuric Acid, H_2SO_4	0.0004904

Sodium Thiosulphate, Tenth-Normal

$Na_2S_2O_3.5H_2O = 248.20$ 24.820 Gm. in 1000 cc.

Dissolve 30 Gm. of sodium thiosulphate in sufficient distilled water, previously boiled for twenty minutes in a flask of hard glass and quickly cooled, to measure 1000 cc. Ascertain its exact strength by titration against tenth-normal potassium dichromate, in the presence of an excess of potassium iodide and a small amount of sulphuric acid, and adjust to exact normality, or to a known strength of approximate normality. The strength may also be ascertained and adjusted after titration against tenth-normal iodine. This solution should be frequently restandardized.

One cubic centimeter of Tenth-Normal Sodium Thiosulphate is the equivalent of:

	Gram
Sodium Thiosulphate, $Na_2S_2O_3.5H_2O$	0.02482
Arsenic, As (in Arsphenamine and Neoarsphenamine)	0.003748
Bromine, Br	0.007992
Chlorine, Cl	0.003546
Chlorine, Cl (in Chloramine and Dichloramine)	0.001773
Chromium Trioxide, CrO_3	0.003333
Cupric Sulphate, anhydrous, $CuSO_4$	0.01596
Cupric Sulphate, crystallized, $CuSO_4.5H_2O$	0.02497
Iodine, I	0.01269
Iodine, I (in Thymol Iodide and Calcium Iodobehenate)	0.002115
Iron, Fe, in ferric salts	0.005584
Lead Peroxide, PbO_2	0.01196
Potassium Bromate, $KBrO_3$	0.002784
Potassium Dichromate, $K_2Cr_2O_7$	0.004903
Sodium Arsenate, anhydrous, Na_2HAsO_4	0.009299
Sodium Arsenate, crystallized, $Na_2HAsO_4.7H_2O$	0.01560
Sodium Hypochlorite, NaOCl	0.003723

Sodium Thiosulphate, Two-Hundredth-Normal

$Na_2S_2O_3.5H_2O = 248.20$ 1.241 Gm. in 1000 cc.

This solution should be frequently restandardized.

One cubic centimeter of Two-Hundredth-Normal Sodium Thiosulphate is the equivalent of:

	Gram
Sodium Thiosulphate, $Na_2S_2O_3.5H_2O$	0.001241
Iodine, I	0.0006346
Iodine, I (from Thyroxin and Thyroid Glands)	0.0001058

Sulphuric Acid, Normal

$H_2SO_4 = 98.076$ 49.038 Gm. in 1000 cc.

Add slowly, with constant stirring, 30 cc. of sulphuric acid to 1020 cc. of distilled water and allow the solution to cool to 25° C. Ascertain its exact strength by titration against freshly standardized normal sodium hydroxide, methyl orange T.S. being used as indicator, and adjust to exact normality or to a known strength of approximate normality.

The strength may also be ascertained and adjusted after titration against an accurately weighed amount of reagent anhydrous sodium carbonate. It may also be standardized gravimetrically by precipitation and weighing as barium sulphate.

One cubic centimeter of Normal Sulphuric Acid is the equivalent of:

	Gram
Sulphuric Acid, H_2SO_4	0.04904
Ammonia Gas, NH_3	0.01703
Ammonium Acetate, $NH_4C_2H_3O_2$	0.07707
Calcium Hydroxide, $Ca(OH)_2$	0.03705
Calcium Oxide, CaO	0.02804
Lithium Carbonate, Li_2CO_3	0.03695
Lithium Salicylate, $LiC_7H_5O_3$	0.1440
Magnesium Carbonate, $(MgCO_3)_4Mg(OH)_2.5H_2O$	0.04857
Magnesium Hydroxide, $Mg(OH)_2$	0.02917
Magnesium Oxide, MgO	0.02016
Methenamine, $(CH_2)_6N_4$	0.03504
Potassium Acetate, $KC_2H_3O_2$	0.09813
Potassium Bicarbonate, $KHCO_3$	0.1001
Potassium Bitartrate, $KHC_4H_4O_6$	0.1882
Potassium Carbonate, anhydrous, K_2CO_3	0.06911
Potassium Citrate, crystallized, $K_3C_6H_5O_7.H_2O$	0.1081
Potassium Hydroxide, KOH	0.05611
Potassium and Sodium Tartrate, $KNaC_4H_4O_6.4H_2O$	0.1411
Sodium Acetate, $NaC_2H_3O_2.3H_2O$	0.1361
Sodium Bicarbonate, $NaHCO_3$	0.08401
Sodium Borate, crystallized, $Na_2B_4O_7.10H_2O$	0.1909
Sodium Carbonate, anhydrous, Na_2CO_3	0.05301
Sodium Carbonate, monohydrated, $Na_2CO_3.H_2O$	0.06201
Sodium Hydroxide, NaOH	0.04001
Sodium Salicylate, $NaC_7H_5O_3$	0.16008
Zinc Oxide, ZnO	0.04069

Sulphuric Acid, Half-Normal

$H_2SO_4 = 98.076$ 24.519 Gm. in 1000 cc.

One cubic centimeter of Half-Normal Sulphuric Acid is the equivalent of:

	Gram
Sulphuric Acid, H_2SO_4	0.02452
Ammonia Gas, NH_3	0.008520
Benzaldehyde, C_7H_6O	0.05304
Calcium Glycerophosphate, $CaC_3H_7PO_6$	0.10509
Calcium Lactate, $Ca(C_3H_5O_3)_2$ anhydrous	0.05455
Cinnamic Aldehyde, C_9H_8O	0.03303
Citral, $C_{10}H_{16}O$	0.07609
Lithium Citrate, anhydrous, $Li_3C_6H_5O_7$	0.03498
Lithium Citrate, crystallized, $Li_3C_6H_5O_7.4H_2O$	0.04699
Lithium Salicylate, $LiC_7H_5O_3$	0.07201
Magnesium Hydroxide, $Mg(OH)_2$	0.01459
Potassium Acetate, $KC_2H_3O_2$	0.04907
Potassium and Sodium Tartrate, anhydrous, $KNaC_4H_4O_6$	0.05254
Potassium and Sodium Tartrate, crystallized, $KNaC_4H_4O_6.4H_2O$	0.07056
Potassium Bicarbonate, $KHCO_3$	0.05006
Potassium Bitartrate, $KHC_4H_4O_6$	0.09408
Potassium Carbonate, anhydrous, K_2CO_3	0.03455
Potassium Citrate, anhydrous, $K_3C_6H_5O_7$	0.05106
Potassium Citrate, crystallized, $K_3C_6H_5O_7.H_2O$	0.05407
Potassium Hydroxide, KOH	0.02806
Sodium Acetate, anhydrous, $NaC_2H_3O_2$	0.04102
Sodium Acetate, crystallized, $NaC_2H_3O_2.3H_2O$	0.06804
Sodium Benzoate, $NaC_7H_5O_2$	0.07204
Sodium Bicarbonate, $NaHCO_3$	0.04201
Sodium Carbonate, anhydrous, Na_2CO_3	0.02650
Sodium Carbonate, monohydrated, $Na_2CO_3.H_2O$	0.03101
Sodium Citrate, anhydrous, $Na_3C_6H_5O_7$	0.04301
Sodium Citrate, crystallized, $Na_3C_6H_5O_7.2H_2O$	0.04902
Sodium Hydroxide, NaOH	0.02001
Sodium Salicylate, $NaC_7H_5O_3$	0.08004
Sodium Tartrate, neutral, $Na_2C_4H_4O_6.2H_2O$	0.05752
Strontium Salicylate, anhydrous, $Sr(C_7H_5O_3)_2$	0.09045
Strontium Salicylate, crystallized, $Sr(C_7H_5O_3)_2.2H_2O$	0.09945

Sulphuric Acid, Tenth-Normal

$H_2SO_4 = 98.076$ 4.9038 Gm. in 1000 cc.

One cubic centimeter of Tenth-Normal Sulphuric Acid is the equivalent of:

	Gram
Sulphuric Acid, H_2SO_4	0.004904
Atropine, $C_{17}H_{23}O_3N$	0.02893
Belladonna, combined alkaloids	0.02893
Brucine, $C_{23}H_{26}O_4N_2$	0.03943
Calcium Hydroxide, $Ca(OH)_2$	0.003705

	Gram
Cephaëline, $C_{14}H_{19}O_2N$	0.02332
Cinchona, combined alkaloids	0.0309
Cinchonidine, $C_{19}H_{22}ON_2$	0.02943
Cinchonine, $C_{19}H_{22}ON_2$	0.02943
Cocaine, $C_{17}H_{21}O_4N$	0.03033
Codeine, $C_{18}H_{21}O_3N$	0.02993
Coniine, $C_8H_{17}N$	0.01272
Emetine, $C_{15}H_{21}O_2N$	0.02483
Hydrastine, $C_{21}H_{21}O_6N$	0.03833
Hyoscyamus, combined alkaloids	0.02893
Ipecac, ether-soluble alkaloids	0.0240
Morphine, anhydrous, $C_{17}H_{19}O_3N$	0.02853
Morphine, crystallized, $C_{17}H_{19}O_3N.H_2O$	0.03033
Nux Vomica, combined alkaloids	0.0364
Physostigmine, $C_{15}H_{21}O_2N_3$	0.02753
Pilocarpine, $C_{11}H_{16}O_2N_2$	0.02082
Potassium Hydroxide, KOH	0.005611
Quinidine, anhydrous, $C_{20}H_{24}O_2N_2$	0.03243
Quinine, anhydrous, $C_{20}H_{24}O_2N_2$	0.03243
Sodium Carbonate, anhydrous, Na_2CO_3	0.005301
Stramonium, combined alkaloids	0.02893
Strychnine, $C_{21}H_{22}O_2N_2$	0.03343
Zinc Oxide, ZnO	0.004069

Sulphuric Acid, Fiftieth-Normal

$H_2SO_4 = 98.076$ 0.98076 Gm. in 1000 cc.

One cubic centimeter of Fiftieth-Normal Sulphuric Acid is the equivalent of:

	Gram
Sulphuric Acid, H_2SO_4	0.0009808
Atropine, $C_{17}H_{23}O_3N$	0.005786
Cinchonidine, $C_{19}H_{22}ON_2$	0.005886
Cinchonine, $C_{19}H_{22}ON_2$	0.005886
Cocaine, $C_{17}H_{21}O_4N$	0.006065
Coniine, $C_8H_{17}N$	0.002544
Hydrastine, $C_{21}H_{21}O_6N$	0.007666
Ipecac, combined alkaloids	0.00480
Morphine, anhydrous, $C_{17}H_{19}O_3N$	0.005705
Morphine, crystallized, $C_{17}H_{19}O_3N.H_2O$	0.006065
Physostigmine, $C_{15}H_{21}O_2N_3$	0.005505
Pilocarpine, $C_{11}H_{16}O_2N_2$	0.004164
Quinine, anhydrous, $C_{20}H_{24}O_2N_2$	0.006486
Strychnine, $C_{21}H_{22}O_2N_2$	0.006686

CHAPTER XCIII

DIAGNOSTICAL REAGENTS AND CLINICAL TESTS

IN THE following pages of Diagnostical Reagents and Clinical Tests it is understood that the standard for official substances like Iodine, Potassium Iodide, Gelatin, Sodium Chloride, etc., are those to be found in the text of the Pharmacopœia or among the reagents. If the solutions are not clear, filter them.

Reagents for Examination of Urine

For Acetone Reaction

Sodium Nitroprusside (used for Legal's test and Lange's test).
Iodine Potassium Iodide Solution (for Lieben's solution):

Potassium Iodide	6 Gm.
Iodine	4 Gm.
Distilled Water, a sufficient quantity, To make	100 cc.

Dissolve the potassium iodide in the distilled water, add the iodine and shake the mixture frequently until a solution is obtained.

Alcoholic Solution of Iodine (10 per cent), for Gunning's reaction. To be freshly prepared.

For Albumin Reaction

Saturated Aqueous Solution of Trinitrophenol.

Esbach's Reagent:

Trinitrophenol	1 Gm.
Citric Acid	2 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	100 cc.

Spiegler-Jolles' Reagent:

Corrosive Mercuric Chloride	2 Gm.
Succinic Acid	4 Gm.
Sodium Chloride	4 Gm.
Distilled Water, a sufficient quantity, To make	100 cc.

Mix the several ingredients and dissolve them in the distilled water.

Tsuchyias' Reagent:

Phosphotungstic Acid	1.5 Gm.
Hydrochloric Acid	5 cc.
Alcohol, a sufficient quantity, To make	100 cc.

Dissolve the phosphotungstic acid in 90 cc. of alcohol with stirring. Add the hydrochloric acid and sufficient alcohol to make 100 cc. If not clear, allow to settle and decant the clear liquid.

For Bile Reactions

UROBILIN

Solution of Zinc Chloride

Zinc Chloride	10 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	100 cc.

Mixture of Zinc Acetate:

Zinc Acetate	10 Gm.
Dehydrated Alcohol, a sufficient quantity, To make	100 cc.

Finely powder the zinc acetate and intimately mix it with the alcohol. Dispense the mixture with directions "to be well shaken before using".

UROBILINOGEN

Ehrlich's Solution:

Paradimethylamidobenzaldehyde	2 Gm.
Hydrochloric Acid	50 cc.
Distilled Water, a sufficient quantity, To make a solution measuring	100 cc.

BILIARY COLOR REACTIONS

Nitric Acid (containing a trace of nitrous acid).

Solution of Calcium Chloride (Hupert's reaction):

Calcium Chloride	10 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	100 cc.

Smith's Reagent:

Tincture of Iodine	10 cc.
Alcohol	90 cc.

For Blood Reaction

Solution of Guaiac:

Guaiac	2 Gm.
Dehydrated Alcohol, a sufficient quantity, To make a solution measuring	100 cc.

Oxygenated Oil of Turpentine.

Ether containing Hydrogen Dioxide.

Aloin, isobarbaloin, containing barbaloin.

For Diacetic Acid Reaction

Solution of Ferric Chloride used for Gerhardt's test.

For Diazo Reaction, Ehrlich

1. Sodium Nitrite	1 Gm.
Distilled Water, a sufficient quantity, To make	200 cc.
2. Sulphanilic Acid	5 Gm.
Hydrochloric Acid	50 cc.
Distilled Water, a sufficient quantity, To make	100 cc.

Dissolve the sulphanilic acid in about 700 cc. of distilled water to which the hydrochloric acid has been added and follow with enough distilled water to make the product measure 1000 cc.

For use, 1 cc. of the sodium nitrite solution should be mixed with 50 cc. of the sulphanilic acid solution.

For Indican Reactions

Solution of Chlorinated Lime:

A saturated solution of chlorinated lime diluted with an equal volume of distilled water and filtered.

Obermeyer's Solution:

Ferric Chloride	0.4 Gm.
Hydrochloric Acid, a sufficient quantity, To make a solution measuring	100 cc.

Solution of Lead Acetate:

Lead Acetate	25 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	100 cc.

For Pentose Reactions

Bial's Reagent:

Orcin	1 Gm.
Hydrochloric Acid	500 cc.
Solution of Ferric Chloride	25 drops

Dissolve the orcin in the hydrochloric acid and add the solution of ferric chloride.

For the Estimation of Urea

Solution of Sodium Hypobromite:

1. Bromine	125 Gm.
Sodium Bromide	125 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	1000 cc.
2. Sodium Hydroxide	225 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	1000 cc.

The reagent should be freshly prepared by mixing equal volumes of solutions 1 and 2 and diluting the resulting mixture with one and a half volumes of distilled water.

For Sugar Reactions

Solution of Sodium Hydroxide:

Sodium Hydroxide	10 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	100 cc.

Solution of Copper Sulphate:

Copper Sulphate	10 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	100 cc.

Benedict's Qualitative Reagent:

Copper Sulphate	17.3 Gm.
Sodium Citrate	173.0 Gm.
Sodium Carbonate (anhydrous)	100.0 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	1000.0 cc.

With the aid of heat, dissolve the sodium citrate and carbonate in about 600 cc. of water. Pour (through a folded filter paper if necessary) into a glass graduate and make up to 850 cc. Dissolve the copper sulphate in about 100 cc. of water and make up to 150 cc. Pour the carbonate-citrate solution into a large beaker or casserole and add the copper sulphate solution slowly, with constant stirring. The mixed solution is ready for use and does not deteriorate upon long standing.

Benedict's Quantitative Reagent:

Copper Sulphate Crystals showing no efflorescence	18.00 Gm.
Sodium Carbonate (anhydrous)	74.10 Gm.
Sodium Citrate	200.00 Gm.
Potassium Thiocyanate	125.00 Gm.
Solution Potassium Ferrocyanide, 5 per cent	5.00 cc.
Distilled Water, a sufficient quantity, To make a solution measuring	1000.00 cc.

Dissolve the carbonate, citrate and thiocyanate, with the aid of heat in sufficient water to make about 800 cc. and filter this solution if necessary. Dissolve the copper suphate in about 100 cc. of water and pour this solution slowly and with constant stirring into the first solution. Add the ferrocyanide solution, cool, and dilute with water to exactly 1000 cc.

Of the various ingredients, the copper salt only, need be weighed with exactness.

Twenty-five cc. of Benedict's Reagent will reduce 50 milligrammes of Glucose.

Haines' Solution:

Copper Sulphate	12.00 Gm.
Sodium Hydroxide	32.00 Gm.
Glycerin	90.00 cc.
Distilled Water, a sufficient quantity, To make a solution measuring	1000.00 cc.

Nylander's Reagent:

Sodium Hydroxide	10 Gm.
Potassium and Sodium Tartrate	4 Gm.
Bismuth Subnitrate	2 Gm.
Distilled Water, a sufficient quantity, To make	100 cc.

Dissolve the potassium and sodium tartrate in 90 cc. of distilled water. Add the bismuth subnitrate to the solution, shake the mixture thoroughly and then filter through glass wool. Preserve and dispense this solution in amber-colored bottles.

Fehling's Solution (use Alkaline Cupric Tartrate V.S.).

Pavy's Solution:

1. Copper Sulphate	4.158 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	500.000 cc.
2. Potassium and Sodium Tartrate	20.4 Gm.
Potassium Hydroxide	20.4 Gm.
Stronger Ammonia Water	300.0 cc.
Distilled Water, a sufficient quantity, To make a solution measuring	500.0 cc.

For use, mix equal quantities of the two solutions

Sodium Acetate: Neutral to litmus paper.

Reagents for the Examination of Gastric Contents

Alizarin Solution:

Alizarin yellow R (p-nitrobenzene-azo-salicylic-acid)	0.1 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	1000.0 cc.

Congo Red Test Paper:

Saturate filter paper with an aqueous solution of Congo Red (1 in 1000). Dry and cut the paper into strips and preserve them in well-stoppered glass vials.

Benzidin in Glacial Acetic Acid.

Benzidin Saturated Solution in Alcohol.

Saturated Alcoholic Solution of Methylthionine Chloride (Methylene Blue).

Alcoholic Solution, of Dimethylaminoazobenzene (1 in 200).

Günzburg's Reagent:

Phloroglucinol	2 Gm.
Vanillin	1 Gm.
Alcohol	30 cc.

Dissolve the ingredients in the alcohol.

Tenth-normal Hydrochloric Acid V.S.: Dilute 1 volume of normal hydrochloric acid V.S. with exactly 9 volumes of distilled water.

Phenolphthalein (1 per cent alcoholic).

Solution of Rosolic Acid:

Rosolic Acid	1 Gm.
Alcohol, a sufficient quantity, To make a solution measuring	100 cc.

Carminfibrin:

Heat freshly-drawn beef blood, wash the stringy coagulated fibrin in running water until decolorized, cut the fibrin into small pieces of uniform size and macerate it in alcohol for several days. Then transfer the fibrin for one or two days to a 0.5 per cent ammoniacal solution of carmine, which contains as little excess of ammonia as possible, and keep it cool until the fibrin is thoroughly stained. Wash the product in distilled water until the wash-water is no longer colored, squeeze it out well, and then preserve it in glycerin. Before using carefully wash the carminfibrin in distilled water to free it from glycerin.

Reagents for the Examination of Blood

Hayem's Solution:

For red blood corpuscles:

Sodium Sulphate	5 Gm.
Sodium Chloride	1 Gm.
Corrosive Mercuric Chloride	0.5 Gm.
Distilled Water	200.0 cc.

Dissolve the salts in the distilled water and filter.

Toison's Solution:

Methyl Violet 6B	0.125 Gm.
Sodium Chloride	1.000 Gm.
Sodium Sulphate	8.000 Gm.
Glycerin	30.000 cc.
Distilled Water	300.000 cc.

Dissolve the salts in the distilled water and add the methyl violet and the glycerin.

For white corpuscles:

Acetic Acid (U. S. P.)	1 cc.
Distilled Water	99 cc.

Mix them.

Solution for Hemoglobin Estimation (Sahli's hemometer):

Tenth-normal hydrochloric acid V.S. saturated with chloroform. This solution should always be freshly prepared and be dispensed in dark amber-colored bottles.

Jenner's Stain:

1. Eosin	0.5 Gm.
[1] Methyl Alcohol, a sufficient quantity, To make a solution measuring	100.0 cc.
2. Methylthionine Chloride (Methylene Blue)	0.5 Gm.
[1] Methyl Alcohol, a sufficient quantity, To make a solution measuring	100.0 cc.

For use mix 25 cc. of eosin solution with 20 cc. of methylene blue solution.

Ehrlich's Triacid Stain:

Saturated Aqueous Solution of Orange-G	120 to 125 cc.
Saturated Aqueous Solution of Acid Fuchsin	80 to 165 cc.
Saturated Aqueous Solution of Methylene Green	125 cc.
Distilled Water	300 cc.
Dehydrated Alcohol	200 cc.
Glycerin	100 cc.

Mix.

Wright's Stain:

Sodium Bicarbonate	0.50 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	100.00 cc.
Methylene Blue (Methylthionine Chloride)	0.75 Gm.
Eosin, A, Water-soluble (sodium tetra-bromfluorescein)	0.50 Gm.
Distilled Water, a sufficient quantity, To make a solution measuring	500.00 cc.
Methyl Alcohol (C. P. Neutral, Acetone-Free)	60.00 cc.

[1] Rectified wood alcohol, sp. gr. about 0.812 at 25° C.

Add the methylene blue to the sodium bicarbonate solution and heat one hour in flowing steam. The flask should be of such size and shape that the depth of the fluid does not exceed 2½ inches. When cool, add the eosin solution slowly, stirring constantly, until the blue color is lost and the mixture becomes purple with a yellow metallic luster on the surface and a finely granular black precipitate is formed. Collect the precipitate on a filter. When dry, dissolve 1 Gm. of the precipitate in the 60 cc. of methyl alcohol.

Giemsa's Stain:

Azur II-Eosin	0.3 Gm.
Azur II	0.8 Gm.
Glycerin	250.0 cc.
[1] Methyl Alcohol	250.0 cc.

Dissolve the dyes in the methyl alcohol and add the glycerin and filter.

Stains and Accessories for Use in Connection with the Study of Micro-organisms

Alum-hematoxylin Solution:

Hematoxylin crystals	1.0 Gm.
Saturated Aqueous Solution of Ammonium Alum	100.0 cc.
Distilled Water	300.0 cc.
Thymol	0.5 Gm.

Dissolve the hematoxylin in a little distilled water by the aid of heat, add the other ingredients, and expose the combined solution to the light, in a bottle loosely stoppered, until it has assumed a dark red color, then filter. The thymol is added as a preservative.

Mayer's Hemalum:

Hematein or its ammonium salt	1.0 Gm.
Alcohol, 90 per cent	50.0 cc.
Alum	50.0 Gm.
Distilled Water	1000.0 cc.
Thymol	0.5 Gm.

Dissolve the hematein in the alcohol by the aid of heat, add the thymol, and then this solution to the alum dissolved in the distilled water, and then filter. The thymol is added as a preservative.

Alcoholic Solution of Methyl Violet 6B:

Methyl Violet 6B	10 Gm.
Alcohol, a sufficient quantity, To make a solution measuring	100 cc.

Borax-Methylene Blue Solution:

Methylthionine Chloride (Methylene Blue)	2 Gm.
Boiling Solution of Sodium Borate (1 in 20), a sufficient quantity, To make a solution measuring	100 cc.

Löffler's Methylene Blue Solution:

Methylthionine Chloride (Methylene Blue)	0.5 Gm.
Alcohol	30.0 cc.
Tenth-normal Potassium Hydroxide V.S.	2.0 cc.
Distilled Water	98.0 cc.

Dissolve the methylene blue in the alcohol, add the potassium hydroxide and distilled water.

Solution of Carbol Methyl Violet:

Alcoholic Solution of Methyl Violet 6B	10 cc.
Aqueous Solution of Phenol (1 in 20), a sufficient quantity, To make a solution measuring	100 cc.

Solution of Carbolfuchsin:

Alcoholic Solution of Fuchsin (1 in 10)	10 cc.
Aqueous Solution of Phenol (1 in 20)	100 cc.

Mix.

[1] Rectified wood alcohol, sp. gr. about 0.812 at 25° C.

For Tubercle Bacilli

Gabbett's Acid Blue (For Gabbett's Stain for Tubercle Bacilli)

Methylene Blue (Methylthionine Chloride)	2.0 Gm.
Sulphuric Acid	25.0 cc.
Distilled Water, a sufficient quantity, To make	100.0 cc.

Orth's Acid Alcohol:

Hydrochloric Acid	3.00 cc.
Alcohol	70.00 cc.
Distilled Water, a sufficient quantity, To make	100.00 cc.

Solution of Carbolfuchsin. (See above.)

For Decolorizing

Ebner's Fluid:

Hydrochloric Acid	2.5 cc.
Sodium Chloride	2.5 Gm.
Distilled Water	100.0 cc.
Alcohol	500.0 cc.

Prepare a solution.

Nitric Acid Solution:

Nitric Acid	30 cc.
Distilled Water, a sufficient quantity, To make	100 cc.

Diluted Lugol's Solution (Gram's Iodine Solution):

Iodine	1 Gm.
Potassium Iodide	2 Gm.
Distilled Water, a sufficient quantity, To make	200 cc.

For Counter Staining

Löffler's Methylene Blue Solution.

Gram's Stain (Aniline Water—Methyl Violet 6B Solution):

Aniline oil[1]	15 cc.
Saturated Alcoholic Solution of Methyl Violet 6B	7 cc.
Dehydrated Alcohol	10 cc.
Distilled Water, a sufficient quantity, To make	100 cc.

Shake the aniline with 65 cc. of distilled water for several minutes; filter the resulting opalescent aniline water through a moistened filter, pour the filtrate into a solution prepared by mixing the other liquids and add sufficient distilled water to make 100 cc.

Diluted Carbolfuchsin Solution:

Solution of Carbolfuchsin (see above)	1 cc.
Distilled Water	4 cc.

Prepare a solution.

Culture Media

Bouillon Stock:

Lean Beef	500 Gm.
Or Extract of Beef	3 Gm.
Distilled Water, a sufficient quantity, To make	1000 cc.

Mix thoroughly 500 Gm. of finely minced lean beef with 1000 cc. of cold distilled water, heat it to boiling in a closely covered dish or flask and keep it at that temperature for one

[1] The commercial aniline oil is preferable to pure aniline.

hour. If extract of beef is used to make bouillon stock, boil the solution for one-half hour. Filter the resulting bouillon through a well-wetted filter, until clear and use it as the basis for the following combinations:

Plain Bouillon:

Peptone	10 Gm.
Sodium Chloride	5 Gm.
Normal Sodium Hydroxide V.S.,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the peptone and sodium chloride in the bouillon stock by means of heat and add sufficient normal sodium hydroxide V.S. to make the mixture neutral to litmus. Then filter the product through a well-wetted filter, fill it into suitable containers and sterilize.

Glucose Bouillon:

Glucose (dry)	10 Gm.
Peptone	10 Gm.
Sodium Chloride	5 Gm.
Normal Sodium Hydroxide V.S.,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the glucose, peptone and sodium chloride in the bouillon stock by means of heat and add sufficient normal sodium hydroxide V.S. to neutralize the resulting solution. Then filter the product through a well-wetted filter, fill it into suitable containers and sterilize by the discontinuous method.

Plain Gelatin:

Gelatin	100 Gm.
Peptone	10 Gm.
Sodium Chloride	5 Gm.
Normal Sodium Hydroxide V.S.,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the gelatin, peptone, and sodium chloride in the bouillon stock by means of heat and add sufficient normal sodium hydroxide V.S. to neutralize the resulting mixture. Filter the warmed product through filter paper, fill it into suitable containers and sterilize by the discontinuous method.

Glucose Gelatin:

Glucose (dry)	10 Gm.
Gelatin	100 Gm.
Peptone	10 Gm.
Sodium Chloride	5 Gm.
Normal Sodium Hydroxide V.S.,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the glucose, gelatin, peptone, and sodium chloride in the bouillon stock by means of heat and add sufficient normal sodium hydroxide V.S. to neutralize the resulting mixture. Then filter the product through paper, fill it into suitable containers and sterilize by the discontinuous method.

Plain Agar-agar:

Agar	15 Gm.
Peptone	10 Gm.
Sodium Chloride	5 Gm.
Normal Sodium Hydroxide V.S.,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the agar, peptone, and sodium chloride in the bouillon stock by means of heat and add a sufficient quantity of normal sodium hydroxide V.S. to neutralize the resulting mixture. Then filter the warmed product through paper, fill it into suitable containers and sterilize.

Glucose Agar-agar:

Glucose (dry)	10 Gm.
Agar	15 Gm.
Peptone	10 Gm.
Sodium Chloride	5 Gm.
Normal Sodium Hydroxide V.S.,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the glucose, peptone, and sodium chloride in the bouillon stock by means of heat and add a sufficient quantity of normal sodium hydroxide V.S. to neutralize the resulting mixture. Then filter the warmed product through paper, fill it into suitable containers and sterilize by the discontinuous method.

Glycerin Agar-agar:

Glycerin	60 cc.
Agar	15 Gm.
Peptone	10 Gm.
Sodium Chloride	5 Gm.
Normal Sodium Hydroxide V.S.,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the glycerin, agar, peptone and sodium chloride in the bouillon stock by means of heat and add a sufficient quantity of normal sodium hydroxide V.S. to neutralize the resulting mixture. Then filter the warmed product through paper, fill it into suitable containers and sterilize.

Lactose-litmus Agar-agar:

Sugar of Milk	10 Gm.
Agar	15 Gm.
Peptone	10 Gm.
Sodium Chloride	15 Gm.
Normal Sodium Hydroxide V.S.,	
Azolitmin Test Solution,	
Bouillon Stock, each, a sufficient quantity,	
To make	1000 cc.

Dissolve the sugar of milk, agar, peptone and sodium chloride in the bouillon stock by means of heat and add a sufficient quantity of normal sodium hydroxide V.S. to neutralize the resulting mixture. Then filter the warmed product through paper, add a sufficient quantity of azolitmin solution to impart to the resulting mixture a pale blue color, fill into suitable containers and sterilize by the discontinuous method.

Blood Serum (Löffler's Mixture):

Glucose Bouillon	250 cc.
Horse or Beef Blood Serum	750 cc.

Run the mixture of glucose bouillon and beef or horse blood serum into properly sterilized test tubes, and coagulate it by means of heat so as to form a slanting surface for culture purposes.

PART X

THE MANUFACTURING PHARMACIST

CHAPTER XCIV

CHEMICAL AND MECHANICAL CONTROL IN MANUFACTURING PHARMACY

WHEN a pharmaceutical preparation is manufactured in a retail store or pharmacy, the quantity prepared is usually a relatively small one, and the entire operation is performed by the pharmacist himself, or under his immediate supervision. In a manufacturing plant, where pharmaceutical preparations are made in large quantities, the immediate personal supervision of any one responsible pharmacist or pharmaceutical chemist is obviously impossible. The various steps in the preparation of pills or tablets or an elixir may be performed in different departments of the factory by different groups of men or women working under the direction and supervision of different foremen or sub-foremen. In a factory where pharmaceutical preparations are manufactured on a relatively large scale, it becomes necessary therefore to install a comprehensive supervisory or control system, whereby the identity, purity, and strength of the manufactured preparation sent out into commerce shall be just as surely established as is that of the preparation or prescription made on a small scale by a single responsible operator.

In every establishment where pharmaceutical preparations are manufactured, provision must be made for pharmaceutical testing (see Part IX). The place where this work is done is usually called the *laboratory* or *analytical laboratory*. But in order to carry out the comprehensive system of control mentioned above, the mere possession of an analytical laboratory in which occasional tests and assays are made is far from adequate. A well organized *control department*, of which the analytical laboratory is only a part, but an important part, must be provided.

To insure the proper functioning of such a control department, it is absolutely essential that each department in the plant should harmonize its work with that of every other department and that all work together for the good of the whole. This harmonious relationship so essential to the success of a manufacturing pharmaceutical plant depends largely upon the personnel, or the men and women in charge of the various divisions, subdivisions, and departments which make up the organization, and just to the extent that they are scientifically trained experts in their respective lines of work—pharmacists, chemists, botanists, bacteriologists, physicians, experts in finance, accounting, salesmanship, etc., constituting a *scientific staff*—just to that extent will the work of the control department function smoothly and effectually.

The function of the control department is to assume responsibility for the *identity*, *purity*, and *strength* of everything used in the manufacture of the products of the factory, and to exercise such a watchfulness over all outgoing finished products as to be able to guarantee their *quality*, *strength*, and *conformity to label*.

The equipment of the control department includes the following well defined divisions or departments:

Analytical Laboratory—Because of the widely varying nature and great distribution of materials used in medicine, the variety of testing work required in a pharmaceutical manufacturing plant is greater than in the case of any other line of manufacture requiring chemical control. The analytical laboratory must therefore be equipped for literally all kinds of analytical operations, and must be of a size commensurate with the size of the plant. It should be located in a place quickly accessible to the manufacturing operations of the plant, and yet be sufficiently removed to provide quiet and freedom from the annoyance of factory din and distraction, gases, odors, and vibration. It must be well lighted, both artificially and by sunlight, and be relatively free from dust, an important point if located in a large city.

Physiologic Testing Laboratory—The increasing importance of physiologic assaying and standardization, as evidenced by the several added requirements of the United States Pharmacopœia X, makes a well equipped physiologic testing laboratory an essential part of the control department. Owing to the fact, however, that there are not enough trained experts in this field of work to enable every manufacturing house to do its own physiologic testing, together with the fact that it would not be economically possible to do so, for many years to come much of the required work of this nature will be sent out to experts who have established commercial laboratories for this purpose.

Working Library and Reference Room—To operate a control department successfully, quick reference to all leading authorities is necessary. Since no firm can hope to provide in its own library every publication needed for reference purposes, it follows that plants located near large public and technical libraries of cities and colleges are particularly fortunate. But these cannot take the place entirely of a *control department library*, as complete as the generosity of the firm will permit. Such a working library will contain not merely a complete assortment of the latest reference and textbooks on pharmacy, chemistry, and allied branches, but will also be provided with files of all the current technical journals. Systematic provision should be made for the reading of these journals, as, for example, by the assignment of certain journals to individuals in the department and by the holding of meetings at stated intervals to discuss the articles published in them. Provision should also be made for the card-indexing of all important articles, and for their permanent preservation, either by clipping and filing, or by binding, at the end of each year.

Research Laboratory—When a control department has been established, problems concerning the improvement of manufacturing processes, the recovery and utilization of by-products, the production of new products, etc., will constantly arise. These problems can best be worked out in a properly equipped laboratory adjacent to, but separate from, the analytical laboratory. The research laboratory should be equipped, aside from any specially designed apparatus for the study of special problems, with a complete outfit of apparatus on a small manufacturing scale, so that conditions in the plant may be simulated when necessary.

Control Department Office—Ample provision must be made for the liaison work of the control department. The control department is the clearing house for disputes and provides contacts between the work of all other departments and a meeting place for the harmonizing of all interests. Moreover, a complete system of records must be kept, covering all of the work done in the analytical, physiological, and research laboratories, and these records must always be available at all times. Hence a carefully organized office force must be maintained for the systematic making and filing of all records. In large establish-

ments, this force will consist of a librarian, filing clerks, and stenographers, but in smaller organizations some or all of these positions may be combined.

Organization of Control Department—A fully functioning control department cannot be established in a day or a month or a year. It must grow with the needs of the developing activities of the plant. Usually the control department is managed by the *chief chemist* or *chemical director* of the plant, who maintains direct supervision of the control department office. Chiefs are provided for the analytical, physiological, and research laboratories, and sufficient assistants to carry on the work. One of the first and most important tasks devolving upon the control department, is to establish and adopt *standard methods* for all routine work, so that all workers in the department will obtain their results by uniform methods. Naturally, the methods of the United States Pharmacopœia afford the starting point for this work, but the testing and examination of all products not official in the United States Pharmacopœia or the National Formulary must also be provided for by selected methods which should be changed or modified only after thorough discussion, and approval by the chief of the control department.

Relationship of Control Department to the Plant—In order that the control department may exercise its function as outlined on page 1577 and thus discharge its responsibility, it naturally must establish and maintain certain relationships to other departments of the plant. These may well be divided into three groups, as follows:

Relationship to Purchasing Department—Every manufacturing plant has or should have a centralized purchasing department in charge of a specially trained purchasing agent. In purchasing all supplies, including the crude materials, drugs, and chemicals from which the products of the plant are to be manufactured, this department has three things to bear always in mind: 1. Quality. 2. Peculiar requirements of goods for special purposes. 3. Cost. Of these three, the purchasing department must depend upon the advice of the control department for the first and second, namely *quality* and *peculiar requirements*. Hence the necessity for close touch and complete harmony between these two departments. The control department must have the absolute confidence of the purchasing department, which in turn must be absolutely governed in its purchases by sanction of the control department. *Quality* must always take precedent over considerations of *cost*.

Supplies should as far as possible be purchased from submitted samples, which the purchasing department in turn submits to the control department for examination and advice. This advice must always be followed by the purchasing department, and, since the control department is responsible for the quality of all materials used in the plant, the purchasing department must not arbitrarily change a source of supply, because offered at an advantageous price, without the consent of the control department.

By "*peculiar requirements of goods for special purposes*", the reference is to the fact that each manufacturing plant has its own special preparations in the manufacture of which materials not intrinsically better perhaps than other materials on the market, but differing somewhat from the usual or the ordinary, must be purchased to fill these special wants. In the selection of such materials the purchasing department must be guided absolutely by the advice of the control department.

Relationship to Manufacturing Departments—Since the control department must assume responsibility for the *identity*, *purity*, and *strength* of all materials used in manufacturing, it is highly essential that the rule be adopted that *no purchased material may be used for manufacturing until it has been approved*

by the control laboratory. To this end, it is necessary that a sample be taken from each and every container, bag, bale, box, bottle, barrel, keg, drum, etc., received as crude material for manufacturing purposes, and be submitted to the control laboratory for approval.

In order to carry out this requirement, all manufacturing plants must have one or more centralized *stock departments*. Each lot of goods as it is received is given a *serial number* by which its identity may be insured. A sample from each lot—from each container—is then submitted, properly numbered, dated, and labeled with name, source, and any other information, to the control laboratory. A written report approving or passing these goods, or stating the conditions or proportions in which they may be used, must be received, and the goods so labeled, before they may be supplied for manufacturing purposes.

Naturally, the amount of work done in the control laboratory on these supplies is enormous, covers all phases of analytical operations, and varies greatly with the nature and importance of the substances examined. It may vary also as sources change, with the *probability* of a substance being adulterated or of inferior quality. Much work may be deemed necessary in the case of one substance, a volatile oil for example, and very little work in the case of another substance, crystals of ferrous sulphate for example, but the important fact remains, *viz.*, the control department is responsible for the identity, purity, and strength and there the responsibility rests as to how much or how little work shall be required before the stamp of approval of the control department may be placed upon the goods.

One of the most important duties of the stock department in its relationship to the control laboratory lies in the care which it must exercise in taking the sample for analysis. This is so important that *rules for sampling* must be formulated by the control department who must see that they are properly carried out. Unless the sample sent to the control laboratory for analysis is truly representative of the lot from which it is taken, its examination and approval or rejection is of little value.

Relationship to Sales Department—As the ultimate purpose of the control department is to guarantee the quality, strength, and conformity to label of all outgoing finished products, its relationship to the sales department and through it to the medical profession and the public, is a most important one.

First of all, standards of quality, strength, and excellence must be adopted for all goods manufactured. If they are official in the United States Pharmacopœia or National Formulary, or are described in the pharmacopœias of other countries or by recognized authorities, these descriptions, of course, form the starting point for the standards to be adopted.

Next, samples of all lots of goods manufactured, which are subject or liable to variation, must be sent to the control laboratory for assay and approval. The same *rules for sampling* provided for the stock department must be enforced in the taking of samples of manufactured goods. These samples, properly labeled and serially numbered for future identification, representing lots of completed or partially completed preparations, are then either *approved*, or written directions are given as to what corrections of strength or of quality are necessary to bring them up to standard. If corrections are required and made, new samples must be submitted for approval. Goods may be "finished", *i.e.*, placed in finished package form and labeled, only after the control laboratory approval has been obtained in report form.

In submitting samples of tinctures, fluidextracts, and other liquid preparations for assay, it is generally advisable to prepare the sample intentionally

slightly over-strength, as it is much easier to make the final adjustment to standard by dilution than by fortification.

Considerable diversity of opinion exists in different manufacturing plants as to the products which may be regarded as reasonably free from *liability to variation.* All are agreed, of course, that preparations involving the processes of percolation, evaporation, the application of heat, etc., are subject to variation and hence must be assayed. These groups include tinctures, fluidextracts, solid and powdered extracts, and certain kinds of elixirs, syrups, etc. Again, practically all are agreed that an assay should not be necessary where the manufacture of the preparation requires only simple solution or mixing, with possibly subsequent filtration, especially in view of the fact that all of the entering ingredients have already been approved by the control department.

When preparations are manufactured and sent out in dose form, such as pills, tablets, lozenges, suppositories, etc., there is room for argument as to the necessity for *chemical control* in addition to the *mechanical control* which is automatically applied by the process of manufacture itself.

Illustration of Control Methods—In order that a clearer view of just what is meant by *mechanical control* may be presented, the following brief outline of the steps involved in the manufacture of a compressed medicinal tablet is given. Suppose it is desired to manufacture 70,000 tablets of the following formula:

Acetanilid	$\frac{7}{10}$ gr.
Caffeine	$\frac{1}{10}$ gr.
Sodium Bicarbonate	$\frac{1}{6}$ gr.

A master formula card, kept in the production manager's or superintendent's office contains the formula with full working directions. Fig. 546 is a reproduction of such a master card.

A copy of this card, which may be photographed, or blue-printed, to guarantee accuracy, is sent to the stock department, together with a requisition for all of the supplies or ingredients necessary for the manufacture of this lot. Fig. 547 illustrates such a requisition for supplies.

If the stock department has on hand the necessary quantities of all ingredients which have been approved by the control department, the order is filled—each item being checked in by the stock man with the serial number of the ingredient used in order to check its identity with the control laboratory's records, and the quantities are checked by a competent assistant.

The goods, together with the copy of the master formula card and the requisition for supplies, are then delivered to the granulating department where they are receipted for and again checked. The granulation is then prepared, dried, and sifted, after which it is weighed and the weight entered on the card where it may be compared with the theoretical weight.

The granulation is then passed on to the compressing department where designated amounts of starch as a disintegrator and talc as a lubricant are added, and the mixture is placed in the hopper of the tablet compressing machine. A few tablets are run off, and twenty are taken and carefully weighed to see if the punches have been set properly to deliver the weight of tablet required by the master card. Several adjustments may be necessary to secure the proper weight of twenty tablets, and when this has been accomplished, the entire lot of 70,000 tablets is run off, twenty tablets being taken from time to time and weighed to determine whether the run has been uniform, *i.e.*, that no change has occurred in the set of the punches and that the granulation has continued to feed uniformly into the dies. Finally, the total yield of

FIG. 546

TABLET DEPARTMENT

Formula for C. T.* Acetanilid Comp. No. 1 (White)

PER TABLET	INGREDIENTS	QUANTITY LBS.	QUANTITY OZS.	QUANTITY GRS.	
7/10	gr. Acetanilid	7			1
1/10	gr. Caffeine	.1			2
1/5	gr. Sodium Bicarbonate	2			3
	Starch	4			4
					5
					6
					7
					8
					9
					10
					11
					12
					13
					14
	GRANULATE WITH 10% Acacia Solution				15
	UNMIXED DRY GRANULATION SHOULD WEIGH	14			16
	ADD Starch		8		17
	Talc		8		18
					19
	FINISHED WEIGHT SHOULD BE	15			20

1 1/2 GR.	C. T.	1/4" DIE	concave	TO MAKE 70000

WEIGHT OF COATED TABLET

SPECIAL INFORMATION

℞ WRITTEN BY A. B. C.

VERIFIED BY J. L. D.

DATE 11/27/25

*"C. T." is the commonly used abbreviation for "Compressed Tablet".

(Master formula card)

FIG. 547

REQUISITION on CRUDE STOCK DEPT.

FOR SUPPLIES AS SPECIFIED BELOW — MANUFACTURE

C.T. Acetanilid Comp. No. 1 (White)

BUREAU of FORMULAE

ISSUED BY: A.B.C.

Checked by: J.L.D.

LAB. LOT NUMBER: 9235

MANUFACTURING DEPT.: TABLET

RECEIVED BY	WEIGHED BY
H.S.	V.S.

DATE ISSUED	DATE FILLED
11/21/25	11/22/25

TO MAKE 70000

ITEMS	POUNDS OR PINTS	AV. OZS. OR FL. OZS.	MINS. OR GRS.	CHECK
Acetanilid	7			348
Caffeine	1			369
Sodium Bicarbonate	2			249
Starch	4			350
Starch		8		350
Talc		8		342

GRAN. SHOULD WEIGH...14 lb.

GRAN. WEIGHS..13 lb. 15 oz.

20 SHOULD WEIGH...30 gr.....

20 WEIGH.....30 gr.....

FINISHED WEIGHT 14 lb. 15 oz.

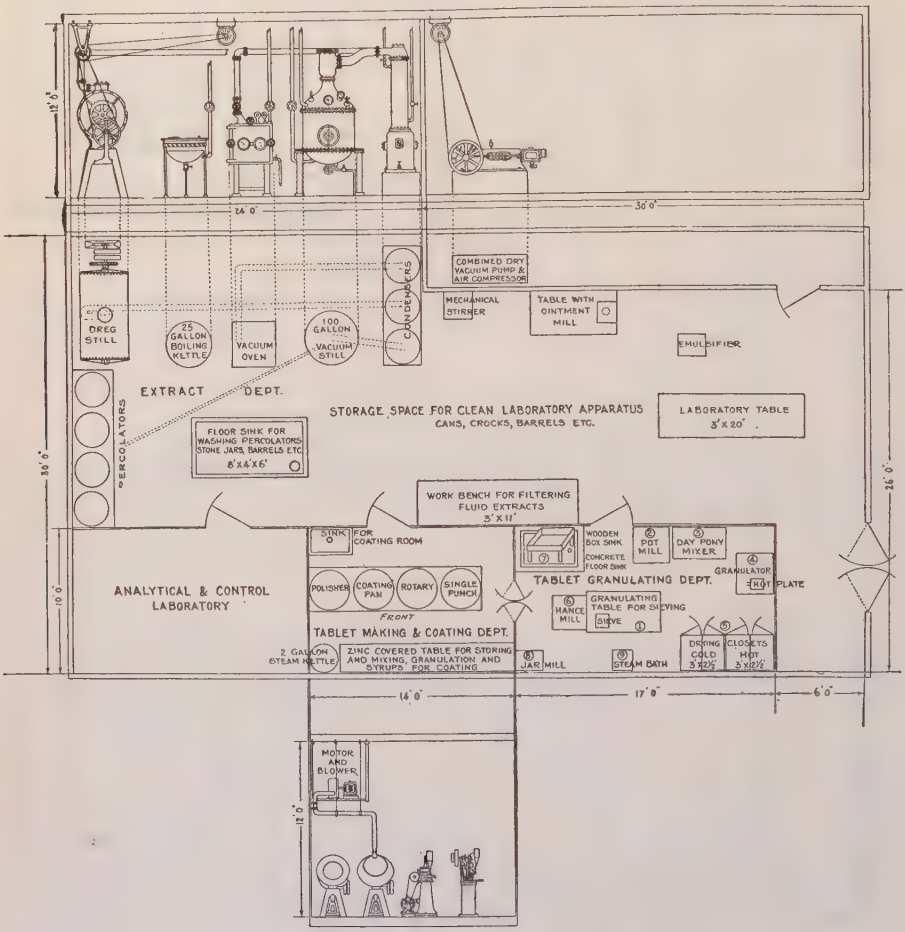
11/25/25 H.H.S.

Requisition for supplies from stockroom

tablets obtained is weighed, and the weight obtained checked against the theoretical yield, a small allowance being permitted for mechanical losses during the process.

When all of these weights check out closely with the theoretical, it must be admitted that the opportunity for variation or error is less than the error which may reasonably be expected in the making of a chemical assay. How-

FIG. 548



The layout of a small pharmaceutical laboratory

ever, it is now considered good practice, particularly in the case of hypodermic tablets, and all tablets of potent remedies, to have the final approval of the lot await the assay by the control laboratory.

The responsibility of the control laboratory to the sales department does not finally end until it has made sure that the outgoing products are "*true to label*". To this end it is often necessary for the control department to see to it that conversely the *labels* and accompanying *circulars* are "true to the product". In other words, an essential duty of the control department is to

take a responsible part in the preparation of all of the labels for manufactured goods. A thorough knowledge of the requirements of the Federal Food and Drugs Act, the several Food and Drugs Acts of the states in which the manufactured products are to be sold, the Federal Insecticide and Fungicide Act, and the Federal Narcotic Law is necessary for this purpose.

Manufacturing Operations on a Large Scale—Most of the large manufacturing pharmaceutical laboratories in this and other countries have developed from small retail pharmacies and the same principles of integrity, accuracy, and care, which are of first consideration at the prescription counter and in the service rendered the physician and community by the retail pharmacist, must dominate the policy of the manufacturing pharmacist, if confidence and success are to be attained.

It is true that the preparation of pharmaceuticals on a large scale introduces many problems not encountered by the small manufacturer and retailer such as those of control, just enumerated. It is also necessary to operate a manufacturing plant with efficiency and economy and these problems are of such importance that efficiency experts have been developed who materially aid in planning and constructing modern laboratories and also in developing better processes of manufacture.

Most of the subjects discussed in this book have direct application to the operations carried out in a manufacturing laboratory. Often, however, they must be modified to meet new conditions, although the principles still apply.

In some parts of this book the operations described are exclusively those carried out on a large scale, such as those requiring a vacuum dryer or a dreg still, or the process of pill or tablet coating, etc. Needless to say the manufacturing pharmacist requires special training and large experience before becoming efficient; but adequate technical training in a college, in the principles of pharmacy, and practical experience in a professional pharmacy has been the foundation for the success of most of the able manufacturing pharmacists of today.

Laboratory Planning—Fig. 548 illustrates an efficient layout or arrangement for a small pharmaceutical laboratory, suitable for commercial or teaching purposes, as planned by Charles S. Herron. It is self-evident that every laboratory must be arranged to meet the specific conditions presented and these will be as varied as the number of laboratories established.

Sales Price Calculation—The necessary factors for correctly determining the price for which a manufactured product may be profitably sold are illustrated by the following typical calculation. Again it must be recognized that conditions will vary with every item and each plant and this example is only offered as an indication of the many factors which must be taken into consideration in determining the right price.

Factors in Calculating a Sales Price—Illustration: A capsule formula.

List of ingredients .....

Take the actual cost (averaged for period) and enter each item separately.

Cost of materials for 7000 capsules, $16.21	
Cost for 1000	$2.32
5 per cent for waste	0.12
Cost of mixing in laboratory	0.08
Cost of 1000 capsules	0.85
Labor in filling capsules (piece work)	0.60
Cost per 1000 (materials and bulk manufacture cost, including direct and indirect labor	$3.97

100

Sales packages are in 500, cost therefore ½ of $3.97 or	$1.99
Finishing cost per bottle (cork, label, labor, and factory overhead	0.14
Actual factory cost of finished package of 500	$2.13

If the business is now based on the following plan:

Net profit	15 per cent	
Salesman's commission	25 per cent	
General overhead and selling expense	20 per cent	
Total	60 per cent	
First cost	40 per cent	= $2.13
Sale price	100 per cent	or $5.33

If there is a 40 per cent discount to be allowed the trade the following calculation must be followed:

Net price to be obtained by manufacturer		$5.33	
Discount to trade, 40 per cent			
Therefore	60 per cent =	5.33	
Discount	40 per cent =	3.55	
List price	100 per cent	$8.88	or $9.00

PART XI

THE PROFESSIONAL AND PRESCRIPTION PHARMACIST

CHAPTER XCV

MAGISTRAL PHARMACY[1]

UNDER this head will be considered the preparation and dispensing of medicines intended to be compounded extemporaneously or as the occasion or the physician's needs may require. It includes a consideration of other subjects, as facts concerning surgical supplies, sterilization, and other distinctly professional services. The subject of official or galenical pharmacy has been considered in previous chapters, the distinction being made that such preparations are intended to be permanent, and are generally made in advance and kept on hand ready for use, while those which are magistral are usually only intended to last during the occasion which calls them into existence.

There are several classes of official medicines in which both permanent and extemporaneous preparations are embraced. These have been divided so that the official formulas are given in Part III but their discussion, from the viewpoint of dispensing pharmacy, will be found under this heading. Examples are found in plasters, powders, ointments, etc. Some of these are often kept on hand ready for use, but the experienced and conscientious prescription pharmacist will recognize deterioration and dispense only such medicinal substances as are of proper quality and freshness and of full therapeutic activity, discarding those which have deteriorated. To carry out such a policy there must be adequate technical training and sufficient equipment for testing and for such manufacturing and dispensing as may be required.

Magistral Pharmacy is unquestionably the most important division of true pharmaceutical practice. It calls for the exercise of more tact, knowledge, and ability than any other activity in the pharmacy. Owing to the fact that the ability to successfully practice extemporaneous pharmacy depends largely upon the personal qualities of the pharmacist, very little can be written upon the subject which would be generally useful. Good training in a college and help from the watchful eye of a skilled pharmacist, and practical experience, will alone give the confidence and knowledge of details that assure success. All that will be attempted under this head will be to collect and arrange such points as have been found useful in the actual practice of present-day pharmacy in the hope that at least some of them may be of service to others. The arrangement of a pharmacy, chiefly from the merchandising viewpoint, has already been presented (see page 1317, etc.), but the arrangement and equipment of the prescription counter and the facilities for other professional services will be specially studied in this section.

[1] The word magistral is derived from *magister*, a master, and is defined as "a term applied to medicines prescribed for the occasion, by a competent person, in distinction from such as are official, or kept prepared in the shops. As the latter are prepared according to a certain formula, an intelligent assistant is generally equal to the task; but the knowledge of a master is needed to give directions for an original preparation". —*Thomas.*

The Form of the Prescription

The word prescription is derived from the Latin word *præscriptio* (*præ*, "before", and *scribo*, "I write"). It may be defined as the formula which a physician writes, specifying the substances he intends to have administered to a patient.

The Latin language is preferred here in writing prescriptions as it is also in Great Britain, Germany, and other European countries. The advantages of the use of Latin in designating the ingredients of the prescription are obvious: 1. It is the language of science, and is understood, to a greater or less extent, throughout the civilized world. 2. It is a dead language, and therefore not subject to the changes that are common to all living forms of speech. 3. The Latin names for medicines are distinctive, and very nearly the same in all countries. 4. It is frequently necessary, and always advisable, to withhold from a patient the names and properties of the medicinal agents administered. This can usually be effected by the use of the Latin technical terms.

The Parts of a Prescription—For the purpose of examination or study, a model prescription may be divided into six parts: 1. *The superscription, or heading.* 2. *The name of the patient.* 3. *The inscription, or the names and quantities of the ingredients.* 4. *The subscription, or the directions to the compounder.* 5. *The signa* (*mark*), *or the directions for the patient.* 6. *The name or initial of the physician, with the date.*

1. **The Superscription, or Heading**—This invariably consists, in Latin prescriptions, of the symbol ℞, which is an abbreviation of the word *recipe* ("take"), the imperative of the Latin verb *recipio*. In French prescriptions the letter *P*, the initial letter of the word *prenez* ("take"), is used.

The use of the inclined stroke upon the tail of the ℞ is traced to a custom, common in the ancient days of superstition, of placing at the top of the prescription an abbreviation, called an invocation, which represented a prayer to a favorite deity. The sign of Jupiter (♃), the chief mythological divinity of the ancient Romans, was usually employed. This was gradually replaced by the letter R; but the last stroke of the symbol of the all-powerful Jove has not yet been surrendered, and it remains as an ornament to the superscription to the present day.

2. **The Name of the Patient**—This is frequently omitted from the prescription through inattention. It should always be placed at the top of the prescription by the prescriber, and should be transferred to the label by the compounder. Serious accidents have sometimes occurred through neglect of this direction, as when an adult dose of a medicine has been given to a child, owing to the similarity of the appearance of an adult's medicine and that of a child, and the name of the patient not appearing on either label.

3. **The Inscription, or the Names and Quantities of the Ingredients**—This part of the prescription is undoubtedly the most important of all, and requires the greatest amount of care. The official titles (see page 17) of the ingredients should always be used for designating those which are official. A model prescription, if it is of the compound class, is presumed to embrace the following: 1. The *basis*, or chief active ingredient. 2. The *adjuvant*, or aid to the basis, to assist its action. 3. The *corrective*, which is intended to qualify the action of the basis and adjuvant. 4. The *vehicle*, the ingredient which serves to "carry all", or hold them together, dilute them, and give to the whole the proper consistence, form and color. This is sometimes called the *diluent*.

The ingredients are occasionally written down by the physician in the order given above; but this rule is frequently deviated from, and they follow in the

order of their importance. This is a matter of small moment to the pharmacist, however, for he always has to consider solubility, compatibility, and other necessary considerations which determine the order, if the prescription is to be compounded properly.

Many prescriptions contain but one or two ingredients, there being no especial need of a corrective, vehicle, or diluent, the tendency of modern therapeutics being against polypharmacy and in the direction of simple and concentrated remedies, or those having positive effects. There are many advantages to be derived, however, from the combination of ingredients, even when these have similar medicinal action.

The name of each ingredient and the quantity attached to it, should occupy but one line, and great care should be observed in abbreviating, to see that the abbreviation is distinctive and not liable to be mistaken for an article not intended by the writer. The cabalistic characters in present use, designating the quantities in a Latin prescription, must be very plainly written, if serious errors are to be avoided.

The method of ascertaining the quantities of each of the constituents generally followed by physicians, is first to write down the names of the ingredients in the proper order, each on a separate line, without affixing the quantities; then having decided upon the total number of doses that are to be given, or the total number of pills, lozenges, capsules, suppositories, etc., by multiplying this by the amount proper to give for the single dose the quantity of the ingredient is obtained.

Method of Allotting Quantities

Parts in Order	℞ Ingredients	No. of Doses	Multiplied by	Single Dose	Quantity of each Ingredient
Basis	Chloralis	16	×	7½ gr.	℥ ii
Adjuvant	Potassii Bromidi	16	×	15 gr.	℥ iv
Corrective	Syrupi Zingiberis	16	×	f℥ ss	f℥ i
Vehicle	Syrupi	16	×	f℥ iss	f℥ iii

Symbolic Characters used in Latin Prescriptions—Although the subject of weights and measures is treated in the earlier chapters of this work, the special characters used in prescriptions, with their values attached, may be appropriately recalled in this connection. They are as follows:

M, *Minim*, $\frac{1}{60}$ of a fluidrachm
gtt., *Gutta*, a drop; plural, *guttæ*, drops
gr., *Granum*, a grain; plural, *grana*, grains
ss, *Semis*, a half
℈, *Scrupulus*, a scruple (20 grains)[1]
℥, *Drachma*, a drachm (60 grains)
f℥, *Fluidrachma*, a fluidrachm (60 minims)
℔, *Uncia*, a troyounce (480 grains)
f℥, *Fluiduncia*, a fluidounce (8 fluidrachms)
lb, *Libra*, a pound, rarely used in prescriptions (5760 grains)
O, *Octarius*, a pint (16 fluidounces)

The Roman numerals are used to designate quantities—i, ii, iii, iv, v, vi, vii, viii, ix, x, xx, xxx, xl, l, lx, lxx, lxxx, xc, c, etc. These are always written after the ingredient, as Sacchari ℥iv. Care should be taken to dot the i's in each case, to avoid possible errors. The "j" is sometimes used in place of "i" where more than one "i" is needed at the end of the quantity; thus,

[1]This weight is rapidly passing out of use. It is quite as convenient to write gr. xx, and this is not likely to be mistaken for ℥, as ℈ is.

"gr. ij", meaning two grains. The "j" is oftener written like an elongated "i"; thus, "ij".

4. **The Subscription, or the Directions to the Compounder**—The progress made in pharmacy is well shown by the present custom of omitting specific directions to the compounder. In the vast majority of prescriptions the subscription is contracted to a single letter or word, as *M.*, or *misce; S.*, or *solve; F., fiat,* etc. The physician relies upon the skill of the pharmacist, and generally gives no specific directions.

5. **The Signa, or Directions for the Patient,** sometimes called Signatura, is usually abbreviated *Sig.* or *S.* Formerly these directions were written in Latin, but this is rarely the case now, except in Great Britain. There is, indeed, no good reason for writing them in Latin. The Latin which is in common use in prescription writing is idiomatic, and, although the ordinary rules of Latin grammar are generally applicable to it, many of the terms have a special meaning, and it differs in several respects from classical Latin, and hence has to be a special object of study. The directions should be known to the patient and should be written in the vernacular on the label in a clear, distinct hand. *The careless habit of not specifying the directions, by writing, "As dir." for "As directed" or "Use as directed", is greatly to be deprecated.* Frequently the patient forgets the verbal directions, or misunderstands them, and asks the pharmacist, "How is this medicine to be taken?" The answer must of necessity be as worthless as the direction, unless the pharmacist by skilful questioning can cause the directions to be recalled by the patient. Then, again, the dose of the prescription gives the only clue to its safety. Without knowing it, the pharmacist cannot be held responsible for not detecting an error. The patient even if he remembers at the time the verbal directions may soon forget them, and afterwards take a double dose by mistake. The directions for the patient should be written in full, explicitly, and in plain English.

6. **The Name or Initials of the Physician with Date**—The name of the prescriber is rarely signed in full, particularly since the very general use of printed prescription blanks, which contain not only the full name and address of the physician but also his office hours. It is very necessary sometimes to communicate quickly with the physician in case of error or ambiguity, and, when printed blanks are not used, the name and address of the prescriber should be written in full.

Unusual Doses in Prescriptions—It is to be regretted that some uniform system of indicating unusual doses has not been adopted by physicians. Occasions frequently arise where the patient, either from becoming habituated to its use, or from some other cause, will tolerate an excessive or ordinarily poisonous dose of a remedy. A careful pharmacist always hesitates to compound such a prescription if the dose is not especially marked as unusual, and delays necessarily occur. The most satisfactory method of indicating such a dose is that of underscoring the quantity deemed unusual, as shown in the following:

℞ Morph. Sulph. gr. vi
Syrup. Limonis f℥ ii
Aquæ q. s. ft. f℥ i.

Sig. A teaspoonful every two hours until relieved.

Other marks are sometimes used—the exclamation mark (!), for instance, or Q. R. (*quantum rectum*). These are not so distinctive as underscoring, and are open to the objection that in handwriting, which is very apt to be defec-

tive, they are likely to puzzle or mislead the pharmacist by being mistaken for some other parts of the prescription. A heavy black line under the unusual dose cannot be mistaken.

A very useful book upon pharmaceutical Latin, and one which is highly recommended to the student of pharmacy is Sturmer's Pharmaceutical Latin. The following Latin prescription from Whitla's Elements, with the grammatical analysis, is so thoroughly illustrative that it is inserted almost in its entirety:

℞		Superscription
(Basis)	*Pot. Acet.* ℥ v.	Inscription
(Adjuvant)	*Tinct. Digitalis* f ℥ i.	
(Corrective)	*Syr. Aurantii* f ℥ i.	
(Vehicle)	*Decoct. Scoparii ad* f ℥ viii.	
M., ft. mist.		Subscription
Cpt. cochl. mag. ii. 4ta q.q. hora ex paul. aquæ...		Signa

Without abbreviations or contractions it would read thus:

Recipe
Potassii Acetatis drachmas quinque.
Tincturæ Digitalis drachmam unam.
Syrupi Aurantii unciam unam.
Decocti Scoparii ad uncias octo.

Misce, fiat mistura. Capiat cochlearia duo magna quanta quaque hora ex paululo aquæ.

The student will obtain needful information from a careful study of the following page, in which the Latin of the above prescription is arranged according to the English idiom, and each word parsed and translated.

Recipe Potassii Acetatis drachmas quinque

℞ (Recipe)	v.irr. tr. imp. m. 2d per. s., to agree with its nom. Tu—"thou" (understood). Recipi-o, recepi, receptum, recipere. From re and capio.	Take thou
v (quinque)	num. adj. indec. ac. pl. qual. and agreeing with drachmas	five
℥ (drachmas)	n. f. ac. pl. drachma, -æ	drachms.
Acet. (acetatis)	n. f. gen. s. qual. drachmas. Acetas, -atis.	of acetate
Pot. (potassii)	n. f. gen. s. qual. acetatis. Potassium, -ii.	of potash

Recipe Digitalis Tincturæ drachmam unam

℞ (Recipe)	(understood).	Take thou
i (unam)	num. adj. ac. s. qual. and agreeing with drachmam. Unus, -a, -um.	one
f ℥ (drachmam)	n. f. ac. s. gov. by recipe. Drachma, -æ.	drachm
Tinct. (tinctura)	n. f. gen. s. qual. drachmam. Tinctura, -æ.	of the tincture
Digit. (digitalis)	n. f. gen. s. qual. tincturæ. Digitalis, -is.	of digitalis

Recipe Aurantii Syrupi unciam unam

℞ (Recipe)	(understood).	Take thou
i (unam)	(Parsed as before.)	one
f ℥ (unciam)	n. f. ac. s. gov. by recipe. Uncia, -æ.	ounce
Syr. (syrupi)	n. m. gen. s. qual. unciam. Syrupus, -i.	of syrup
Aur. (aurantii)	n. neut. gen. s. qual. syrupi. Aurantium, -ii.	of orange peel

Recipe Decocti Scoparii ad uncias octo

℞ (Recipe)	(understood.)	Take thou
ad.	prep. used adverbially.	up to
viij (octo)	num. adj. indec. qual. uncias.	eight
f ℥ (uncias)	n. f. ac. pl. gov. by recipe. Uncia, -æ.	ounces
Decoct.[1] (decocti)	n. neut. gen. s. qual. uncias. Decoctum, -i.	of the decoction
Scop. (scoparii)	n. mas. gen. s. qual. decocti. Scoparius, -ii.	of broom

[1]Some authorities would put Decoct. in the accusative, governed by recipe. In the same way, where the student meets Aquæ ad f ℥ in the different prescriptions and formulæ throughout this work, he may substitute Aquam ad f ℥; but this latter is by no means so idiomatic as Aquæ ad f ℥.

Misce, fiat mistura

M. (misce)	v. trans. imp. m. p. t., agreeing with and governed by Tu (understood). Misceo, -ui, mixtum or mistum, miscere.	Mix you, or mix
Mist. (mistura)	n. f. nom. s. governing fiat. Mistura, -æ	Let the mixture
Ft. (fiat)	v. used as passive of facio, pres. sub. 3d s. Used as imp. gov. by and agreeing with mistura. Fio, factus sum, fieri; to be made or become.	be made

Capiat cochlearia duo magna quarta quaque hora ex paululo aquæ

Cpt. (capiat)	irr. v. tr. sub. m. pr. t. 3d per. s., agreeing with and gov. by Is—"he" (understood). Capio, cepi, captum, capere, the present subjunctive used as an imperative.	He may take, or let him take
ii (duo)	num. adj. ac. pl. neut. qual. and agreeing with cochlearia. Duo, -æ, -o.	two
Mag. (magna)	adj. ac. pl. neut. qual. and agreeing with cochlearia. Magnus, -a, -um.	large
Coch. (cochlearia)	n. ac. pl. neut., gov. by capiat. Cochleare, -is.	tablespoonfuls
q.q. (quaque)	pron. indef. abl. s., qualifying and agreeing with hora. Quisque, quæque, quoque.	at each
4ta (quarta)	num. adj. abl. s., qualifying and agreeing with hora. Quartus, -a, -um.	fourth
Horâ	n. f. abl. s. Hora, -æ.	hour
Ex.	prep.	out of
Paul. (paululo)	adj. abl. s. Used as a noun, gov. by ex. paululus, -a, -um.	a little
Aq. (Aquæ)	n. f. gen. s. qual. paululo. Aqua, -æ.	of water

A number of Latin prescriptions will be found below, the first ten of which are printed without abbreviations; it is very unusual to receive prescriptions of this kind, nevertheless their translation and study will furnish useful information.

Translate the following prescriptions, and also the accompanying directions:

1. Recipe Liquoris Ammonii Acetatis, drachmas tres cum semisse;
Vini Antimonii, drachmas duas;
Tincturæ Cardamomi Compositæ, drachmas tres;
Aquæ Menthæ Piperitæ, uncias quatuor.

Fiat mistura, cujus unciæ duæ omni horæ quadrante calefactæ summendæ, durante frigore.

2. Recipe Rosæ Gallicæ, unciam dimidiam;
Aquæ ferventis, uncias octo.

Stent per horam; colaturæ adde Succi Limonum, Sacchari, ana, quantum sufficit, ad gratam acerbitatem dulcedinemque.

3. Recipe Extracti Colocynthidis Compositi, drachmam unam;
Scammonii pulveris, scrupulum unum;
Gambogiæ pulveris, grana quinque.

Misce.—Fiant pilulæ viginti, quarum duæ deglutiantur horâ decubitûs; diluculô, ut infra.

4. Recipe Infusi Sennæ, unciam unam.

5. Recipe Potassii et Sodii Tartratis, sesquidrachmam;
Cretæ Præparatæ, semidrachmam;
Misce.—Fiat pulvis in jusculo tenuissimo sumendus.

6. Recipe Ammonii Carbonatis, grana sex;
Syrupi Aurantii, drachmas duas;
Aquæ, drachmas decem.

Misce.—Fiat haustus, cui, tempore capiendi, adde Succi Limonis recentis cochleare medium unum, et in effervescentiâ sumatur.

7. Recipe Tincturæ Opii, semidrachmam;
Spiritûs Chloroformi, drachmam;
Misturæ Cretæ,
Aquæ Menthæ Piperitæ, ana, uncias tres.

Misce.—Fiat mistura, cujus sumantur cochlearia duo magna post unamquamque sedem mollem, phialâ prius concussâ.

8. Recipe Misturæ Ammoniaci, uncias sex;
Tincturæ Opii, drachmam.
Misce.—Capiat cochlearia duo magna statim; iterentur post horam, si tussis accreverit.

9. Recipe Fluidextracti Belladonnæ, drachmam cum semisse;
Lini Farinæ, uncias duodecim;
Aquæ bullientis, quantum sufficit ut fiat cataplasma admovendum calidè loco adfecto.

10. Recipe Cetrariæ, unciam;
Aquæ frigidæ, octarium.
Coque ad uncias duodenas; stet ut geletur, et utatur æger gelatinô ad libitum.

11. ℞ Magnes. Carb., ʒi;
Pulv. Rhei, gr. xv;
Aq. Anisi, fʒiss.
M.—Fiat julep.[1] cujus unum cochl.[2] minim.[3] infant.[4] lacten.[5] detur, secundis horis: phiala agitata.

12. ℞ Sp. Ammon. Arom., fʒi;
Tinct. Asafœt., fʒss;
Syrupi, fʒiii;
Aq. Cinnam., fʒi.
M.—Exhibe cochl. parv. ter quaterve de die, vel sæpius, urgente convuls.[6] vel spasm[7].

13. ℞ Tinct. Hyoscyami, fʒiss;
Pot. Acet., ʒiv;
Syr., fʒii;
Aq. Menth. Vir., adfʒvi.
Ft. mist. cujus sumant.[8] cochl.[9] ii vel iii minim.[10] bis terve in die, vel ut opus sit.

14. ℞ Tinct. Opii, fʒss;
Mist. Cret., fʒiii.
M.—Cap. cochl. ii magn.[11] omni quadrante horæ, donec leniat.[12] dolor.

15. ℞ Pulv. Ipecac., ʒiss;
Pot. Bitart., ʒi;
Aq. fervent., fʒiiiss.
Macera per horam integr.[13] dein cola et adjice syr., fʒss.
M.—Detur fʒss vel cochl.[14] ampl.[15] omni semihorâ, donec vomit.[16] proritav.[17]

16. ℞ Plumbi Acet., gr. iv;
Syrup., fʒii;
Aq. Menth., fʒii.
M.—Cap. cochl. ampl.[18] mane quotidie; repetat.[19] dosis ad iii vices, et deinde cap.[20] æger haust.[21] aliq.[22] purgant.[23]

17. ℞ Mist. Ammon.,[24] fʒvi;
Cap. æger cochl. mag. bis in die ex poculo jusc.[25] bov.[26]

18. ℞ Morph. Acet., gr. ¼;
P. Colch.,[27] gr. iii.
Ft. pil. 4tis[28] horis s.[29]
Mitte vi fol.[30] arg.[31] inv.[32]

19. ℞ Sodii Bicarb., ʒiii;
Ammon. Bicarb., ℈ii;
Pot. Nit., ʒss;
Syr. Aurant., fʒss;
Ac. Hydrocyan. dil., gtt. xx;
Aquæ, ad fʒviii.
M.—Capiat ʒiss t. in d. cum pulv. i seq.[33] m.[34] stat.[35] effervesce.[36]

20. ℞ Ac. Tart., ℈ i;
Mitte chart. vi.

---

[1] Julepum. [2] Cochleare. [3] Minimum. [4] Infantulo. [5] Lactenti. [6] Convulsione. [7] Spasmo. [8] Sumantur. [9] Cochlearia. [10] Minima. [11] Magna. [12] Leniatur. [13] Integram. [14] Cochleare. [15] Amplum. [16] Vomitum. [17] Proritaverit. [18] Amplum. [19] Repetatur. [20] Capiat. [21] Haustum [22] Aliquem. [23] Purgantem. [24] Ammoniaci. [25] Jusculi. [26] Bovini. [27] Colchici. [28] Quartis. [29] Sumenda. [30] Folio. [31] Argenteo. [32] Involve. [33] Sequenti. [34] Mane. [35] Statu. [36] Effervescentiæ.

21. ℞ Ol. Morrhuæ, f℥viii.
Sum.[1] coch. min. (ad. ampl.[2] augend.[3]) bis die c.[4] mist. sequent.[5] coch. ampl.[6]

22. ℞ Acid. Phosph. dil., f℥ss;
Tinct. Nuc. Vom., f℥ii;
Tinct. Calumb.,
Syr. Zingib., āā f℥i;
Aq. Cinnam., q. s. ut ft. f℥viii.
M.—Ft. mist.

METRIC PRESCRIPTIONS

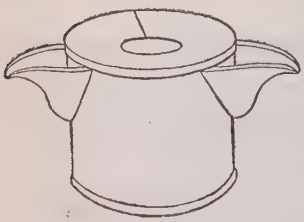
The growth of the metric system has made it necessary for every pharmacist to be acquainted with the methods employed in writing metric prescriptions.

There are two distinct methods employed in this country, which may be termed respectively the *gravimetric* and the *volumetric* method.

1. **Gravimetric Prescriptions**—The gravimetric principle of weighing liquids is used in Germany and some other Continental countries almost exclusively. It was adopted by the United States Pharmacopœia of 1880, and given the name of "parts by weight"; but, although weighing liquids may be practiced with advantage in the laboratory in making large quantities of preparations, and is preferable in the case of thick or adhesive liquids, it is far less convenient in compounding prescriptions than the plan of measuring the liquid ingredients. The advantage in supposed greater accuracy of weighing over measuring is more imaginary than real. A careful pharmacist will compound prescriptions just as accurately by measuring the liquids as he will by weighing them, while a slovenly one will be just as careless in using weights as he is in measuring liquids. The question of accuracy becomes then, practically, a "personal equation".

Several conveniences have been proposed in weighing liquids, which deserve notice. The Germans use a "tare can" (see Fig. 549) for the purpose of quickly taring a bottle. It is a small metallic can having a shallow funnel mouthed opening, with two spouts, one on each side. The bottle, or vessel, is placed on one of the scale pans, and the tare can, containing sufficient shot or clean dry sand to balance it, is placed upon the other. It is better, however, to use two tare cans and pour from one to the other, the one not in use on the scale pan either receiving the excess of shot or supplying the deficiency. Water in a bottle also serves very satisfactorily as a tare as the exact weight may be readily adjusted.

Fig. 549



Tare can

2. **Volumetric Prescriptions**—In these the gram is replaced by the cubic centimeter. The principal reason for preferring the volumetric method is that the physician has the means of more readily calculating and apportioning the number of doses in the prescription. *Liquid medicines are never administered by weight*, but always by teaspoonfuls, tablespoonfuls, or other convenient measure. In some liquids there is a wide difference between their weight and their volume, as specific gravity tables abundantly show. A teaspoonful of ether weighs forty-one grains, while a teaspoonful of chloroform weighs eighty-five grains (more than twice as much). Hence the physician cannot disregard specific gravity. In prescribing gravimetrically and administering

[1] Sumatur. [2] Amplum. [3] Augendum. [4] Cum. [5] Sequentis. [6] Amplo.

volumetrically he must constantly bear in mind these differences, at least approximately. Mistakes are very likely to arise in making these calculations, mentally, at the bedside of a patient. Hence it is far better to avoid them by *prescribing the medicines by the same method as that by which they are dispensed and administered, namely, volumetrically,* thus preserving that harmony of relation which is conducive to safety. If volumetric analysis is preferred to gravimetric analysis in the United States Pharmacopœia because of its greater convenience and at least equal accuracy, why should not liquids be measured rather than weighed in pharmaceutical operations in which extreme accuracy is comparatively of less importance?

The following examples illustrate the forms of metric prescriptions most frequently used. Form A is preferable, for the reasons stated:

Form A

℞ (*Volumetric*)
Gm. and cc.

Quininæ Sulph 1	
Strych. Sulph.	016
Fluidext. Glycyr. 4	
Syrupi 60	

A teaspoonful three times a day.

℞ (*Gravimetric*)

Hydrarg. Clor. Mit. .	5
Aloe. Pulv. 2	
Rhei Pulv. 1	5

Make twenty pills.

The advantages of the decimal line are that the decimal dot is abolished, with its dangerous complications, for a spot or a fly speck on the prescription paper may increase or decrease the quantity of an ingredient *ten times,* and the use of the decimal line is familiar to all who use a dollar and cents column.

Form B

℞ (*Gravimetric*)

Quininæ Sulph. . . . . 1.	
Strych. Sulph.	.016
Fluidext. Glycyr. . . . 4.	
Syrupi . . . . . 60.	

A teaspoonful three times a day.

℞ (*Gravimetric*)

Hydrarg. Chlor. Mit..	.5
Aloe. Pulv.	2.
Rhei Pulv.	1.5

Make twenty pills.

This form is used frequently, because of the familiarity with the arithmetical method of using a dot to denote a decimal fraction; and where metric prescriptions are altogether in use, as in Continental Europe, there is no necessity for indicating the denomination, gram being always understood.

Form C

℞ (*Volumetric*)

Quininæ Sulph. . .	1. Gm.
Strych. Sulph. . .	.016 Gm.
Fluidext. Glycyr.	4. cc.
Syrupi	60. cc.

A teaspoonful three times a day.

℞ (*Gravimetric*)

Hydrarg. Chlor. Mit.	.5 Gm.
Aloe. Pulv.	2. Gm.
Rhei Pulv.	1.5 Gm.

Make twenty pills.

This form is an improvement on Form B, and would be far superior to it for use in this country, where prescriptions written in the old systems will long continue to be used; for the indication of the unusual quantity by underscoring will prevent its being mistaken for *grain.*

Abbreviations are necessary in writing prescriptions, and they are universally employed. Great care must be taken, however, to avoid ambiguities which may mean *death to the patient.* Usually, the careful pharmacist gathers from the directions and the quantities the information which guides him safely. A few examples of defective abbreviations are appended:

Acid. Hydroc.	May mean Acidum Hydrochloricum or Acidum Hydrocyanicum
Aconit.	Aconitina Aconiti Radix Aconiti Folia
Ammon.	Ammonia (alkali) Ammoniac (gum resin)
Aq. Chlor.	Aqua Chlori Aqua Chloroformi
Aq. Fontis.	May often be read Aqua Fortis
Bar. Sulph.	Barium Sulphate Barium Sulphide Barium Sulphite
Calc. Chlor.	Calcium Chloride Chlorinated Lime
Chlor.	Chlorine Chloroform Chloral
Ext. Col.	Extractum Colchici Extractum Colocynthidis
Hyd. Chlor.	Calomel Corrosive Sublimate Hydrated Chloral
Hydr.	Hydrargyrum (mercury) Hydras (hydrate) Hydriodas (hydriodate) Hydrochloras hydrochlorate Hydrocyanas (hydrocyanate)

Hydr. Perox.	Hydrogen Peroxide Hydrargyri Peroxidum
Mist. Ammon.	Ammonia Mixture Mixture of Ammoniac (gum resin)
Potass. Hyd.	Potassium Hydrate (caustic potassa) Potassium Hydriodate (potassium iodide)
Sod. Hypo.	Sodium Hyposulphite Sodium Hypophosphite
Sod. Sulph.	Sodium Sulphate Sodium Sulphite Sodium Sulphide
Sulph.	Sulphur Sulphide Sulphate Sulphite
Zinc. Phosph.	Zinc Phosphate Zinc Phosphide

The above list might be indefinitely prolonged. Sufficient has been clearly shown, however, to convince even the most skeptical practitioner of the grave danger of careless abbreviations. The Pharmacopœia has adopted the abbreviation "sulph." for "sulphate" and suggests that no abbreviation be used for sulphur, sulphite, and sulphide. "Chlor." has also been adopted officially to mean "chloride" and chlorate is not to be abbreviated.

The Pharmacopœia also calls especial attention to the title "Barii Sulphas" which should never be abbreviated. This is to avoid any misunderstanding and the possible dispensing of the poisonous *barium sulphide* or *barium sulphite*.

The following table of abbreviations, terms, etc., used in prescriptions will be of service to the pharmacist, by enabling him to translate some of the technical phrases used in writing prescriptions:

Word or Phrase	Contraction	Meaning	Word or Phrase	Contraction	Meaning
A, āā	.....	Of each	Biduum	.....	Two days
Accuratissime	Accuratiss.	Most carefully	Bis	.....	Twice
Ad	Ad	To, up to	Bis in die	Bis in d.	Twice a day
Adde, addantur, addentum, addendo	Add.	Add, or let them be added, to be added, by adding	Bis in dies	Bis in d.	Twice a day
			Bolus	Bol.	A large pill
			Bonus	.....	Good
Ad libitum	Ad lib.	At pleasure	Brevis	.....	Short
Admove, admoveatur, admoveantur	Admov.	Apply, let it be applied, let them be applied	Bulliat, bulliant	Bull.	Let boil
			Calefactus	.....	Warmed
			Capiat	Cap.	Let him (or her) take
Ad partes dolentes	Ad part. dolent.	To the painful parts	Capsulæ amylaceæ	.....	Starch capsules,—*i. e.*, cachets
Ad tertiam vicem	.....	For three times			
Adversum	Adv.	Against	Carbasus	Carbas.	Lint, linen
Agita	Agit.	Shake, stir	Caute	.....	Cautiously
Albus	Alb.	White	Charta	Chart.	Paper
Alcoholizatus	.....	Alcoholized, finely powdered	Charta cerata	Chart. cerat.	Waxed paper
			Chartula	.....	Small paper
Aliquot	.....	Some, a few	Cibus	.....	Food
Alter	.....	The other	Cito dispensetur	Cito disp.	Dispense quickly
Alternis horis	.....	Every other hour	Cochlear or cochleare, Cochleatim	Coch., Cochleat.	A spoonful, by spoonfuls
Alvo adstricta	Alv. adst.	The bowels being confined			
Amplus	.....	Large	Cochleare amplum	Coch. amp.	A tablespoonful
Ana	A., āā	Of each			
Ante cibum	a. c.	Before meals	Cochleare magnum	Coch. mag.	A large spoonful (about half an ounce)
Aqua aërata	Aq. aërat.	Carbonated water			
Aqua astricta	Aq. astr.	Frozen water			
Aqua bulliens	Aq. bull.	Boiling water	Cochleare medium or modicum	Coch. med.	A dessertspoonful (about two fluidrachms)
Aqua communis	Aq. comm.	Common water			
Aqua fervens	Aq. ferv.	Hot water			
Aqua fluviatilis	Aq. fluv.	River water	Cochleare parvum	Coch. parv.	A teaspoonful (about one fluidrachm)
Aqua fontalis (or fontis or fontana)	Aq. font.	Spring water			
			Cola	Col.	Strain
Aqua marina	Aq. mar.	Sea water	Colatus	Colat.	Strained
Aqua nivalis	Aq. niv.	Snow water	Colentur	Colent.	Let them be strained
Aqua pluviatilis (or pluvialis)	Aq. pluv.	Rain water			
			Coletur	Colet.	Let it be strained
Aut	.....	Or	Collunarium	.....	A nose wash
Baccillum	.....	A bougie	Collutorium	Collut.	A mouth wash
Balneum arenæ	B. A.	Sand bath	Collyrium	Collyr., Coll.	An eye wash
Balneum mariæ or maris	B. M.	A salt water bath	Coloretur	.....	Let it be colored
			Commisce	.....	Mix together
Balneum vaporosum or vaporis	B. V.	A vapor bath	Compositus	Comp.	Compounded
			Confectio	Conf.	Confection
Barbadensis	B.B., B.B.S.	Barbadoes	Confricamentum	.....	A liniment
Bene	.....	Well	Congius	Cogn.	A gallon
Bibe	Bib.	Drink	Conserva	Cons.	A conserve; also to keep (thou)

Word or Phrase	Contraction	Meaning
Consperge	Consperg.	To dust or sprinkle
Continuantur remedia	Cont. rem.	Let the medicines be continued
Contra	.....	Against
Contusus	.....	Bruised
Cor, cordis	.....	The heart
Cortex	Cort.	The bark
Cotula	.....	A measure
Cujus, Cujuslibet	Cuj.	Of which, of any
Cum	C.	With
Da, detur	D., det.	Give, let be given
De	.....	Of, or from
Deaurentur pilulæ	Deaur. pil.	Let the pills be gilded
Debita spissitudo	Deb. spiss.	A proper consistence
Decanta	Dec.	Pour off
Decem, Decimus	.....	Ten, the tenth
De die in diem	De d. in d.	From day to day
Deglutiatur	Deglut.	May or let be swallowed
Dein	.....	Thereupon
Dentur tales doses No. iv	D. t. d. No. iv	Let four such doses be given
Detur in duplo	.....	Let twice as much be given
Dexter, Dextra	.....	The right
Diebus alternis	Dieb. alt.	Every other day
Diebus tertiis	Dieb. tert.	Every third day
Digere	.....	Digest
Dilue, Dilutus	Dil.	Dilute (thou), diluted
Dimidius	Dim.	One-half
Directione propria	D. P. or direc. prop.	With a proper direction
Dividatur in partes æquales	D. in p. æq.	Let it be divided into equal parts
Dividendus, -a, -um	.....	To be divided
Donec	.....	Until
Eadem (fem.)	.....	The same
Ejusdem	Ejusd.	Of the same
Electuarium	Elect.	An electuary
Emulgens	.....	An emulsifying agent
Enema	En.	An enema, a clyster
Enemata	.....	Clysters
Epistomium	Epistom.	A stopper
Et	.....	And
Etiam	.....	Also, besides
Ex or E	E.	From, one of
Ex modo prescripto	E. m. p.	After the manner prescribed, as directed
Extende	Ext.	Spread
Fac, Fiat, Fiant	F., Ft.	Make, let it be made, let them be made
Fac pilulas duodecim	F. pil. xii	Make 12 pills
Farina	.....	Flour
Febris	.....	Fever
Fervens	Ferv.	Boiling
Fiant chartulæ xii	Ft. chart. xii	Let 12 powders be made
Fiant pilulæ xii	Ft. pil. xii	Let 12 pills be made
Fiant pulveres xii	Ft. pulv. xii	Let 12 powders be made
Fiant suppositoria iv	Ft. suppos. iv	Let 4 suppositories be made
Fiat cataplasma	Ft. cataplasm.	Let a poultice be made
Fiat ceratum	Ft. cerat.	Let a cerate be made
Fiat collyrium	Ft. collyr.	Let an eye wash be made
Fiat confectio	Ft. confec.	Let a confection be made
Fiat electuarium	Ft. elect.	Let an electuary be made
Fiat emplastrum 6 × 4	Ft. emp. 6 × 4	Let a plaster 6 by 4 inches be made
Fiat emplastrum epispasticum	Ft. emp. epispast.	Let a blister be made
Fiat emplastrum vesicatorium	Ft. emp. vesicat.	Let a blister be made
Fiat emulsio	Ft. emuls.	Let an emulsion be made
Fiat enema	Ft. enema.	Let an injection be made (for rectum)
Fiat gargarisma	Ft. garg.	Let a gargle be made
Fiat haustus	Ft. haust.	Let a draught be made
Fiat infusum	Ft. infus.	Let an infusion be made
Fiat injectio	Ft. injec.	Let an injection be made (for urethra)
Fiat lege artis	F. L. A.	Let it be made by the rules of art.
Fiat linimentum	Ft. linim.	Let a liniment be made
Fiat massa	Ft. massa	Let a mass be made
Fiat massa et divide in pilulas xii	Ft. mas. div. in. pil. xii	Let 12 pills be made
Fiat massa in pilulas xii dividenda	Ft. mas. div. in. pil. xii	Let 12 pills be made
Fiat massa in trochiscos xl dividenda	Ft. mas. in troch. xl. div.	Let 40 lozenges be made
Fiat mistura	Ft. mist.	Let a mixture be made
Fiat pulvis	Ft. pulv.	Let a powder be made
Fiat pulvis et divide in chartulas xii	Ft. pulv. et. div. in char. xii	Let 12 powders be made
Fiat pulvis in chartulas xii dividenda	.....	Let 12 powders be made
Fiat secundum artis regulas	F. S. A. R.	Let it be made according to the rules of art
Fiat solutio	Ft. solut.	Let a solution be made
Fiat suppositorium	Ft. suppos.	Let a suppository be made
Fiat trochisci xxiv	Ft. troch. xxiv	Let 24 lozenges be made
Fiat unguentum	Ft. ung.	Let an ointment be made
Filtra	.....	Filter (thou)
Fistula armata	.....	A syringe fitted for use
Flavus	Flav.	Yellow
Folium	Fol.	A leaf
Fuerit	.....	Shall have been
Gargarisma	Garg.	A gargle
Gradatim	.....	By degrees, gradually
Grana sex pondere	.....	Six grains by weight
Granum, Grana	.....	Grain, grains
Gratus	.....	Pleasant
Grossus	.....	Large, coarse
Gutta	Gtt.	A drop
Guttæ	Gtt.	Drops
Guttatim	Guttat.	By drops
Haustus	Haust.	A draught
Herba	.....	A herb
Hic, Hæc, Hoc	.....	This
Hirudo	.....	A leech
Hora	H.	An hour
Hora decubitus	H. D.	At the hour of going to bed
Horæ unius spatio	Hor. un. spatio	At the expiration of an hour
Hora somni	H. S. or Hor. som.	Just before going to sleep, or on retiring to rest
Horis intermediis	Hor. interm.	In the intermediate hours
Idem	.....	The same
Identidem	.....	Repeatedly
Inde	.....	Therefrom
In dies	In d.	From day to day, daily
Ingerendo capsulas	.....	Put in capsules

Word or Phrase	Contraction	Meaning
In impetu effervescentiæ	.....	In the height of effervescence
Injectio	.....	An injection
Injiciatur enema	.....	Let an injection or clyster be given
In lagena bene obturata	.....	In a well-stoppered bottle
Inter	.....	Between
Involve gelatina	.....	Coat with gelatin
Ita	.....	In such manner
Jam	.....	Now
Lac	.....	Milk
Lamella	.....	Leaf or scale
Laridum	.....	Lard
Leniter terendo	.....	By rubbing gently
Leviter	.....	Lightly
Magnus	Mag.	Large
Massa, Massa pilularis	.....	A mass, a pill mass
Mica panis	Mic. pan.	Crumb of bread
Minimum	M. or Min.	A minim
Minutum	.....	A minute
Misce	M.	Mix
Mitte, Mittatur, Mittantur	.....	Send, let it be sent, let them be sent
Mitte talis	.....	Send of such or this
Modicus	.....	Middle-sized
Modo præscripto	Mod. præsc.	In the manner prescribed
More dictu, More solito	More dict., More sol.	In the manner directed, in the usual manner
Mortarium	.....	A mortar
Necnon	.....	Also
Ne tradas sine nummo	Ne. tr. s. num.	Do not deliver it unless paid. (Used by apothecaries as a caution to the assistant when the presence of the patient prevents the master from giving a verbal direction)
Nisi	.....	Unless
Non	.....	Not
Non repetatur	Non. rep.	Do not repeat
Nox, noctis	.....	Night
Numerus	No.	Number
Nunc	.....	Now
Nux Moschata	.....	A nutmeg
Obduce	.....	Cover, conceal, or coat
Octarius	O.	A pint
Octavus	.....	Eighth
Octo	.....	Eight
Oculus	.....	The eye
Oleum olivæ optimum	O. O. O.	Best olive oil
Omni hora, Omni bihorio, Omni quadrante horæ	Omn. hor., Omn. bih., Omn. quadr. hor.	Every hour, every two hours, every quarter of an hour
Omni mane	.....	Every morning
Omni nocte	.....	Every night
Ovum	.....	An egg
Panis	.....	Bread
Pars, partis	.....	A part
Partes æquales	P. æ.	Equal parts
Partitis vicibus	Part. vic.	In divided doses
Parvulus	.....	An infant
Parvus	.....	Little
Pastillus, Pastillum	.....	A little ball of paste, to take like a lozenge, etc.
Pectus	.....	The breast
Pediluvium	.....	A foot bath
Per	.....	Through, by
Perinde	.....	In the same manner as before
Pes	.....	The foot
Phiala prius agitata	P. P. A.	The bottle having been first shaken
Pilula	.....	A pill
Pilus	.....	The hair
Pinguis	.....	Fat, grease
Placebo	.....	To please, satisfy
Poculum, Pocillum	Pocul., Pocill.	A cup, a little cup
Pondere	P.	By weight
Pondus medicinale	.....	Medicinal (apothecaries') weight
Pone aurem	.....	Behind the ear
Post cibo	p. c.	After eating
Potus	.....	Drink
Prandium	Prand.	Dinner
Primo mane	.....	Very early in the morning
Primus	.....	The first
Pro	.....	For
Pro ratione ætatis	.....	According to the age of the patient
Pro re nata	P. r. n.	Occasionally
Proximo	.....	Nearest
Prius	.....	Before, former
Pulpa	.....	Pulp
Pulvis, Pulverizatus	Pulv.	A powder, powdered
Pyxis	.....	A pill box
Quam libet	.....	As much as you wish
Quantum libet, Quantum placet, Quantum vis, Quantum volueris	Q. l., Q. p., Q. v.	As much as you please
Quantum sufficiat, Quantum satis	Q. S.	As much as is sufficient
Quaque	Q. Q.	Each or every
Quaque hora	.....	Each hour
Quartus	.....	Fourth
Quater	.....	Four times
Quatuor	.....	Four
Quibus	.....	From which
Qui libet	.....	Whatever you please
Quinque	.....	Five
Quintus	.....	The fifth
Quoque	Q. Q.	Also
Quorum	Quor.	Of which
Quotidie	.....	Daily
Quoties	.....	As often as
Ratio	.....	Proportion
Recens	Rec.	Fresh
Recipe	.....	Take
Redactus in pulverem, redigatur in pulverem	Red. in pulv., redig. in pulv.	Let it be reduced to powder
Renovetur semel	.....	Renew once only
Repetatur, Repetantur	Rept.	Let it be repeated, let them be repeated
Res., rei	.....	Thing, substance, object, etc.
Residuus	.....	Remaining
Respondere	.....	To answer
Ruber	.....	Red, ruddy
Saccellatio	.....	A dry poultice
Saepis	.....	Often, frequently
Saltem	.....	At least
Scatula	Scat.	A box
Scilicet	.....	Namely
Secundum artem, Secundum naturam	S. A., S. N.	According to art, according to nature
Secundus	.....	Second
Semel	.....	Once
Semidrachma	Semidr.	Half a drachm
Semihora	Semih.	Half an hour
Semis	Ss.	A half
Septem	.....	Seven
Septimana	.....	A week
Sescuncia	.....	An ounce and a half
Sesquihora	.....	An hour and a half

Word or Phrase	Contraction	Meaning
Sex	.....	Six
Sextus	.....	Sixth
Si	.....	If
Siccus	.....	Dry, dried
Sic, Sic?	.....	So, is it so?
Signa	Sig. S.	Mark thou
Signetur nomine proprio	.....	Let it be written upon with the proper name (not a tradename)
Simul	.....	Together
Sine	.....	Without
Si opus sit	Si op. sit	If necessary
Sit	.....	Let it be
Solitus	.....	Accustomed, ordinary
Solus	.....	Alone
Solve	.....	Dissolve
Solvo, solvere, Solutus	.....	To dissolve, dissolved
Somnus	.....	Sleep
Sparadrapus	.....	A spread plaster
Spiritus vini rectificatus	S. V. R.	Rectified spirit of wine (alcohol)
Spiritus vini tenuis	.....	Proof spirit
Spiritus vinosus	.....	Ardent spirit of any strength
Spissus	.....	Dense, hard
Statim	Stat.	Immediately
Stet, Stent	St.	Let it stand, let them stand
Stillatim	.....	By drops, or in small quantities
Stilus	.....	Pencil, stick, or crayon
Stratum super stratum	S. S. S.	Layer upon layer
Subinde	.....	Frequently
Subtilis	.....	Fine, smooth, nice
Succus	.....	Juice, sap
Sumat talem	.....	Let the patient take one like this
Sume, Sumat, Sumatur, Sumantur, Sumendus	Sum.	Take (thou), let him take, let it be taken, let them be taken, to be taken
Superbibendo haustum	.....	Drinking afterwards this draught
Supra	.....	Above
Tabella (dim. of tabula, a table)	Tabel.	A lozenge
Talis	.....	Such, like this
Tandem	.....	At last, finally
Tantum	.....	So much, so many
Tegmen or Tegumen	.....	A cover
Tempus, temporis	.....	Time or temple
Tenuis	.....	Fine, thin
Ter	.....	Three times
Tere	Ter.	Rub
Ter in, or ter die	T.i.d., or t.d.	Three times a day
Tertius	.....	Third
Tres	.....	Three
Triduum	.....	Three days
Tritura	Trit.	Triturate
Tussis	.....	A cough
Ubi	.....	Where, wherever, whenever
Uncia	.....	An ounce
Unctulus	.....	Besmeared, anointed
Unguilla	.....	An ointment box
Ustus	.....	Burned
Ut dictum	Ut Dict.	As directed
Utendum	Utend.	To be used
Uto, uti	.....	To make use of
Vas Vitreum	.....	A glass vessel
Vehiculum	.....	A vehicle
Vel	.....	Or
Venenosus	.....	Poisonous, a poison
Verus	.....	True, genuine
Vesper, vesperis	Vesp.	The evening
Vitellus	.....	Yolk
Vitello ovi solutus	.....	Dissolved in the yolk of an egg
Vitreum vitrum	.....	Glass

CHAPTER XCVI

FILLING THE PRESCRIPTION

The Meaning of Professional Service—Through centuries of civilization there has been a sharp distinction between those who claim professional ideals and those who were tradesmen. Those who performed the latter functions were long considered inferior, socially, and in fact were generally believed to represent sharp business practice. In fact the legal phrase "*caveat emptor*"—"let the buyer beware"—reflects the impression of centuries concerning trade practices. It was long recognized that if the buyer was not sufficiently clever or shrewd and was beaten in a trade or deal that it was legitimate and the reverse situation was equally accepted. The object of trade is primarily to sell at a profit, the motive being wholly selfish. On the other hand, professional service depended upon the underlying principle of service to humanity, without thought of gain. The elaborate codes of ethics (see page 9), promulgated by professional savants, reflect the ideals of professionalism.

All professional service sprang from religious sources, from an innate, God-given, instinct in humanity prompting a desire to help those who are less fortunate. This was first exhibited in an effort on the part of a priest to bring to the souls of men needed comfort and hope. It soon became evident that the soul ills were often accompanied by bodily ills. Since the desire was to serve, it was natural that there should be added to the initial effort, an attempt to cure bodily sickness, and from this developed the medical profession.

Another great evil also became apparent to the priest—the injustice in the world, often responsible for much suffering. Once again from the priests emanated certain principles and laws expressing justice and right, and the legal profession was the outgrowth. Education was also one of the activities of the church for centuries.

These several professional services were rooted in the principle of service to humanity, for the good of those served and not for the gain of the doer, and was an expression of the finest instincts of the human heart.

Pharmacy finds its place in the professions through its being an important medical specialty. It occupies today a place among the divisions of the medical sciences fully equal in importance to many other special divisions of medicine. This may be emphasized forcibly by considering the organization of a modern hospital.

A number of the divisions of the hospital could be closed for a week without serious inconvenience—the pathological laboratory, the X-ray division, and even the clinical laboratory, but should the pharmacy be closed for a single day the hospital would be disorganized. Its services are manifold and important in maintaining medical and sanitary supplies.

It is important at this time, since reference has been made to the traditions of trade, to refer to the development of modern business in which the older practices have been largely abandoned. Of course, they are still found under some conditions, but in the large business of today, especially in organizations conducting a national business and doing national advertising, the highest ethical ideals are taught and practiced. In fact, many phases of modern business are professional in spirit.

As an illustration of the professional service rendered by pharmacy, it is only necessary to consider the peculiar opportunities afforded the neighbor-

hood pharmacist. It is assumed, of course, that the pharmacist personally represents the best training and ideals of pharmacy. Unfortunately, many in recent years have entered the drug business without professional ideals and with no purpose other than the handling of merchandise and the gaining of profit.

The true pharmacist, however, is properly equipped and trained and possesses the confidence of physicians and of the community through his personality and ability. As an illustration of this relationship of the pharmacist to the community the following experience is cited.

In a nearby home a child is taken seriously ill. A physician is called and verifies the worst fears. It is pneumonia. Several prescriptions are written, perhaps an order given for material for an enema, an ice-cap, a hot-water bottle, a bed-pan, and a dozen other medical aids. The pharmacist is called upon to supply these various needs and he is as deeply interested as the physician in giving every service possible and makes himself available at any hour of the day or night. Perhaps a crisis arises and oxygen is needed; a telephone call and he delivers it without delay.

Now suppose one of the prescriptions had been for digitalis and this was needed in the crisis. Suppose it had been allowed to deteriorate or had not been standardized. The responsibility would have rested directly upon the pharmacist. The life of the child was at that moment dependent upon his integrity and skilful service.

This illustration is multiplied within the year by hundreds of similar responsibilities. He is consulted for advice upon a thousand matters. The training, and honesty, and tact of the pharmacist should be an important community asset and the demand for service will be in direct proportion to the willingness to serve and the ability to render needed aid. Professional pharmacy is exemplified by the daily routine of hundreds of splendid American pharmacists who receive little reward other than the gratification following professional service well done.

To further emphasize the importance of professional pharmaceutical service, reference need only be made to the production by manufacturing pharmacists of modern biologicals; the extensive researches into the field of new and modern medicine, being promoted by pharmaceutical firms, organizations, and colleges, and by the monumental service rendered the nation through the unselfish and coöperative work done by pharmacists and physicians in the preparation of the national standards, the Pharmacopœia and the National Formulary.

With this introduction and with a clear recognition of the professional services of the pharmacist, the filling of prescriptions, commonly called "*dispensing*", may be undertaken.

THE EQUIPMENT FOR DISPENSING

For the proper organization of a modern prescription department, there must be certain basic equipment. This may be divided into several groups. First, the dispenser, second, the physical equipment—fixtures and apparatus, etc., third, the stock of medicines, fourth the library, fifth the laboratory. These are taken up in order.

The Dispenser—For a proper appreciation of the prescription which is to be filled, the prescriptionist must be imbued with the fundamental principles just described which underlie professional service, and there must be a strong sense of fundamental honesty. The compounded prescription must always represent a sincere effort to supply the physician and the patient with exactly

what is intended, which involves not only proper compounding but also efficient, dependable medicines.

Little need be said about the fundamental training and personality of the prescriptionist, but it is universally conceded that there must be represented proper general education and culture and of course the technical training which is legally required for qualification as a dispenser. Practice, in addition to technical training, is necessary to develop the greatest skill and efficiency.

The Physical Equipment—The exact details of the dispensing department of the pharmacy must be left to the local conditions but there are certain basic principles which may be incorporated in every dispensing department. There must be some place in which the customer may be met. This is usually in the store proper or there may be a special reception room provided, fitted very much like a physician's office. A number of pharmacies in which professional work is emphasized, provide such facilities (see Fig. 440). The receiving of the prescription will be discussed on page 1604.

The Counter, Fixtures, etc.—*The Prescription Counter*—The prescription counter should be fitted with the more frequently used chemicals, drugs, and preparations, and close at hand should be the closet containing actively poisonous substances, and also the closet for narcotics. Provision may be made for other stocks such as less frequently used chemicals, drugs, preparations and the stock of pills, tablets, ampuls, biologicals, ointments, etc. All medicinal substances likely to be called for upon prescriptions, should be neatly and systematically stocked. For this purpose, sectional cases, made up of small drawers, are especially well adapted. Fig. 455 illustrates the Schwartz system which is extensively used. Fig. 457 shows another form of section also adapted for the systematic storage of many small items.

There should be an index on loose-leaf sheets or a card index, indicating the location of every item in the store. Biologicals and ointments should be kept in a refrigerator, the refrigerator is often given a conspicuous place in the dispensing section of the store.

The prescription counter should be kept free from merchandise or an accumulation of bottles or other packages and the lower section should be fitted with small drawers in which may be kept various sizes of clean and dry bottles, powder and pill boxes, and all other forms of containers; also corks, caps, and all of the necessary equipment for prescription filling, such as suppository molds, filtering and sifting devices, mortars and pestles, spatulas, etc.

Figs. 454 and 456 illustrate typical modern prescription counters. Fig. 458 is a prescription case made by the McLean Fixture Company. Fig. 460 is a steel prescription case, recently installed by The Wilkinson Equipment Company of Philadelphia, in the store of Frank E. Morgan, Philadelphia.

The Stock Containers—The stock containers frequently used for chemicals and powdered drugs and also those for liquids needed at the prescription counter, are small glass-stoppered, glass-labeled bottles; many stores however prefer the original bottle in which the drug or chemical was purchased, and as most of the packages are kept in closets or drawers this is often practicable. There is an added advantage for this plan, when only small quantities are bought, since it retains the identity of the manufacturer should any question arise concerning its quality. The elaborate array of glass-stoppered bottles with glass labels, so characteristically a feature of the drug stores of a few years ago, has been almost entirely replaced in the front of the store by attractive fixtures, filled with salable commodities.

In many remodeled stores these older style of bottles containing pharma-

ceuticals, chemicals, and drugs are still found in the vicinity of the prescription department.

Figs. 550 to 553 illustrate the usual types of tincture and salt-mouthed

Fig. 550

Tincture-mouthed shelf bottle (round)

Fig. 551

Salt-mouthed shelf bottle (round)

Fig. 552

Tincture-mouthed shelf bottle (square)

Fig. 553

Salt-mouthed shelf bottle (square)

bottles for the prescription department. Glass labels are usually recessed to avoid clipping the edges or they are of the indestructible type which are painted directly upon the bottle, then glazed, and afterward burned into the glass. Several special styles are also made. Fig. 554 illustrates a syrup bottle

Fig. 554

Syrup bottle

Fig. 555

Oil bottle

Fig. 556

Syrup in an ordinary bottle

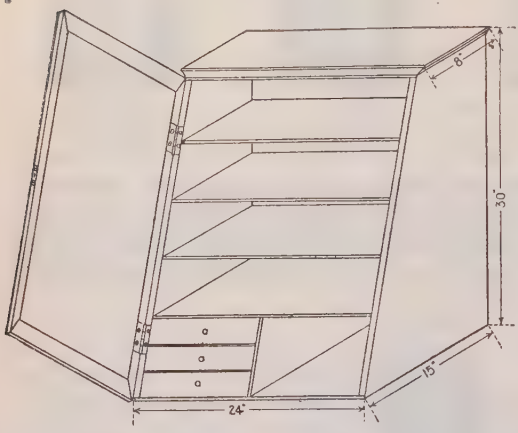
with a loose stopper while Fig. 555 is for oil. This is fitted with a lip from which the excess of oil runs back into the container. A cover keeps the dust from the entire top. Fig. 556 shows the result of using an ordinary glass-stoppered bottle for syrup.

The Sink—The ideals of the pharmacist for cleanliness and neatness are frequently exemplified by the sink in the prescription department. Needless

to say this should be arranged in accordance with the best sanitary plumbing methods and should provide both hot and cold water. A drain board and a graduate rack are important adjuncts. Fig. 461 illustrates the sink arranged with bronze fittings also recently installed in the pharmacy of Frank E. Morgan, in Philadelphia.

The question frequently arises, whether dispensing pharmacists should be expected to clean apparatus. The position usually taken is that should this be necessary it would not be refused but that it is an uneconomical management that requires the pharmacist, whose services are very costly, to perform such menial tasks. In the pharmacy of Hynson, Westcott and Dunning in Baltimore, the dispensing pharmacists are provided with an ample assortment of apparatus which is cleaned and polished. This apparatus is conspicuously placed on glass shelves near the dispensing counter. As the dispenser soils the apparatus it is placed in a small compartment in the prescription case. A woman employed for the purpose, regularly collects the soiled apparatus in a basket, carries it to the rear where adequate facilities are provided for washing and drying. The clean and dry apparatus is then returned ready for use again.

Fig. 557



Poison closet

When the prescription business is sufficiently large, the plan just suggested is undoubtedly the most satisfactory and economic.

The Poison Closet—It is the custom in most stores to keep all poisons, alkaloids, and very powerful substances in a separate closet, and to mark all bottles with a poison label, for, although the pharmacist should early learn to place no absolute dependence upon any *special system* of preventing errors, but always to realize that constant, unremitting vigilance is the only safeguard, the adoption of some expedient which will aid in calling attention to poisonous compounds serves to impress upon all, particularly the assistants, the fact that safety can be secured only at the expense of the most vigilant care. A poison case, which has given much satisfaction is illustrated above. It is about 24 inches wide by 30 inches high; 8 inches wide at top and 15 inches at the base. The three drawers, as shown in Fig. 557 are reserved for the very active poisons, while the shelves hold the less poisonous drugs. No arrangement of poisons otherwise is made so that the pharmacist has to look for the poison wanted which does much to offset any preoccupation of mind. Many of the active liquid poisons are kept in regular poison bottles with sharpened glass stoppers. The form of the case always causes the door to shut. The door should be lettered with the word "POISON" and should also carry the poison symbol, a "skull and cross bones". The door, if glass, should be painted black on the inside, which effectually excludes the light.

This is an easily constructed case and serves its purpose well.

Receiving the Prescription—Fig. 446 illustrates the front part of the store of Hynson, Westcott and Dunning, of Baltimore, which is typical of

the finest development of professional pharmacies The customer is met by someone qualified to represent the professional service offered. Frequently this particular position requires the most skilled pharmacist in the organization. There should be a dignified reception of the customer. All levity or other lack of professional manner should be absent. It should be remembered that the customer has probably come from a sick-room and is deeply concerned over the serious illness of a member of the family. The greatest possible confidence must be inspired through everything that is said and done, and the physician must be supported in his effort to give hope and faith in the treatment.

The prescription is received and read by the pharmacist and he learns whether the customer will wait or have the prescription delivered. Usually these facts are written upon a blank form kept at the counter and this is clipped to the prescription when it is turned over for compounding.

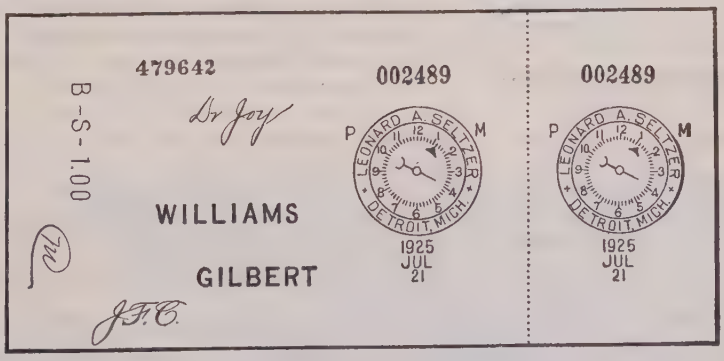
The following prescription memorandum has been used by many stores with excellent results. These blanks are put up in tablet form, and are filled in, in the presence of the customer, or the back of the prescription may be used for noting the points when it is handed in.

MEMORANDUM

Name.
Address.
Is it paid for?
Is it to be charged?
Is it to be called for?
When?
Is it to be sent?
When?
Received by
Compounded by
Number of ℞ and price

Fig. 558 illustrates a form used in the pharmacy of Leonard A. Seltzer, of Detroit. The coupon which carries a call number is handed to the waiting customer to identify the prescription when filled. On the reverse side of this

Fig. 558



Prescription memorandum form (one-half size)

coupon (see Fig. 559) is printed an interesting message which was originally written by H. P. Hynson of Baltimore, and is used by many pharmacists.

The course of a prescription in the pharmacy of Mr. Seltzer is as follows:

1. The prescription is received.
2. The clock number is stamped in duplicate on the blank and on the coupon, and, if it is a call package, the latter is then detached and handed to the waiting customer.

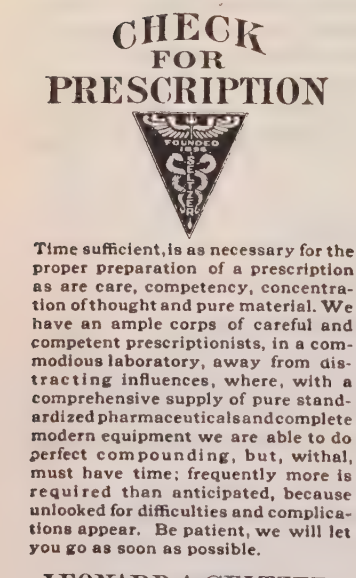
3. If it is a new prescription the number assigned to it is stamped on the blank and also on the prescription and the two are clipped together.

4. The label is now written (see Fig. 560), using the prescription number, and the clock number is also stamped on the label in red.

5. All facts are now recorded in a book ruled for the purpose, as follows:

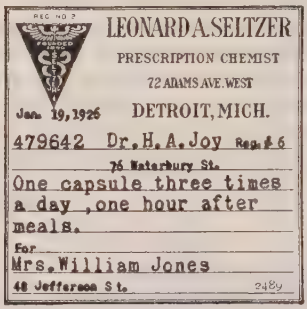
Clock number	Doctor	Patient	Article	Clerk
002487	Brown	Jones	℞ 468474	Williams

Fig. 559


CHECK
FOR
PRESCRIPTION
Time sufficient, is as necessary for the proper preparation of a prescription as are care, competency, concentration of thought and pure material. We have an ample corps of careful and competent prescriptionists, in a commodious laboratory, away from distracting influences, where, with a comprehensive supply of pure standardized pharmaceuticals and complete modern equipment we are able to do perfect compounding, but, withal, must have time; frequently more is required than anticipated, because unlooked for difficulties and complications appear. Be patient, we will let you go as soon as possible.
LEONARD A. SELTZER
60-64 ADAMS AVE. W.

Reverse side of prescription customer's coupon

Fig. 560



Prescription label

6. The compounding clerk then takes the prescription, label, etc., signs his name in the book, fills the prescription and stamps his name on the blank.

7. The dispensing clerk completes the prescription by attaching the label and checking all details of the prescription with another clerk, the latter also placing his name on the blank.

8. The dispensing clerk now wraps the package, attaches the blank to it with an elastic band and hands it out for delivery. He keeps the prescription for filing.

9. If the prescription is called for one of two things happens:

a. It is paid for and the price printed on the end of the slip by the cash register (see Fig. 537), the slip being filed.

b. If not paid for the details of the charge are written on the slip and it is filed for the bookkeeper.

10. If the prescription is to be delivered it is placed on the delivery counter and sent out as soon as a messenger is available. The name of the messenger is placed on the slip and it is placed in the cash register until he returns when he must report. If it has been paid for, the amount is rung up on the cash register which prints the amount on the slip. If it is to be charged the details are written on the slip and it is filed for the bookkeeper. The messenger also obtains a receipt for the package in his own book.

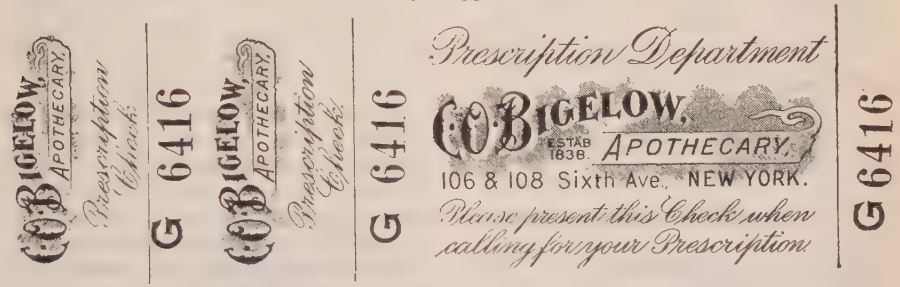
11. On the following morning a clerk files all of the prescriptions of the previous day, arranging them in numerical order and also the corresponding slips, when all can be checked and all records completed.

Fig. 561 is a form of prescription check usually printed with a triplicate

number. The large stub is held by the customer, the second stub is detached and pasted on the prescription blank, and the third number is attached to the filled prescription.

Fig. 562 is a copy of an order form used by Ambrose Hunsberger. He uses no checks or numbered coupon but prefers to use the name of the customer for the identification of the filled prescription. The order blank suggests the necessary information which should accompany every order and when placed

Fig. 561



Prescription check and stub

in the cash register or on a stick file often becomes a valuable reminder of a forgotten charge or other service connected with the order. These order forms are kept at the telephone and at other convenient places in the store and a similar form is stamped on the back of a prescription when received, becoming a permanent record.

Fig. 562

For.....

At.....

.....

Wait.....*Call*.....*Mess*.....*Post*.....*Exp*.....*When*.....

Pd.....*Chg*.....*Coll*.....*Amt*.....*Date*.....

Recd.....*Flld*.....*Del*.....*Checked by*.....

.....

.....

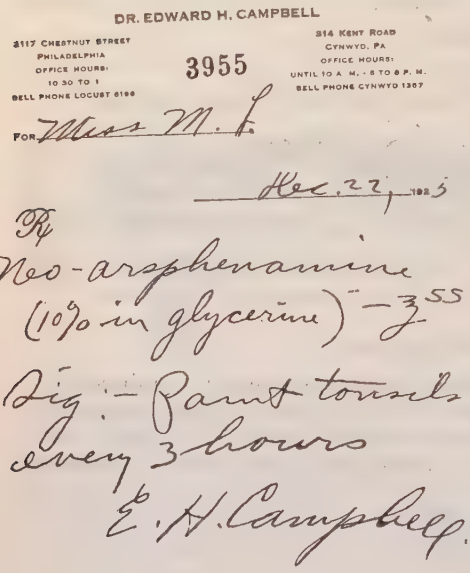
Composite order form

In rendering professional service in the community the pharmacist will constantly be called upon to fill spoken or written orders from the layman. This apparently simple matter, if not carefully considered, is frequently the source of embarrassing mistakes. Very few customers, even if they are intelligent, realize the necessity of forethought or care in calling for articles that they wish. Hence it is an excellent practice for the dispenser to *repeat the order* interrogatively at the time it is given, and obtain from the customer a clearly expressed assent before delivering the article, lest the wrong one be dispensed. If it is a poisonous substance, the use that is to be made of it should be carefully inquired into, and in all cases the sale should be entered in a regular poison book and properly dated and signed by the purchaser. Poisonous or dangerous substances should never be dispensed to children or minors without a written order, and even then the receiver should be cautioned about the contents.

Reading the Prescription—Having received the prescription it should be read over carefully, and judgment mentally pronounced, first upon the

safety of the doses of the respective ingredients, and then upon their compatibility. If this reading be done in the presence of the patient, especial care should be taken that the countenance reveal nothing whatever of what may be going on in the mind of the receiver. A shrug of the shoulders, an elevation of the eyebrows, a contemptuous toss of the scrap of paper on the prescription desk, may convey to the mind of the patient a more lasting impression of the opinion of the receiver as to the merits of the prescription than open criticism. Questions are frequently asked by patients and requests made for opinions. These should always be skilfully parried. A pharmacist has no right to reveal to a patient the character or the medicinal effect of the ingredients which enter into a prescription. When the names of the ingredients in the prescription are persistently demanded by the patient, the dispenser can fall back upon the expedient of frankly stating that it is a breach of etiquette to reveal the character of the ingredients, and intimating that it shows a lack of confidence in the prescriber on the part of the patient; but, if further insisted upon, the offer to send to the physician a written request to get his permission to disclose the ingredients is generally answered by the patient with a gracious "no matter". The pharmacist, as a co-worker with the physician in the healing art, is ethically bound to sustain him and cheerfully coöperate with him, and there should be at all times a spirit of mutual respect between the members of both professions, and a feeling that each is in duty bound to protect the other from unjust censure.

Fig. 563

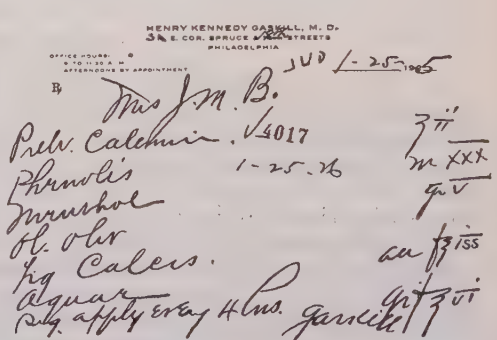


Typical modern prescription

In the majority of cases when the prescription has been received and the necessary information obtained concerning delivery, it is best to retire to the prescription department for a detailed study of the prescription.

Figs. 563 to 568 are typical modern prescriptions inserted here for practice in reading prescriptions.

Fig. 564

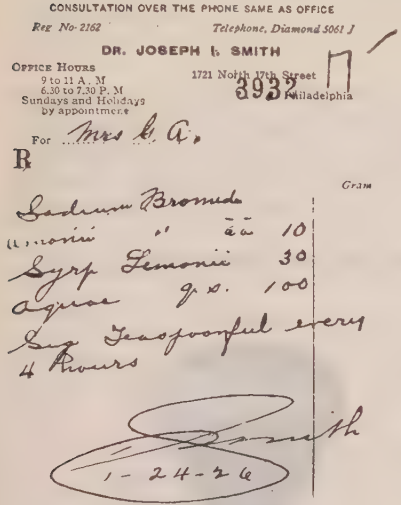


Typical modern prescription

Omissions and Errors—If an *obvious* error or omission in the prescription is detected by the pharmacist, or an unusually large or poisonous dose has been prescribed, it is generally easy to gain the necessary delay, upon the plea that the prescription will require considerable time to compound, or for some

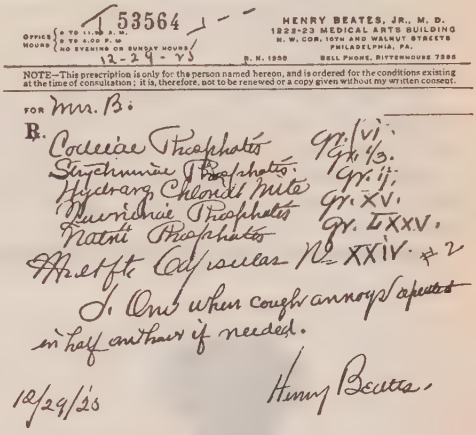
other reason which will not excite the suspicions of the patient and in the meantime the physician may be consulted. The careful pharmacist will always

FIG. 565



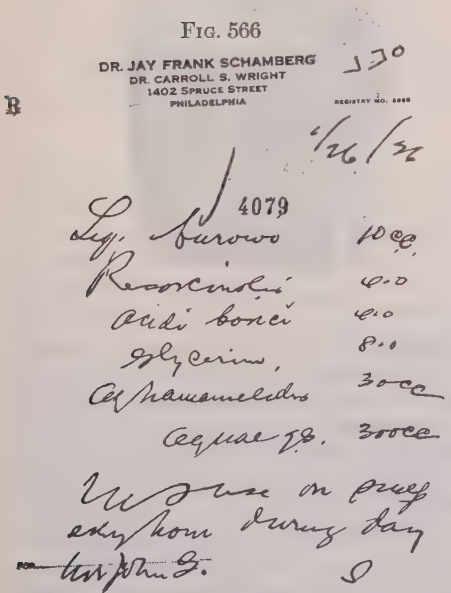
Metric prescription

FIG. 567


53564
HENRY BEATES, JR., M. D.
1822-23 MEDICAL ARTS BUILDING
N. W. COR. 10TH AND WALNUT STREETS
PHILADELPHIA, PA.
OFFICE HOURS 9 TO 11.00 A. M. 2 TO 4.00 P. M (NO EVENING OR SUNDAY HOURS)
12-29-25
R. H. 1990
BELL PHONE, RITTENHOUSE 7295
NOTE—This prescription is only for the person named hereon, and is ordered for the conditions existing at the time of consultation; it is, therefore, not to be renewed or a copy given without my written consent.
FOR Mrs. B.
R.
Codeinae Phosphatis gr. (vi) gr. ½.
Strychninae Phosphatis gr. ij.
Hydrarg. Chloridi Mitis gr. XV.
Quininae Phosphatis gr. LXXV.
Natrii Phosphatis
Aloetic Cathartici No. XXIV. #2
S. One when cough annoys, if needed in half an hour
12/29/25
Henry Beates.

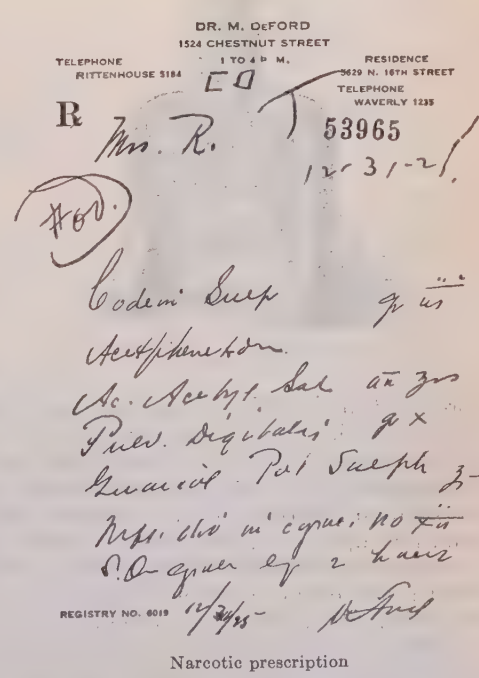
Narcotic prescription

FIG. 566



Metric prescription

FIG. 568



Narcotic prescription

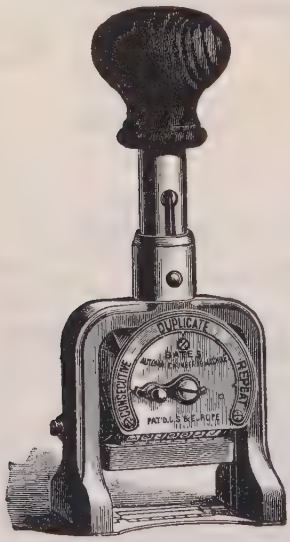
check the dose of potent remedies when prescribed and be confident that they are within reasonable limits of safety. The physician usually indicates an exceptionally large dose by underlining it so that the pharmacist may dispense

it without a question. If this has not been done it is best to consult the physician if he is within reach and in no instance should a dangerously large dose be dispensed without knowing that it is intended. Good judgment is necessary at all times, and where delay is entirely inadmissible there is nothing left for the pharmacist to do but to assume the responsibility of making the dose safe, or of supplying the omission according to his best judgment. In this case a written explanation should be sent immediately to the physician.

In the case of omissions or errors on the part of the pharmacist, so much judgment is needed which must depend upon the circumstances surrounding each case, that it would be unsafe to offer any suggestions. Generally the physician must be appealed to, and upon his skill and tact reliance must be placed. In such cases it is not often that he is found unwilling to exercise his good offices.

Additions or Alterations to Prescriptions by the Pharmacist—At the

Fig. 569



Numbering machine

Fig. 570

Rubber dating machine

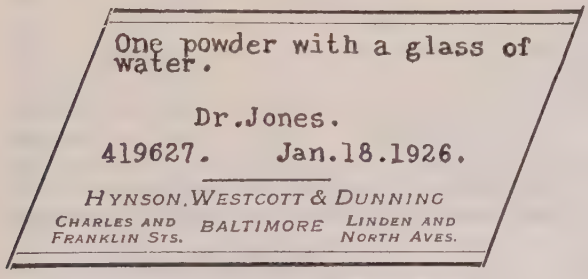
present time it is the custom among physicians to hold the pharmacist responsible for the proper compounding of prescriptions intrusted to his care, and to depend upon him. Such details as the choice of the excipient, method of straining or filtering, etc., are usually not specified. Indeed, with many it is a common practice simply to direct a solution or mixture of definite strength and rely upon the pharmacist to make it palatable. In all cases of this kind, care must be taken to make a note upon the prescription of each addition, so that in the event of renewal there may be no difference between the preparation then obtained and the original. The confidence which physicians place in pharmacists in this respect should be most sedulously guarded and every effort made to deserve and retain it. This can be done only by adhering strictly to the rule of *not permitting an alteration or addition to be made to a prescription which would affect or vitiate its proper medicinal action or interfere with the obvious intention of the prescriber.*

Numbering the Prescription—It is the universal practice to number the prescription, and to place a corresponding number upon the label, the object being to identify the bottle or package in case of renewal and connect it with the original prescription. This apparently simple matter requires, on the part of the compounder, concentration of thought to avoid errors—one of the most frequent lapses being that of duplicating the number of the last prescription, instead of numbering it consecutively. This, in case of renewal, may lead to serious consequences, especially if one prescription happens to be a four ounce aconite liniment and the other a four ounce solution of similar appearance for internal use. The duplication of the numbers is liable to occur when several prescriptions are being compounded at the same time by two or more assistants. Various expedients have been proposed to obviate mistakes of duplication. One is to simply write the numbers on a pad kept for the purpose, carefully avoiding duplication by insisting upon each number being entered before the label is written, but the better plan is to use a numbering machine.

Consecutive Numbering Machines—These are very convenient, and serve excellent purposes if they are properly and durably constructed.

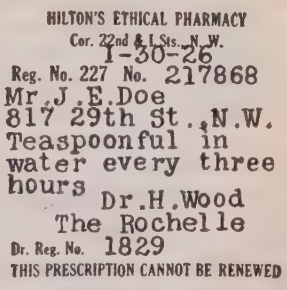
The usefulness of this machine to the pharmacist consists largely in the

Fig. 571



Prescription label for special box

Fig. 572



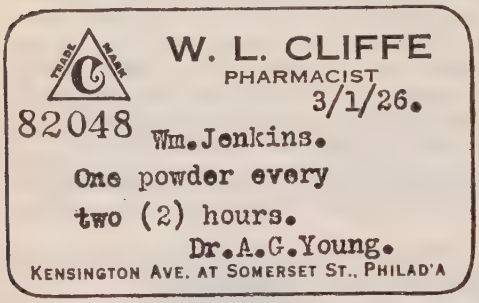
Label for narcotic prescription

fact that it can be made to *number consecutively in duplicate* (13428, 13428; 13429, 13429, etc.), so that if a proper sized machine is chosen (letter *b* is preferred) the number may be clearly and neatly printed upon *both prescription and label;* the machine may then be locked and set, so that there is not the slightest danger of variation of numbering while in use. The Bates automatic numbering machine (see Fig. 569) is believed to be the best numbering machine now available although many others are offered. It can be set so that the numbers will be consecutive, repeated indefinitely, or repeated in duplicate or triplicate as desired. The value of using a mechanical contrivance of this kind consists in its numbering in duplicate with absolute freedom from mistakes, and in the entire elimination of chances of error from defective handwriting, the figures being printed from hardened steel disks, invariably producing clear and distinct impressions. Bates numbering machines are also made which stamp the date in addition to the number.

Rubber numbering stamps are also in use; these are much cheaper and smaller than the consecutive numbering machines, and are very convenient. They are not automatic, however, and mistakes are liable to occur through the operator forgetting occasionally to turn one of the bands, and thus the main reason for using a numbering machine is lost. The numbers are cast upon endless rubber strips, and resemble the daters (see Fig. 570).

Dating—This also serves to fix the identity of a prescription, and it should never be omitted. The physician usually appends the date, but the prescription is frequently held by the patient and not presented for compounding upon the day on which it is written. As in the case of numbering, the date is most frequently written upon the face of the prescription by the pharmacist; and this should not be omitted, even though the date written by the physician be visible. The habit of dating should be firmly established, because it may prove of vital importance in case of a subsequent discussion or difference of opinion. *Rubber daters* are largely used now. Fig. 570 shows one which may be obtained from any stationer. It is inexpensive, not liable to get out of order, and so convenient for prescription work that it soon pays for itself.

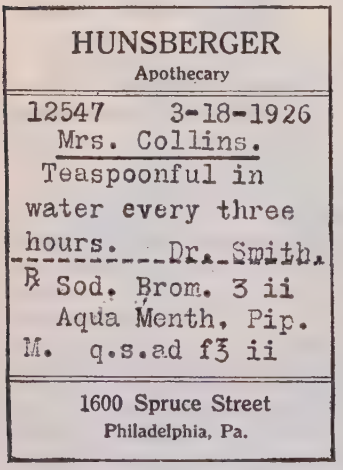
Fig. 573



Prescription label without border

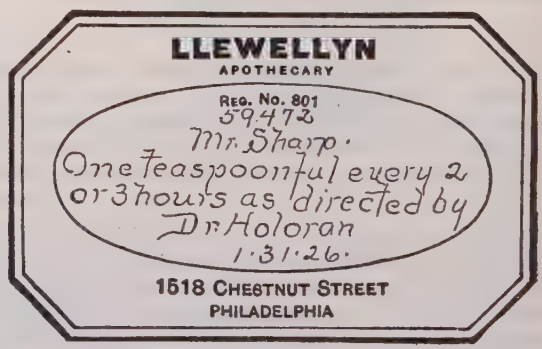
The Prescription Label—Usually the label is written first. This is an opportunity for a study of the prescription, without seeming to delay the filling. In some stores the label writing is done by a special clerk, who either writes exceptionally well or who handles the typewriter skilfully. Most modern prescription labels are typewritten on a special typewriter having a clamp for the label upon the platen of the typewriter. A typewriter for this purpose should be fitted with the smallest obtainable type, at least not larger than "elite", and should be fitted with a medical key-board

Fig. 574



Prescription label with copy

Fig. 575



Prescription label, handwritten

including the following characters: ℨ, ℥, ℈, and *M*. Many such machines are now available.

The labels for typewriting are usually without lines (see Figs. 571 to 575). They are also frequently printed without margins to avoid trimming and others are printed in strips to facilitate handling in the typewriter. Figs. 571 to 578 illustrate typical prescription labels as prepared in leading pharmacies.

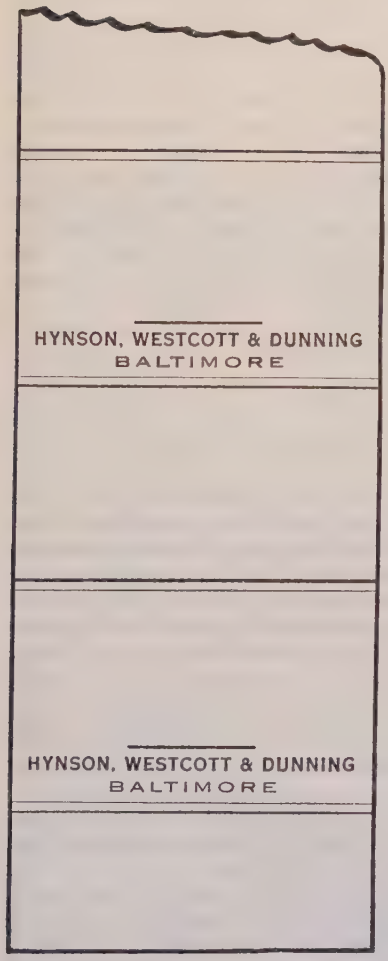
A prescription label should carry the number of the prescription, the date

of filling, the name of the patient, the directions for administration or use, and the name of the physician. Every label statement should be carefully checked to avoid error. It is of importance that the prescription label should be legible and indicate skill so that the impression upon the physician and the patient may be favorable.

When the label is attached to the finished prescription, it hardly seems necessary to suggest that it be straight, be rubbed perfectly smooth, and be without a blur or blot. The main prescription label when attached to a bottle should occupy a position slightly above the center of the bottle. If it is printed with a margin, it should be carefully trimmed with an even white line. This latter suggestion about trimming especially applies to strip labels carrying directions to "shake", "keep in cool place", or other special instructions.

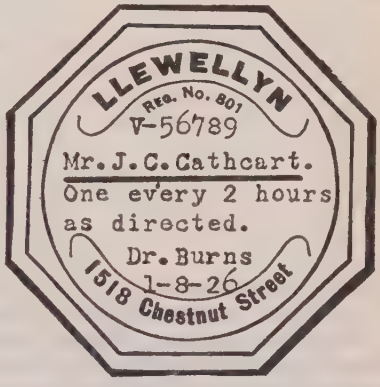
A physician frequently requests that a copy of the prescription be attached. Usually this is written or typed upon a special label, which is attached in an inconspicuous place upon the package.

Fig. 576



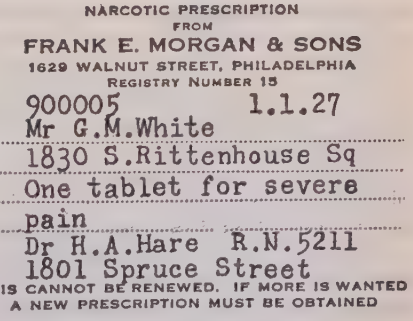
Labels in strips for typewriting

Fig. 577



Prescription label

Fig. 578



Label for narcotic prescription

Some prescription labels are arranged with an extension on the right side or are exceptionally long (see Fig. 574), providing a space upon which the copy may be typed. It is understood, of course, that in case the prescription contains a poison or a narcotic drug a copy must not be attached or given to the patient.

The Stock of Pharmaceuticals—Recognizing that the proper training of the pharmacist and the physical equipment of the dispensing laboratory are important, it must not be forgotten that the maintenance of an efficient stock of pharmaceuticals is an essential part of the service. The training of the pharmacist should qualify him to pass upon the character of the medicinal agents which he dispenses: not only identifying them, but determining their quality; in fact, the dispensing of therapeutically active and reliable medicines should rest upon the conscience of the pharmacist with such force that the selection and maintenance of stock should occupy a degree of importance only second to the accuracy of dispensing.

It is not possible today for the retail pharmacist to make certain products. This question has been discussed elsewhere. However, this does not relieve the pharmacist of the responsibility under the laws and under his conscience to select manufactured products which are dependable and to preserve and store these in such a way that they will not deteriorate. If products are known to have deteriorated they must not be dispensed. The specific action of fluidextract of ergot or a tincture of digitalis in a crisis may save the life of the patient. If the product supplied the physician does not respond as he has reason to believe it should, the responsibility or failure rests upon the pharmacist. It is oftentimes an advantage to select the line of products manufactured by a reliable firm and utilize their reputation in increasing the confidence of the physician in the prescription department.

The Compounding of the Prescription—Having written the label, the dispenser proceeds to the prescription case and assembles every ingredient required by the prescription. These are placed on the left side of the scale, or within a small frame which stands on the counter. As the ingredients are weighed or measured they are transferred to the right side of the scale or lifted from the frame. This provides a mechanical check upon the introduction of each ingredient. The prescriptionist is frequently called to the front of the store during the time of filling, and when he returns, if this policy is followed, there can be no question concerning which ingredients have been used. The prescription being properly compounded, in accordance with the skill of the dispenser, the product is transferred to a suitable container which is then labeled.

Checking Prescriptions—The prescription is now to be checked. If two pharmacists are not available, the careful re-check by the prescriptionist, of every item, should be made the routine practice of the store.

If there are two pharmacists in the store, they should always check each other on every prescription filled. This policy is primarily intended to detect an error which may have been made, but its influence is far broader inasmuch as it insures especial care on the part of the dispenser, as he will be very certain that there is no mistake before exposing himself to the possible criticism of an associate. The rule to check every prescription, therefore, usually prevents an error through the exceptional care which is exercised during the filling.

The checking of the prescription should proceed as follows: The dispenser holds the finished prescription. The one to check has before him the written prescription. The dispenser reads the label in detail and then indicates the ingredients individually, naming the quantities used.

All ingredients must still remain upon the counter, to be verified by the

one checking. Only after following this course should the prescription be released and the ingredients returned to their respective places. The custom so often practiced of reaching for a bottle of a chemical salt or a preparation, measuring or weighing the quantity, and immediately returning the bottle to its place, is reprehensible and dangerous. The momentary glance at the label is not sufficient and often more dependence is placed upon the location of the bottle than the reading of the label.

By the plan suggested the bottle must first be found and placed upon the counter. To weigh and measure the ingredient the bottle or container must again be handled, which means the reading of the label. The one who checks the prescription also sees the package and verifies the label and for the fourth time the label must be read when the container is returned to its permanent location. This quadruple check upon a label eliminates many serious errors.

A Poison—When a poisonous substance is found to be an ingredient in a prescription, there should always be extra caution as a matter of routine. The principle is exactly that involved by the added caution needed and exercised upon approaching a railroad crossing. The pharmacist should ever remember that *"eternal vigilance is the price of liberty"*.

The following routine for filling prescriptions, or slight modification of it, is in force in many drug stores:

Rules Governing Prescription Filling

NO TALKING

(Except in checking prescriptions)

1. Consider the prescription as a whole, including form, dose, incompatibilities, solubilities and method of filling.
2. Write the label.
3. Remove from the prescription case and place together on the counter on the left side, all shop bottles or containers needed in filling the prescription.
4. Compound the prescription, placing the containers of ingredients, as used, on the right side, and transfer the product to a suitable container.
5. Have the label checked by reading it off to the assistant, consider the number, date, name, directions, and doctor's name and then check the ingredients of the prescription.
6. Finish the package for delivery, capping all bottles, calculating the price, wrapping and attaching a delivery card bearing the price to be paid.
7. Return all shop bottles and containers to their proper places.

Pricing the Prescription—The price of the prescription must always be marked upon it. This is necessary in order to fix the sum in case of renewal. The price is usually not subject to variation, except in the case of a patient ordering a larger or smaller quantity of the prescription. In renewals, in all cases the increase or decrease should be noted distinctly, if future annoyance is to be avoided. Few occurrences are apt to create more distrust in the mind of the patient than a neglect of this precaution, the reasoning being that if the pharmacist is so careless as to have two prices for the same prescription, he probably has been careless in compounding it.

It is usual for the pharmacist to adopt a cipher to show the price of the prescription, some word or combination of characters being selected and memorized. If a word is selected, it should have ten letters, and there should be no duplicate letters, thus:

COME AND BUY
1234 567 890 C.YY—$1.00; OA—25 cents, etc.

The following words or phrases may be used as price marks: Behaviour, chemistry, complaints, no mistake, volumetric, duplicates, republican, democrats, epistolary. A word with nine letters requires an odd letter, usually X. Sometimes a repeater, like X, is employed; thus, in "come and buy", $1.00 would be C.YX. The cipher adopted by the National Association of Retail Druggists is largely used. It is PHARMOCIST. (See also page 1332.)

It frequently happens that physicians desire to indicate that a patient is poor and is a proper subject for charity. This is usually done by writing the letter P in the lower corner, or, if very poor, PP.

The pharmacist, although professional in spirit, must exercise business acumen in handling the prescription department. It is evident that there must be a reasonable profit, else the store could not long offer satisfactory service. The ingredients in a prescription are frequently negligible factors in determining the price. The real cost which must be considered in determining the price to be charged for a prescription is the time required for the services of the skilled pharmacist plus the cost of what is termed "overheads". This means the maintenance of the establishment. The time of the dispenser is probably the largest factor.

When it is realized that a competent prescriptionist who probably does not work more than 50 to 60 hours a week is being paid at least at the rate of about a dollar an hour and that even the simplest prescription, considering the time necessary to receive it, write the label, fill the prescription, check, wrap and deliver requires a minimum of from 15 to 20 minutes, there is at once an added cost of 25 to 35 cents. Add to this the proportion of overhead expenses, the cost of the ingredients and the container, and it is found that without any profit, the actual cost not infrequently exceeds the price usually charged. It is therefore desirable that the pharmacist and his assistants should follow a systematic plan of pricing so that there is a positive assurance that the cost is covered and a reasonable profit assured.

Investigations into the prices received for prescriptions in the average drug store have clearly shown the need for the adoption of scientific business methods in deciding upon the price to be charged. Where the old-fashioned method has been followed of having a flat price for a two-ounce mixture, a fixed amount for a dozen pills, etc., it has been shown that often a prescription is dispensed at an actual loss and the department frequently is conducted without any profit. This policy is often indirectly responsible for failure to establish a successful prescription pharmacy. The fundamental principles of business demand that to be successful the price charged must be sufficient to insure the use of the best ingredients and containers, the employment of skilled assistants, the payment of all other costs and expenses and the final making of a profit.

Many pharmacists have found that the adoption of such a policy has given them the opportunity to impress the physicians and the public by the quality of their service and to increase their business instead of reducing it.

But how shall this selling price be determined so that it is sufficient and yet not excessive? It involves, first, the exact cost of ingredients used in the prescription; secondly, the approximate cost of containers, labels, wrapping paper, etc.; thirdly, the labor and overhead cost, and, lastly, the desired profit.

The first of these factors is constantly changing and requires that the pharmacist frequently consult up-to-date price lists; he should not guess at prices but know the current market value, especially of drugs and chemicals. As ingredients are usually bought in comparatively large quantities, and as there

is a large percentage of waste and also loss from deterioration, it is customary to double the cost of materials in calculating the price of a prescription.

The cost of containers should also be known exactly and this with the cost of labels, paper, etc., should next be added to the price.

The actual time spent in compounding the prescription represents a definite cost and each prescription should carry its share of the general overhead expenses, such as rent, light, heat, insurance, etc., which make it possible to open the prescription department. Usually this is estimated, and the calculation for each prescription is based upon the time required, at a fixed rate per hour, say $1.50 or $2.00.

When the actual costs have been determined, the amount to be charged for profit may be given consideration. Sometimes this is included in the amount added for time consumed and that is the simplest plan; again it may be a definite addition to the actual cost, say of 10 to 20 per cent.

A plan for prescription pricing which has proved very satisfactory, is known as the *Evans' rule.* It is as follows: "Add a profit of 100 per cent to the actual cost of ingredients and container and then charge at the rate per hour decided upon in the particular store involved, for the actual time consumed in compounding."

The following general plan of pricing was originally suggested by the National Association of Retail Pharmacists, but has been somewhat modified to meet advances in costs (see Fig. 579).

FIG. 579

AVERAGE PRESCRIPTION PRICES

HOW TO CALCULATE PRICE. THIS IS IMPORTANT:

The price of the prescription is the compounding fee + the cost of the container + twice the cost of the material. (Exception: When the cost of the material is over $1.00, multiply the cost by 1½ instead of 2.)

COMPOUNDING FEES

I.—LIQUID PRESCRIPTIONS: Minimum total charge, 25c. All simple or compound mixtures, internal or external, dry or liquids and veterinary preparations are included in this table. Eye remedies, sprays for nose and throat, injections, etc., should be charged for as in the column: "Dose ℥ii—℥i".

Quantity	Dose 1–5 M.	Dose 10–25 M.	Dose ℥ss–℥i	Dose ℥ii–℥i	Gargle and Liniments only
½ oz.	.35	.30	.25	.20	.20
1 oz.	.45	.40	.30	.25	.20
2 oz.	.55	.45	.35	.30	.25
3 oz.	...	.50	.40	.35	.30
4 oz.	...	...	.45	.40	.35
6 oz.	...	...	.50	.45	.40
8 oz.	...	...	.55	.50	.45
12 oz.	...	...	.65	.55	.50
16 oz.	...	...	.70	.65	.60
32 oz.	...	...	.75	.80	.75

II.—DRY MIXTURES: Minimum total charge, 15c. These figures are compounding fees only. **Pills, Powders, Capsules, Wafers, Etc.**

Number	4	6	8	10	12	15	20	24	30	40	50
Fee	25c	30c	35c	40c	45c	50c	55c	60c	70c	85c	$1.00

Then every additional 25 up to one hundred, 25c. After that 20c. for every additional 25.

III.—OINTMENTS AND CERATES.

½ oz.	.30	2 oz.	.45	4 oz.	.65	8 oz	.85
1 oz.	.35	3 oz.	.55	6 oz.	.75	16 oz.	1.10

IV.—SUPPOSITORIES, BOUGIES, ETC.

1	.30	5	.55	12	.85	24	1.45
2	.40	6	.60	15	1.00	30	1.70
3	.45	8	.70	18	1.15	36	1.90
4	.50	10	.75	21	1.30		

CONTAINERS: Pill and Powder Boxes 10c; Screw Cap Vials 10c; Ointment Jars, ½ oz–1 oz., 10c; Collapsible tubes and box 10c; Bottles, 8 oz. or less, 5c; Glass-stoppered Bottles, three times the price of plain bottles.

In the above schedule it is suggested that not less than 10 cents be considered as the cost of ingredients in any prescription. If the actual cost of the ingredients is less than 10 cents, it is unfair to the pharmacist to consider a lower figure. Medicinal ingredients are often subject to serious deterioration and it is reasonable to consider this figure as a minimum.

The suggestion to double the market cost of ingredients in pricing a prescription is justified by the fact that the prescription sale is in principle a retail sale. The cost of materials may be considered as the wholesale cost. Weighing and measuring small lots from any purchase, always means waste and loss through deterioration, and therefore the justified doubling of cost.

If the ingredients are very expensive the schedule calls for one and one-half times the cost. A criticism frequently made concerning a schedule of this character is the fact that it will not apply to all conditions. The answer is that such is not intended.

Fig. 580

Sullivan transfer file

This pricing schedule is only a suggestion and a principle and pharmacists should modify the prices if necessary to meet the needs of the store. Sometimes they must be decreased, the price being too high, or perhaps they must be advanced if the neighborhood and the overhead expense demand a larger margin or gross profit.

Arguments for a schedule are:

1. Every one in the store gives the same prices for a prescription.
2. The proprietor is assured a reasonable profit.
3. A price is fixed which has been scientifically determined and in which there can be confidence should it be questioned.

Many other rules for pricing have been published but the one suggested has been found practicable and readily understood by everyone and it is flexible.

The Finished Prescription—When a prescription is sent from a retail pharmacy, it carries with it many indications of the skill or of the lack of skill of the pharmacist. It is difficult to advertise a pharmacy in the usual way, but the prescriptions sent out tell much of the training of the pharmacist and of his ideals. It is possible to speak of and demonstrate the dispensing equipment but one of the most potent factors in the advertisement of the dispensing pharmacy is the finished prescription as received by the patient.

The pharmacist seems to overlook the fact that within twenty-four hours after the time he fills a prescription it is almost certain to be examined by the physician. The pharmacist frequently says that he cannot easily meet the physician to promote his pharmaceutical service, but here is the opportunity. The prescription should carry, through its physical appearance, such evidence of the ability and care of the pharmacist that it will create confidence in his ability and insure large returns.

Every prescription leaving the store should, therefore, not only be correctly and skilfully compounded but the physical appearance of the prescription should indicate the pride and care which the pharmacist has taken in his professional work.

Filing, Binding, and Preserving the Prescription—There is very little uniformity of practice among pharmacists in the particulars of filing, binding and preserving prescriptions. The usual practice is one which is most inconvenient—*i.e.*, that of simply filing them away upon a long brass wire yearly, half yearly, or quarterly. By this plan they will certainly become in time torn, dirty, dusty, and fly-specked, and the file is very unsightly. The most satisfactory file of this type is known as the Sullivan transfer file (see Fig. 580). The stick file stands on the counter and is larger in diameter than the longer permanent file so that the prescriptions move freely. In transferring them the stick file is screwed to the long file, and all are slipped on without losing their order.

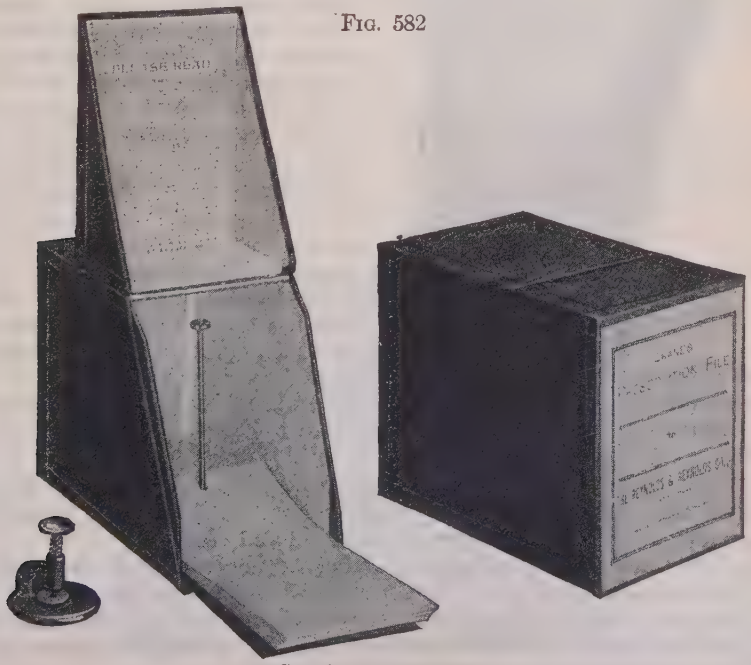
Fig. 581

Acme prescription book

The method of pasting prescriptions daily into a large prescription book is an improvement. The objection to this plan is, however, that the backs of the prescriptions cannot be examined readily, and in an active business the unwieldy books soon accumulate so as to be an inconvenience. Notwithstanding these seeming objections many stores doing a large prescription business use these books. Fig. 581 illustrates the Acme prescription book sold by the Whitall Tatum Company.

Many pharmacists copy their prescriptions into a book kept for the purpose. This plan is not always a judicious one. The chances of making errors are increased, and, in case of dispute, proof of the correctness of the copy would have to be produced.

Fig. 582

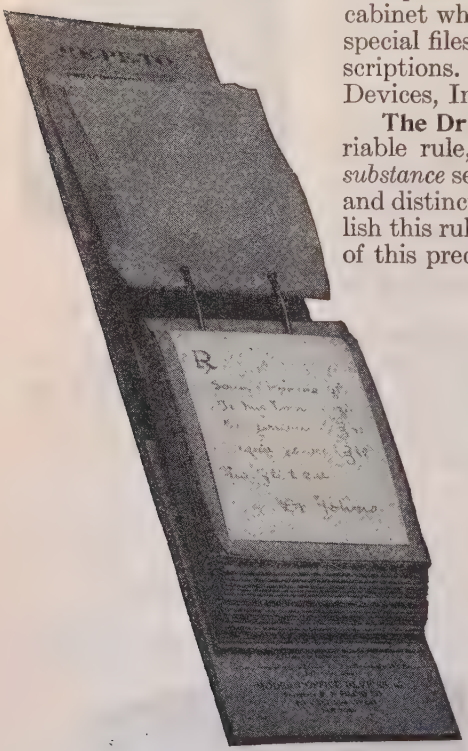


Crane's prescription file

Fig. 582 illustrates the Crane's prescription file, made by the Reynolds and Reynolds Company. The prescriptions are punched near the end and guide cards are provided for each 100 prescriptions, all being filed on a brass post, firmly attached to a wood base. Each file carries 1000 prescriptions and is slipped into a strong box. These boxes may be stacked so as to occupy a small space. One advantage of this file is the ease with which several prescriptions may be consulted simultaneously.

Figs. 583 and 584 illustrate the "Safeway" prescription file in which the prescriptions are pasted on a leaf of strong paper which is punched and held in book form in a strong binder. Each file carries 1000 prescriptions and they are stored in a wooden cabinet which is a part of the outfit. Note the special files for "narcotic" and for "liquor" prescriptions. This file is made by the Modern Office Devices, Inc., of New York City.

Fig. 583



"Safeway" prescription file

The Drug Store Label—It should be an invariable rule, in a drug store, that *every medicinal substance* sent out from the store *must have* a neat and distinct label upon it. It is necessary to establish this rule as a fixed custom or habit, for neglect of this precaution will often result in serious consequences. In addition, every package *should be labeled at once*, particularly in the case of prescriptions. The habit of permitting unlabeled packages to stand about, liable to substitution, will inevitably cause doubt, and give rise to some grave mistake, sooner or later. A very great diversity of opinion and taste is apt to prevail with regard to the most suitable style of label to select for general use. Formerly the home printer was exclusively depended upon, but the principle of division of labor has led to the establishment of "druggists' printing houses" in several sections of the country; this has resulted in cheapening labels, and although at one time it was quite common to see labels of an elaborately gaudy design (see Fig. 585) very few labels of that character are seen today.

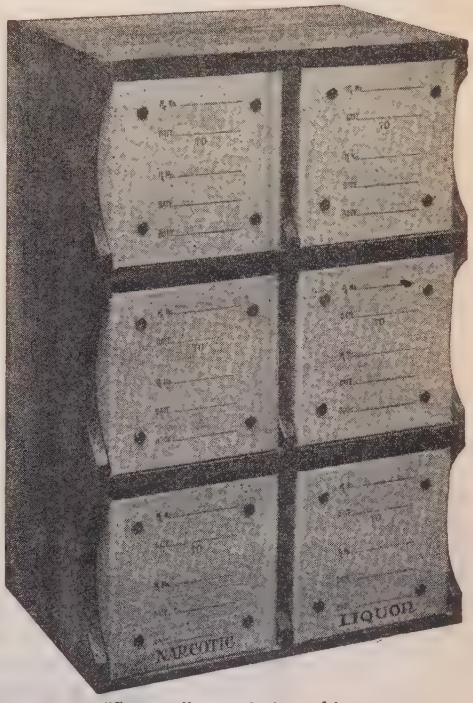
The trend today is toward great simplicity in labels and even the border, almost universally used a few years ago (see Fig. 586), is now omitted (see Fig. 587).

Neatness, distinctness, and simplicity are cardinal principles in designing labels, and the reputation of many establishments is frequently judged from the character of the outward signs of neatness and care.

Fig. 588 illustrates the McCourt label cabinet which finds favor with many pharmacists because of the convenience in finding the desired label. The labels are printed on gummed paper and supplied in rolls. Each roll is placed in a division of the cabinet and a label may readily be pulled out and torn off by quickly drawing it across the knife edge.

Labeling Poisonous Substances—Whenever a poison is dispensed to customers upon an order, without being prescribed by a physician, the word poison should be distinctly written upon the label. If solid, and wrapped in paper, it should have two wrappers upon it, and both should be labeled poison. In the case of prescriptions, the word poison *should not appear upon the package or bottle unless the physician has so directed.* A careful pharmacist will be sorely tempted to prevent possible accident by pasting a poison label upon the package, but he is relieved entirely of responsibility if the dose is not excessive and if the physician has not directed it, because there is usually a special reason *for omitting it* from the label—namely, that of avoiding the possibility of frightening the patient and thus defeating the object of the prescription. When bottles contain prescriptions of dangerous potency, a degree of caution must, however, be aroused in the patient without causing undue alarm by attaching a sticker somewhat as follows: "Caution—take with care", or "Caution—drop with care". If a prescription contains inflammable ingredients such as collodion or ether a sticker should be added cautioning "Keep away from flame". If the medicine is poisonous and not to be taken internally a special label should be attached reading as follows: "Caution—not to be swallowed". When a poison label is to be used upon a bottle one should be pasted on both

Fig. 584



"Safeway" prescription cabinet

Fig. 585

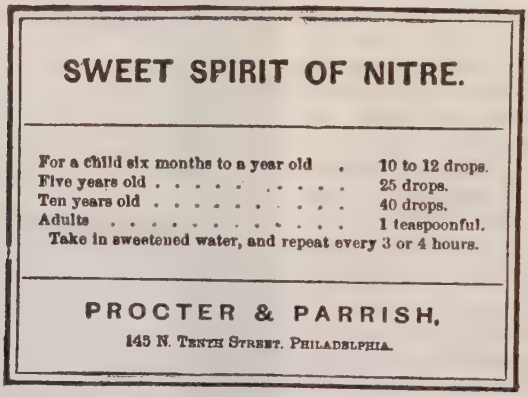
Sweet Spirit of Nitre.
For a child six months to a year old, 10 to 12 drops; five years old, 25 drops; 10 years old, 40 drops; adults, 1 teaspoonful. Take in sweetened water, and repeat every 3 or 4 hours.
PROCTER & PARRISH,
145 N. 10th St., Philada.

Fancy, obscure, and pretentious label

the front and the back of the bottle, so that it will be more likely to be seen, without possibility of failure through being covered by the hand holding the bottle. (See also "poison bottles", page 1666.)

Pasting Labels—Few of the minor operations in dispensing are more

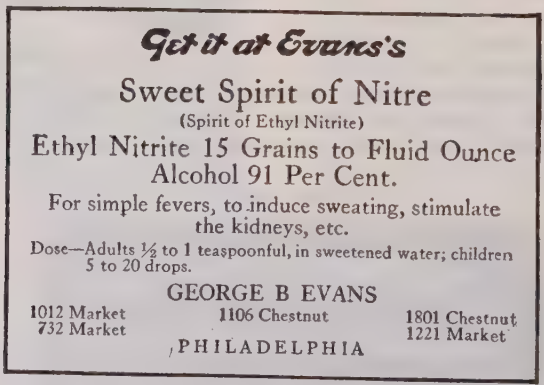
FIG. 586


SWEET SPIRIT OF NITRE.
For a child six months to a year old . 10 to 12 drops.
Five years old . . . . . 25 drops.
Ten years old . . . . . 40 drops.
Adults . . . . . 1 teaspoonful.
Take in sweetened water, and repeat every 3 or 4 hours.
PROCTER & PARRISH,
143 N. TENTH STREET. PHILADELPHIA.

Plain, old fashioned, and inexpensive label

important than this. Although frequently the subject of remark and criticism, there have been comparatively few real improvements in this direction. The selection of a brush to be used is important since most of these available will quickly rust and discolor the paste. A "rubber-set" sash brush, if one can be

FIG. 587


Get it at Evans's
Sweet Spirit of Nitre
(Spirit of Ethyl Nitrite)
Ethyl Nitrite 15 Grains to Fluid Ounce
Alcohol 91 Per Cent.
For simple fevers, to induce sweating, stimulate the kidneys, etc.
Dose—Adults ½ to 1 teaspoonful, in sweetened water; children 5 to 20 drops.
GEORGE B EVANS
1012 Market
732 Market
1106 Chestnut
1801 Chestnut
1221 Market
PHILADELPHIA

Typical modern label

obtained free from a metal ferrule, or a rubber-set shaving brush are most satisfactory and it pays to select one of good quality which should last for a long time.

FLOUR PASTE

Flour (wheat)	**4 oz. troy**
Water	**16 fl. oz.**
Nitric Acid	**1 fl. dr.**
Oil of Cloves	**5 min.**
Boric Acid	**10 gr.**

Thoroughly mix the flour, boric acid, and water, and strain the mixture through a sieve; add the nitric acid; apply heat, with constant stirring, until the mixture has thickened; when nearly cold, add the oil; strain it through coarse muslin if not perfectly smooth. This paste keeps well, and is much superior to tragacanth mucilage and ordinary paste. When required for pasting labels on tinned surfaces, the addition of 10 per cent of glycerin prevents labels from falling off after drying.

If an acid paste is not desired the following formula provides a very satisfactory label paste:

FLOUR PASTE

Flour (wheat)	**2 oz. av.**
Alum	**2 drachms**
Sodium Benzoate	**10 grains**
Oil of Cloves	**15 drops**
Water	**1 pint**

Rub the flour and alum to a smooth paste with the water, heat quickly to boiling with constant stirring, remove from the fire at the first indication of boiling, add the sodium benzoate and the oil, and mix thoroughly.

For some purposes a more adhesive paste is desirable, and a dextrin paste is recommended (see below).

DEXTRIN PASTE

White Dextrin	**1 lb.**
Syrupy Glucose	**2 oz. av.**
Aluminum Sulphate	**1 oz. av.**
Sodium Benzoate	**20 grains**
Water	**24 fl. oz.**

Mix the white dextrin, aluminum sulphate, and sodium benzoate with a portion of the water, rubbing to a smooth paste; add the glucose and the remainder of the water, and heat the mixture on a water bath, with occasional stirring, until it has become translucent; strain if necessary.

LABEL PASTE FOR TIN

Gelatin, granular	**4 oz. av.**
Sugar	**28 oz. av.**
Water	**88 fl. oz.**

Mix the ingredients and boil for ten minutes with constant stirring.

Some pharmacists prefer mucilage of tragacanth which is usually kept in an inverted wide-mouthed bottle, with the mouth covered with muslin or double cheesecloth, and resting in a small flat dish when not being used.

In pasting a prescription label to a box, bottle, or can, care should be used not to touch with the fingers the portion of the label which has been recently written upon, even if it has the appearance of being dry. A piece of blotting pad or filtering paper, slightly larger than the label, should be laid upon it, and pressed gently, smoothly, and evenly, so that the excess of paste which has exuded upon the edges may be absorbed. If a label has had too much paste applied, and the excess has not been pressed out as described, it will have a wrinkled appearance. Labels should be neatly trimmed, showing a very slight but uniform margin around the border. They should be pasted upon bottles *just above the center*, and never over the seams or mold marks, but half way between them.

Gummed labels, or labels printed on paper coated with a solution of dextrin, or gum, on one side, are largely used in some sections of the country. They are satisfactory in some localities where there is a dry atmosphere, but when used on the seaboard or in a damp atmosphere considerable loss is often experienced from their sticking together.

Label moisteners are available (see Fig. 589). The felt pad is continually moistened from the cylinder of water above. A moist piece of cotton is also very satisfactory for moistening gummed labels.

Arranging and Preserving Labels—A method of classifying labels must be adopted by each pharmacist which will be suited to his own requirements. The general rule is to arrange them in label drawers in the most convenient place in the store. The label drawers are preferably shallow, made of wood, and having compartments to receive the labels. Considerable space may be saved by having the compartments made of tinned iron instead of wood. The bottom of the drawer may be lined with cotton flannel, to prevent the labels from slipping underneath the tin divisions and becoming mixed by the continuous opening and closing of the drawer. It will be found convenient to separate the plain labels required constantly for articles in daily request from those of larger size or special design; and the former may be classified into labels for solids and labels for liquids. These may be arranged alphabetically in each drawer, so that they can be quickly found. *A regular system should be adopted and rigidly carried out; and when a place has been once fixed for a label, it should never be changed,* as few trifles give more annoyance than inability to find a label in a pressing rush of business.

FIG. 588

Use of McCourt label cabinet

FIG. 589

Label dampener

The upright label cabinets which have been contrived answer an excellent purpose where upright space can be spared.

The McCourt label cabinet, Fig. 588, is again referred to in this connection.

The Library—The pharmacist who is sincerely interested in his professional work will not only keep abreast of the scientific progress of the times by reading current literature, but will gradually accumulate a working library and a reference library which will enable him to perform his professional duties more satisfactorily and to act as scientific adviser to the public more intelligently. It is unfortunately true that many pharmacists overlook or neglect this feature, but the experience of those who properly equip themselves and the professional standing which they attain indicate that it is a factor of no mean importance in the development of professional pride and reputation.

It is thought advisable, therefore, to include for purposes of reference lists of books covering all phases of professional and merchandising activities for the convenience of those who may thus make use of it when emergency requires or opportunity arises.

No selective preference is given or advice offered in connection with specific purchases, of books, but authorities are mentioned in a number of fields, for there has long been a wise saying "Beware of the man of one book", which is supplemented and confirmed by another to the effect that "In the multitude of counsellors there is safety". No attempt is made to offer here a complete list of available books; it is believed, however, that if the books mentioned are purchased and used that the buyer will be prompted to find for himself many additional books for his growing and valuable library.

A "Five Foot" Shelf of Pharmaceutical Books [1]

(For a list of books on chemical analysis see page 1431)

List No. 1—(Approximately $35.00).

The United States Pharmacopœia, latest edition[3]

The National Formulary, latest edition[45]

The Dispensatory, latest edition (either the United States[3] or the National[4]

A treatise on pharmacy (latest edition) Remington[3], Caspari[4], or Arny[6]

A treatise on general chemistry. There is a confusing abundance of works to choose from, including Sadtler and Coblentz[3], Simon and Base[4], Deming[20], Newell[46], Attfield[4] and many others

Scoville's Art of Compounding[2]

New and Non-official Remedies[15], latest edition

A general formulary (like the Pharmaceutical Formulas[7], the Standard[8], Henley's[9], and the Scientific American Cyclopedia[10], The Era, The Druggists Circular)

List No. 2—(Approximately $65.00)
Total of 1 and the following:

A treatise on botany and pharmacognosy, such as Kraemer[20], Culbreth[4], Sayre[2], Youngken[2]

Lyons' Plant Names[14]

The Propaganda for Reform in Proprietary Medicines[15]

Nostrums and Quackery[15]

Useful Drugs[15]

A treatise on pharmaceutical arithmetic, such as Oldberg[16], Sturmer[17], Beal[18], Stevens[19] or Snow[44]

A treatise on pharmaceutical Latin, such as Sturmer[17], Muldoon[20], or Robinson[2]

Leach's Food Inspection and Analysis[20]

Beal's Prescription Practice[18]

Ruddiman's Incompatibilities in Prescriptions[20]

Robinson's Incompatibilities in Prescriptions[44]

Todd's Clinical Chemistry[44], a good all-round clinical laboratory book

List No. 3. (Approximately $100.00)
Total of 1 and 2 and the following:

A treatise on materia medica and therapeutics, such as Wood[3], Potter[2], Shoemaker[21], Bethea[21], Sollmann[5], Hare[4], or Bastedo[6]

Rideal's Disinfection

A book on industrial chemistry, such as Thorpe[22], Sadtler[3], Rogers[23], Molinari[2], or Allen and Aubert[23]

The Extra Pharmacopœia[24]

A treatise on organic chemistry, such as Loury and Harrow[20], or Norris[47]

A treatise on bacteriology for pharmacists, such as Schneider[2], Heinemann[25], Frost and McCampbell[22], McFarland, or Roddy

A treatise on veterinary medicine, such as Hiss[8] or the Chemist and Druggist's Veterinary Counter Practice[7]

One or two of the smaller books on the practice of pharmacy, such as Oldberg[28], Snow, Sayre and Havenhill[5], Stevens[4], Maltbie[29], Lucas[3], the latter an English book devoted largely to manufacturing processes

The United States Government publications[31] on the horse, the cow, poultry, swine, rodents, vermin, and many other subjects. The lists and prices may be obtained by application to Washington, D. C.

A book on Toxicology such as Trumper[2], or Underhill[5]

A medical dictionary such as Gould or Dorland[5]

The Condensed Chemical Dictionary[45]

Wood's Tablet Manufacture[3]

A treatise on soda water by Hiss[8], or any one of a half dozen other authors

Rudolphy's Directory of Drug Names[6]

Candy Medication, Fantus[44]

The Prescription, Wall[44]

Whys in Pharmacy, Ruddiman[20]

---

[1] These books may be obtained from the publishers, indicated in the second list by the number following the title, or they may be obtained through any dealer in medical, pharmaceutical or, other scientific books, such as the Philadelphia Book Co., 22 N. 9th Street, Philadelphia.

Books on Business—

These books are not included in the cost indicated for the previous lists.

Publishers—

The small figures refer to the publishers (or sellers) of the books whose names appear on page 1625.

1. E. F. Kelly, 10 W. Chase Street, Baltimore, Md.
2. P. Blakiston's Son and Co., Philadelphia
3. J. B. Lippincott Company, Philadelphia
4. Lea and Febiger, Philadelphia
5. W. B. Saunders Company, Philadelphia
6. The Druggists Circular, New York
7. McKesson and Robbins, New York
8. G. P. Engelhard and Company, Chicago
9. The Norman W. Henley Publishing Company, New York
10. Munn and Company, New York
11. T. M. Griffiths, 4214 Olive Street, St. Louis
12. Dr. W. L. Cummings, Syracuse, New York
13. Julius Springer, Berlin
14. Nelson, Baker and Company, Detroit
15. American Medical Association, Chicago
16. Chicago Medical Book Company, Chicago
17. Dr. J. W. Sturmer, 145 No. Tenth St., Philadelphia
18. Midland Publishing Company, Columbus, Ohio
19. Merck and Company, New York
20. John Wiley's Sons, New York
21. F. A. Davis Company, Philadelphia
22. The MacMillan Company, New York
23. D. Van Nostrand Company, New York
24. H. K. Lewis, 136 Gower Street, London
25. Baker and Taylor, New York
26. Longmans, Green and Company, New York
27. William Wood and Company, New York
28. George D. Oglesby, Chicago
29. Physicians Drug News Company, Newark, N. J.
30. J. and A. Churchill, London
31. Superintendent of Documents, Washington, D. C.
32. Advertising World, Columbus, Ohio
33. Merchants Record Company, Chicago
34. Spatula Publishing Company, Boston
35. Byxbee Publishing Company, Chicago
36. Midland Publishing Company, St. Louis
37. Bookkeeper Publishing Company, Detroit
36. A. C. McClurg and Company, Chicago
39. Daniel Stern, 355 Dearborn Street, Chicago
40. E. G. Swift, Detroit
41. Dry Goods Reporter, Chicago
42. W. A. Thompson, Pontiac, Mich.
43. Dr. J. H. Beal, 801 West Nevada St., Urbana, Ill.
44. C. V. Mosby, St. Louis, Mo.
45. The Chemical Catalog Company, 19 East 24th St., New York
46. D. C. Heath and Company, Boston, Mass.
47. McGraw-Hill Book Co., 239 W. 39th St., New York

In addition to modern pharmaceutical books there should always be available at least one of the professional journals, also a commercial journal, carrying a current price list and also the Journal of the American Medical Association. It would be desirable to have the magazine, "Hygeia", so placed that customers waiting for prescriptions, may read it, and the pharmacist should also be familiar with this magazine and its many suggestions for improving public health conditions.

The Laboratory—There should be associated with the pharmacy a special section or preferably a room devoted to the manufacture of pharmaceuticals and preparations and for the carrying out of clinical or bacteriological tests. It is desirable to have special equipment for this purpose, independent of the prescription counter as that department should be kept inviolate, ready for emergency calls. Many manufacturing operations require time for completion, and such should not be conducted in the section which is busy with daily store activities.

The possibilities for manufacture and analysis have been discussed elsewhere (see page 1427).

CHAPTER XCVII

INCOMPATIBILITY

INCOMPATIBILITY means disagreement. In Pharmacy it comprehends the study of the properties of substances which when prescribed in the same combination or when mixed together, show some physical change or undergo decomposition, or in some other manner show repellant or antagonistic qualities.

Types of Incompatibility—There are three subheadings under which incompatibility may be studied: *Therapeutic incompatibility*, *physical*, and *chemical incompatibility*.

Therapeutic incompatibility is exemplified in prescriptions containing ingredients which are antagonistic as regards their therapeutic effects. This type of incompatibility is entirely outside of the province of pharmacy so far as criticism or correction is concerned and will not be considered at all, except to point out that in some instances examples of this type of incompatibility are intentional and have the sanction of medical usage, as in the prescribing of morphine and atropine in combination.

Physical incompatibility is concerned with combinations of ingredients which are physically repellant to each other, such as oil and water, or with prescriptions or mixtures in which changes take place at the time of their compounding or subsequent thereto, in which no chemical alteration or decomposition of the ingredients is involved.

Chemical incompatibility is concerned with changes which take place in prescriptions or preparations in which, through chemical dissociation or decomposition, alterations in composition are produced, which may or may not be evidenced in a changed appearance of the preparation, or which may or may not have an effect upon its therapeutic value.

An intelligent study of incompatibility requires a comprehensive knowledge of the physical and chemical properties of a wide range of substances. Fundamental laws of both physics and chemistry are exemplified continually in a study of this subject. The possibilities are only limited by the number of substances used in prescription practice. No individual can ever expect to master the subject, nor can any treatise upon incompatibility completely cover it, except as regards underlying principles and more or less in complete lists of examples, for new remedies are coming into use constantly and unusual combinations will result as long as some few medical practitioners learn much of their prescription writing by the trial and error method. The medical curriculum provides for very little training in prescription writing, and much of what is taught is too early in the medical course to be remembered by the graduate when he enters practice. The medical journals and medical textbooks are for the most part silent upon the subject, so it becomes a distinctively pharmaceutical problem in which all of the scientific and professional knowledge of the pharmacist is required to be skilfully combined with much tact and diplomacy in order to handle the subject in a judicious and appropriate manner.

The proper management of the subject by the pharmacist who has a large prescription practice entails responsibilities, duties and opportunities which when properly combined and utilized lead to the development of mutual respect and coöperation between the physician and pharmacist in a field of work where the intelligent services of both are needed.

The pharmacist who advertises, as some have been known to do, "all physicians' prescriptions compounded exactly as written", advertises himself to his professional brethren, and to physicians, as either a fool or a knave, for the time comes to every pharmacist when he must exercise his professional skill in the interest of the physician and of the patient and must make minor changes in compounding a difficult combination in such a manner as to conform to the obvious intent of the prescriber.

In an historic legal case which occurred some years ago in Philadelphia, a physician wrote a prescription for a lotion composed of 1 fluidrachm of phenol in sufficient distilled water to make 1 fluidounce. The pharmacist dispensed the prescription exactly as written and the patient inserted the brush with which the lotion was directed to be applied, into the underlying layer of liquefied phenol, with the result that a severe burn was produced and a suit for damages was instituted against the physician for carelessness and malpractice. When in the course of the trial it was brought out in testimony that the addition of a fluidrachm of glycerin would have made a perfect solution of an obviously incompatible mixture, the pharmacist was censured for not having exercised his professional knowledge to overcome the evident lack of information of the part of the physician regarding the solubility of phenol in water.

Before entering into a discussion of specific examples illustrative of different types of incompatible prescriptions, some general principles may be considered.

There is a vast difference between being able to recognize an incompatibility and being able to overcome it. The making of an emulsion is an illustration of how a physical incompatibility may be properly overcome, for no one can deny the advantage of using gum in such a contingency.

Evidence of Incompatibility—There are a number of ways in which incompatibility may be evidenced. Among these are the following:

1. The failure to mix or dissolve when two or more ingredients are combined.
2. The separation of an immiscible liquid after the prescription is compounded.
3. The production of a precipitate, immediately or gradually, after the prescription is compounded.
4. The evolution of a gas gradually or with explosive violence.
5. The development of heat or of cold.
6. The exhibition of a change in color.
7. Liquefaction of solid ingredients.
8. Development of poisonous constituents by chemical reaction.

Incompatibility may also exist without any objective evidence of its existence. This is the most dangerous form and a few instances will be discussed at the close of this chapter.

There are many examples of incompatible preparations in which the incompatibility is intentional. In some of these cases corrective measures are applied in order to provide a presentable and satisfactory preparation. Emulsions are illustrative of this type. In other cases, as in mixtures containing insoluble solids where the insoluble material is of importance, the efforts of the pharmacist are directed toward compounding the preparation so as to insure the fine subdivision of the insoluble solid and its accompanying ease of suspension when the preparation is used or administered. The classic example of the prescription in which zinc sulphate and lead acetate react

to form soluble zinc acetate and insoluble lead sulphate illustrates this type and will be considered in detail in its proper place. (See incompatible prescription, number 16.) Still another type, and probably the most common of all is the prescription in which unexpected precipitation occurs. The cause of precipitation may be obvious or it may be obscure, but as a fundamental principle of magistral pharmacy, the difficulty should be remedied if it is possible to do so.

Some careless pharmacists simply follow the line of least resistance and put a "shake" label upon every prescription in which a precipitate appears, regardless of whether the exercise of a little skill in compounding would eliminate the trouble. In the following list of ways to be considered in remedying such a condition, reference is given to the number of the prescription in this chapter illustrative of the particular method mentioned.

1. Omission of an unimportant ingredient of no therapeutic significance (see incompatible prescription, number 25).
2. Addition of an inert constituent, the mere presence of which corrects the difficulty (see incompatible prescriptions, numbers 2, 3, 12 and 18).
3. Changing the character of the solvent (see incompatible prescriptions, numbers 10 and 19).
4. Emulsification (see incompatible prescription, number 1).
5. Adding the ingredients in a certain order (see incompatible prescriptions, numbers 8, 29 and 39).
6. Increasing the bulk of the prescription by adding an additional amount of the vehicle (see incompatible prescription, numbers 11 and 15).

It must be emphatically stated that when any important change is made in compounding a prescription, such as the omission of an ingredient or a change in the character of the solvent, the physician should be consulted beforehand if possible, or failing in that should be notified of the change, and the reasons therefor.

This by no means exhausts the possibilities of what may or must be done to overcome an obvious incompatibility. Other methods of procedure are discussed in the specific examples which follow.

The detailed consideration of the subject may best be accomplished by making no distinction in the classification as to whether the cause is physical or chemical—but following the list on page 1628 outlining the ways in which incompatibility may be evidenced.

Typical Incompatible Prescriptions

1. **The failure to mix or dissolve when two or more ingredients are combined**—This condition is always due to physicial causes. There are many examples, of which the following are illustrations.

No. 1

℞ Olei Olivæ f℥ii
Aquæ Destillatæ f℥ii
M. Make an emulsion *secundum artem.*
Sig.—Take a teaspoonful three times a day.
Dr. J.

Here the appropriate procedure is obvious. The proper amount of gum should be used (see Chapter on Emulsification), and an emulsion prepared by the Continental method.

No. 2 ℞ Bromoformi 2 cc.
Syrupi 20 cc.
Aquæ Fœniculi 40 cc.
M. ft. mist.
Sig.—2 cc. in water every 4 hours.
Dr. G.

Here is another example of physical incompatibility in which the liquids are mutually immiscible. In this case simple emulsification with gum will not avail unless the amount of gum is so great that the mixture will scarcely pour from the bottle. Bromoform has such slight viscosity and is so much heavier than water that it will not emulsify satisfactorily by itself. If, however, 5 cc. of olive oil or almond oil is mixed with the bromoform, this mixture may then be emulsified by the aid of gum and a portion of the fennel water and the subsequent dilution will enable a homogeneous preparation to be dispensed.

No. 3 ℞ Phenolis ℥i
Aquæ Destillatæ q.s. ad f℥i
M. ft. sol.
Sig.—Apply as directed with a camel's hair brush.
Dr. J.

Here is an example of a physical incompatibility due to forgetfulness on the part of the physician that phenol is not soluble in water to the extent directed. In this case, the obvious remedy is for the pharmacist to add a volume of glycerin equal to that of the phenol, *i.e.*, one fluidrachm. This will make a clear and permanent solution. This prescription has already been discussed under the general introductory principles. In such a case as this, it is imperative that the pharmacist utilize his professional skill in compounding the prescription in such a manner as to protect the patient from possible injury, as might result if the prescription were dispensed as written.

No. 4 ℞ Potassii Chloratis ℥iv
Phenolis gtt. xv.
Infusi Salviæ q. s. f℥iv
M. ft. sol.
Sig.—Use as a gargle.
Dr. M.

This is another example of an excess of the substance to be dissolved. The potassium chlorate is in great excess over the amount needed to make a saturated solution. If heat is used, the potassium chlorate will go into solution temporarily, but will crystallize out as the solution becomes cold. In either case the excess of potassium chlorate, if allowed to remain, will act as an irritant to the throat when used as a gargle. This preparation should be filtered before being dispensed.

No. 5 ℞ Magnesiæ Ponderosæ ℥iss
Massæ Hydrargyri ℥ss
Sucrosi ℥i
Aquæ Menthæ Piperitæ q. s. ad. f℥iv
M. ft. mist.
Sig.—One teaspoonful at bedtime.
Dr. C.

This is an example of a common type of physical incompatibility in which active insoluble constituents are present in a prescription. Filtration or solution are both out of the question in such a case. The only thing to be done is to dispense the mixture exactly as written and put on a "shake well" label.

No. 6 ℞ Petrolati Liquidi f℥ii
Fluidextracti Cascaræ Sagradæ f℥i
M. ft. mist.
Sig.—Take a dessertspoonful at night.
Dr. C.

In this case, the cause of the incompatibility is apparent. Mineral oil will not dissolve hydroalcoholic liquids. There is no emulsifying agent that can be used in such a case, and there is no remedy for the condition. The prescription must be dispensed as written, and must have a "shake" label. This same combination is sometimes encountered with the additional ingredient of precipitated sulphur which adds to the difficulties involved, for it is soluble in neither of the liquids and the combination can only be dispensed as an unattractive looking mess.

No. 7 ℞ Acidi Borici ℥i
Aquæ Destillatæ f℥ii
M. ft. sol.
Sig.—Apply locally to eyes with eye cup.
Dr. C.

This is another case of incomplete solution. The physician undoubtedly desires a saturated solution of boric acid but instead of writing for it as such, writes a prescription for a specific amount of boric acid to be dissolved in a directed amount of water. In this case, the amount of water is insufficient. It would require just about 2½ fluidounces of water to dissolve one drachm of boric acid. The proper procedure in this case would be to dispense a saturated solution of boric acid, as that is undoubtedly intended. To dispense this prescription exactly as written, allowing the excess of boric acid to remain in the bottle, might result in injury to the patient, as eye lotions should always be dispensed clear.

No. 8 ℞ Zinci Oxidi ℥ii
Linimenti Calcis f℥ii
M. ft. mist.
Sig.—Apply locally.
Dr. D.

If the zinc oxide is added to the previously prepared lime liniment, the emulsification of the latter is destroyed and a curdy mixture results. If, however, the zinc oxide is first triturated with the lime water (1 fluidounce) and the creamy liquid transferred to a bottle and agitated thoroughly with the linseed oil (1 fluidounce) a smooth, satisfactory preparation results. This is an excellent example of the influence of changing the order of mixing the ingredients.

2. **The separation of an immiscible liquid after the prescription is compounded**—There are a number of possibilities of this kind, a few of which seem to occur frequently in prescription practice.

No. 9 ℞ Potassii Bromidi ℥v
Aquæ Menthæ Piperitæ f℥i
M. ft. sol.
Sig.—One half teaspoonful at bedtime.
Dr. X.

This is an example of a physical incompatibility in which the selective preference of a solvent for a second solute after it has been previously saturated with another. Peppermint water is a saturated aqueous solution of peppermint oil. When this solution is used as a solvent for potassium bromide, the latter is taken up almost to saturation, with the result that about half of

the oil of peppermint previously dissolved is thrown out of solution and separates in the form of floating oily globules. This phenomenon is sometimes referred to as "salting out". To dispense the preparation in this turbid condition would not be productive of any harmful result, but would not be "good pharmacy".

There are two alternatives possible. The prescription may be compounded as written and the solution subsequently filtered to remove the oil globules; or the peppermint water may first be reduced in strength by adding an equal amount of distilled water, in which case it would require but ½ fluidounce of peppermint water to compound the prescription which would then require no filtration and the result would be practically the same as in the previous case, with much less trouble.

No. 10

℞ Potassii Bromidi ℥v
Chloralis Hydratis
Elixir Aromatici f℥iv
M. ft. sol.
Sig.—One teaspoonful at bedtime.

Dr. Y.

This is another case of physical incompatibility and selective preference of solvents for certain constituents. The potassium bromide exercises a selective preference for the water present in the simple elixir and the chloral hydrate does the same with the alcohol. When first compounded, the prescription appears to be in the form of a perfect solution. Turbidity almost immediately ensues, and the preparation ultimately separates into two layers. The lower layer, which is the greater in bulk, contains all of the potassium bromide and the water, with a portion of the alcohol, while the upper layer contains all of the chloral and the remainder of the alcohol. This condition is potentially dangerous, as the colorless supernatant layer might easily be overlooked by the patient, even if a "shake well" label were attached, and an overdose of chloral might be taken. Several alternatives have been suggested as remedies. The simple elixir may be diluted with an equal volume of water, the prescription may be doubled in bulk by dilution with water and the dose correspondingly increased; the aromatic elixir may be replaced by an aromatic water or by one of the elixirs of the National Formulary of low alcoholic strength. Whichever procedure is adopted, the physician should be notified and proper notation should be made upon the original prescription to ensure uniformity in case of a "refill".

No. 11

℞ Spiritus Æthylis Nitritis f℥iv
Potassii Citratis ℥i
Syrupi Acidi Citrici
Aquæ Destillatæ aa f℥i
M. ft. sol.
Sig.—One teaspoonful every two hours.

Dr. Z.

This is another example of physical incompatibility depending upon the selective preferences of solvents. In this case, the ethyl nitrite separates out in concentrated alcoholic solution upon the surface of the nearly saturated solution of potassium citrate. This is undoubtedly a potentially dangerous condition and can only be remedied by increasing the bulk of the prescription by adding more water, and making a corresponding increase in the dose.

3. **The production of a precipitate, immediately or gradually after the prescription is compounded**—This condition may be due to physical causes or to chemical changes. It is probably the most frequently encountered type

of incompatibility. Examples will be given of a number of prescriptions illustrating various causes of this condition.

No. 12 ℞ Tincturæ Cannabis Indicæ
Tincturæ Aurantii Amari aa f℥i
Tincturæ Rhei f℥ii
Misc.
Sig.—One half teaspoonful at night.
Dr. R.

This is an instance of physical precipitation caused by mixing the highly alcoholic, resinous tincture of cannabis with tinctures of lower alcoholic strength, the resinous matter of the cannabis being precipitated. The best procedure to follow in this case is to use a small amount of acacia which will aid in overcoming the difficulty and will prevent the resins from depositing permanently upon the inside surface of the bottle.

When alcoholic solutions of resins such as preparations of cannabis, guaiac, etc., are to be diluted with aqueous liquids, the addition of an equal volume of honey to the alcoholic liquid and the adding of this mixture slowly to the aqueous liquid, aids in effecting a satisfactory suspension of the resins.

No. 13 ℞ Tincturæ Nucis Vomicæ f℥ss
Infusi Gentianæ Compositæ f℥iiss
Tinctura Cinchonæ Compositæ f℥iii
Misc.
Sig.—One teaspoonful three times a day before meals.
Dr. C.

In this case, the precipitate consists of drug extractives thrown out on account of the differing alcoholic strengths of the ingredients. The amount of precipitate is not very great, but inasmuch as it might contain some of the active principles, carried down by adsorption, it is not proper to filter the mixture, but it may be dispensed with a "shake" label.

No. 14 ℞ Magnesiæ Sulphatis ℥i
Tincturæ Zingiberis f℥i
Tincturæ Aurantii Dulcis f℥i
Aquæ Menthæ Piperitæ f℥ii
M. ft. sol.
Sig.—One teaspoonful before breakfast.
Dr. E.

The magnesium sulphate may be dissolved in the peppermint water but as soon as the alcoholic tinctures are added crystallization of the magnesium sulphate takes place, and in a very short time almost the entire amount of the salt will have separated in a crystalline mass in the bottom of the bottle, and no amount of agitation will effect its incorporation. In such a case the physician should be consulted before making any change.

No. 15 ℞ Sodii Bromidi ℥iv
Elixir Pepsini et Rennini f℥ii
M. ft. sol.
Sig.—One teaspoonful every two hours.
Dr. B.

In this prescription, a slimy precipitate occurs which is difficult to incorporate by shaking. The precipitate consists of the enzymes of the elixir, which are salted out by the sodium bromide. The best remedy would be to reduce the concentration, with the consent of the physician, by diluting the mixture to four fluidounces and doubling the dose.

No. 16

℞ Plumbi Acetatis ℥ss
Zinci Sulphatis gr.xv
Aquæ Rosæ f℥iv
M. ft. injectio.
Sig.—Use as an injection.
Dr. B.

This is a classic example of an intentional incompatibility in which precipitation occurs, the precipitate being produced by chemical reaction. Lead acetate and zinc sulphate are used in clear solutions, separately, for their astringent effects when applied externally. When solutions of the two salts are mixed, mutual decomposition occurs, soluble zinc acetate remaining in solution and insoluble lead sulphate separating as a precipitate. It has been found in practice that when this prescription is compounded so as to produce a finely divided precipitate of lead sulphate which can be incorporated uniformly at the time of injection, the coating of lead sulphate deposited on the mucous surfaces, exercises a soothing and protective effect which is advantageous.

Great care must be exercised in compounding this prescription to avoid the formation of a coarse granular precipitate which would be irritating. If the lead acetate and zinc sulphate are triturated together in a dry condition and the rose water gradually added, such a coarse granular precipitate as it is desirable to avoid would be formed. The proper method of compounding this prescription is to dissolve the zinc sulphate and the lead acetate separately, each in two fluidounces of rose water, and mix these solutions by pouring the lead acetate solution gradually into the zinc sulphate solution with constant agitation. This same principle, which follows the fundamental rules governing precipitation (see Chapter XIX, page 216), may be applied in many similar instances when precipitates are produced in compounding prescriptions.

No. 17

℞ Quininæ Sulphatis gr.x
Potassii Acetatis gr.xv
Acidi Sulphurici Diluti gtt.xv
Aquæ Cinnamomi f℥i
M. ft. sol.
Sig.—A tablespoonful at a dose.
Dr. W.

Prescriptions containing quinine salts in liquid mixtures are not so commonly encountered as they were some years ago, but they are occasionally seen even yet. This one illustrates a type in which precipitation of an almost insoluble salt of quinine results. In this case, it is the formation of quinine acetate which is the cause of the trouble. The prescription becomes almost solid from the voluminous character of the precipitate, and should not be dispensed at all, as the liquid is so thick that it cannot be poured from the bottle. This is an instance where the physician should be called upon to revise his prescription. The use of aromatic elixir as a vehicle instead of cinnamon water remedies the difficulty, but it would not be advisable to make such a change without consulting the physician.

No. 18

℞ Magnesii Sulphatis
Potassii et Sodii Tartratis aa ℥i
Sodii Phosphatis ℥ss
Tincturæ Capsici mxx
Aquæ ad f℥ii
M. ft. sol.
Sig.—One teaspoonful every hour.
Dr. X.

The sodium phosphate is the disturbing factor in this combination. It produces gradually a flocculent precipitate of magnesium phosphate. The

addition of a small amount of tartaric acid to the solution of the first two ingredients in one-half of the water will prevent the formation of this precipitate when the solution of the sodium phosphate, in the remainder of the water, is added.

No. 19

℞ Argenti Nitratis gr.xxv
Liquor Sodii Chloridi Physiologici f℥vi
M. ft. sol.
Sig.—Use as an injection, as directed.
Dr. L.

Soluble silver salts are incompatible with chlorides. In this case, the silver would be entirely thrown out of solution as the insoluble silver chloride. Physiological salt solution is an advantageous solvent for some types of injections, but not for this one. Distilled water should be used as the solvent and the physician should be notified of the change. Even rose water, which is sometimes prescribed as a solvent for silver nitrate, will decompose some of the silver salt with the formation of a dark precipitate.

No. 20

℞ Strychninæ Sulphatis gr.i
Potassii Bromidi ℥viii
Aquæ Destillatæ q. s. ft. f℥viii
M. ft. sol.
Sig.—One teaspoonful every four hours.
Dr. J.

One who is inexperienced in prescription practice would quickly compound this and send it out without a "shake" label. This procedure would be dangerous. A transparent solution results at first, but within a few hours, the sparingly soluble strychnine begins to separate as a microcrystalline precipitate, which by its small amount and inconspicuous character might be entirely overlooked by the patient and be allowed to deposit in the bottom of the bottle. This is due to the slightly alkaline reaction of the potassium bromide. Little or no strychnine would be present in the clear liquid which would be poured off as the various doses are administered, but in pouring out the last dose there is great danger that the entire grain of strychnine might be taken at one dose and dangerous results follow. The proper procedure in prescriptions of this type is to put on a "shake" label, whether the prescription is perfectly clear at the time of dispensing or not, as it has been found by experience that this precipitate sometimes does not make its appearance for some hours after the solution has been made.

No. 21

℞ Morphinæ Sulphatis gr.ii
Spiritus Ammoniæ Aromatici f℥ii
Aquæ Menthæ Piperitæ f℥vi
M. ft. sol.
Sig.—One teaspoonful when required.
Dr. R.

Here is another and more common type of alkaloidal precipitation in which an alkaloidal salt, which is soluble in water, is decomposed by an alkali with the liberation of the insoluble free alkaloid. There are many possibilities of this kind and the prescription in each case requires a "shake" label. If the pharmacist is well acquainted with the physician writing such a prescription a little missionary work may not be amiss, for, as a general principle, it is dangerous to have a powerful active ingredient in a state of suspension in a mixture.

No. 22 ℞ Cocainæ Hydrochloridi gr.v
Sodii Boratis gr.x
Aquæ Destillatæ f℥i
M. ft. sol.
Sig.—Two drops in each eye at night.
Dr. B.

The alkalinity of the borax causes the precipitation of the cocaine and the production of an irritating turbid mixture. The proper remedy is to replace the sodium borate with an equal amount of boric acid which will make a clear solution in accord with the expectation and desire of the physician prescribing it.

No. 23 ℞ Sodii Salicylatis ℥ii
Syrupi Acidi Citrici f℥iv
M. ft. sol.
Sig.—One teaspoonful every two hours until pain is relieved.
Dr. F.

This prescription illustrates a frequently occurring type in which salicylates or benzoates are present as ingredients. Sodium salicylate is completely soluble in plain syrup in the amount prescribed, but the citric acid decomposes the sodium salicylate with the formation of sodium citrate and free salicylic acid. Free salicylic acid is only soluble in aqueous solutions to the extent of about one grain to the fluidounce, so that a voluminous precipitate of salicylic acid occurs, which not only makes the prescription unsightly and difficult to dispense, but makes it more likely to be irritating to the alimentary tract. Here is another opportunity for missionary work with the physician who cannot possibly be expected to keep in mind all of the variations in solubility of the hundreds of substances that he is called upon to prescribe.

No. 24 ℞ Acidi Acetylsalicylici ℥i
Potassii Iodidi ℥i
Glycerini f℥iv
Aquæ Anisi q. s. ad f℥iv
M. ft. sol.
Sig.—One teaspoonful every three hours.
Dr. N.

A gradual separation of a crystalline precipitate occurs in this prescription. Upon investigation it has been found to consist of free salicylic acid. Acetylsalicylic acid is easily dissociated in aqueous solutions with the liberation of salicylic and acetic acids. Even the use of solution of potassium or sodium citrate as the solvent, in the hope of preventing this change, is not effective. For this reason acetylsalicylic acid is usually prescribed in tablets or capsules.

No. 25 ℞ Quininæ Sulphatis gr. xxx
Acidi Sulphurici Diluti q. s.
Fluidextracti Glycyrrhizæ f℥ii
Syrupi f℥iv
M. ft. sol.
Sig.—One teaspoonful three times a day.
Dr. R.

It is not likely that this combination is frequently prescribed at the present time. As it illustrates a principle of procedure, however, it is worthy of consideration. The question hinges on the interpretation of the quantity "q. s." following the second ingredient. It was formerly the practice to dispense quinine sulphate in acidulated preparations to insure perfect solution. It was later discovered that the more thorough the solution the more

intensely bitter was the taste. Then came the practice of using glycyrrhiza preparations for masking the bitterness of the quinine. In the above prescription, if any sulphuric acid is used at all, it will not only intensify the bitterness of the quinine, but it will have the effect of diminishing the sweetness of the glycyrrhiza, by precipitating out the glycyrrhizin, which is only soluble in slightly alkaline mixtures.

The sensible interpretation of "q. s." in this prescription, therefore, is *none at all.* This agrees with the obvious intent of the prescriber who put the fluidextract of glycyrrhiza in to get the benefit of its sweetness.

No. 26 ℞ Liquoris Plumbi Subacetatis f℥ii
Mucilaginis Acaciæ f℥ii
Aquæ q. s. ad f℥xvi
M. ft. sol.
Sig.—Apply on a cloth kept constantly moistened.
Dr. Y.

Solution of lead subacetate gives a thick gelatinous precipitate with mucilage of acacia. The lumpiness of this precipitate may be minimized by diluting the lead subacetate solution with 6 fluidounces of water and the mucilage of acacia with an equal amount, and pouring the former into the latter with constant and vigorous agitation. Even at its best, however, the mixture is thick and unsatisfactory for use in the manner directed. If the physician is available, the suggestion should be made to replace the 2 fluidounces of lead subacetate solution with 2 fluidounces of a 25 per cent solution of normal lead acetate which will have a similar therapeutic effect and will not precipitate the acacia.

No. 27 ℞ Strontii Bromidi ℥ii
Liquor Potassii Citratis q. s. f℥ii
M. ft. sol.
Sig.—One teaspoonful at night.
Dr. M.

The precipitate which occurs in this prescription is strontium citrate, which is sparingly soluble and comes down rather gradually. The preparation may be dispensed with a "shake" label.

Another somewhat similar instance is when aromatic spirit of ammonia is present in a prescription with strontium bromide, the precipitate in this case being strontium carbonate.

These incompatibilities of the strontium salts are easily understood by the pharmacist, but are usually a surprise to the physician who has prescribed other bromides such as potassium, sodium, lithium, etc., in similar combinations with no occurrence of precipitation.

No. 28 Liquoris Potassii Arsenitis
Syrupi Ferri Iodidi aa f℥i
Misce
Sig.—Two drops three times a day, increasing the dose a drop each day until five drops are taken.
Dr. D.

A precipitation of ferrous carbonate occurs in this prescription in consequence of the alkalinity of the Fowler's solution. The preparation may be dispensed with a "shake" label.

No. 29

℞ Hydrargyri Chloridi Corrosivi gr.iii
Mucilaginis Acaciæ f℥i
Liquoris Calcis
Aquæ Destillatæ aa q. s. f℥iv
M. ft. sol.
Sig.—Apply locally.
Dr. R.

This is an interesting example of a prescription which when compounded in one order of mixing will show precipitation, while if another order is followed the preparation will be in the form of a clear solution.

If the lime water is added directly to the corrosive sublimate, a reddish-yellow precipitate of mercuric oxide will occur which will not redissolve when the other ingredients are added. If, however, the corrosive sublimate is first dissolved in the distilled water, the mucilage of acacia added next, and the lime water added last, no precipitation occurs.

4. **The evolution of a gas, gradually or with explosive violence**—Chemical reaction frequently results in the evolution of gaseous constituents. This is sometimes intentional and desirable, as in the administration of granular effervescent salts, or of an effervescing solution prepared extemporaneously. Sometimes, however, the effervescence is unexpected and sometimes the gas is liberated with explosive violence, occasionally with serious results. The condition may occur in either solid or liquid mixtures.

No. 30

℞ Ammonii Chloridi ℥ss
Ammonii Carbonatis gr.xl
Syrupi Scillæ f℥i
Syrupi Tolu ad f℥ii
M. ft. sol.
Sig.—One teaspoonful as required.
Dr. R.

In this prescription, carbon dioxide is liberated from the ammonium carbonate by the acetic acid present in the syrup of squill. Explosions have resulted from combinations of this kind having been carelessly compounded by placing the ingredients successively in the bottle and stoppering securely. The best method to pursue in compounding this prescription is to use a capacious mortar, and permit the effervescence to cease entirely before transferring the mixture to the bottle.

No. 31

℞ Phenolis gr.xxv
Sodii Bicarbonatis
Sodii Boratis aa ℥i
Glycerini f℥i
Aquæ ad f℥iv
M. ft. sol.
Sig.—Apply locally.
Dr. D.

The reaction involved in this prescription is similar to that observed in preparing Dobell's solution. There is no acid present to react with the sodium bicarbonate and yet effervescence occurs. The explanation is found in the fact that glycerin decomposes alkaline sodium borate with the production of neutral sodium metaborate and free boric acid, and this latter constituent then reacts with the sodium bicarbonate to produce the effervescence.

No. 32 ℞ Ammonii Chloridi ℥ii
Potassii Bicarbonatis ℥iss
Misturæ Glycyrrhizæ Compositæ f℥iii
M. ft. sol.
Sig.—One teaspoonful at night for cough.
Dr. S.

In this prescription, no effervescence will be observed, but decomposition changes will gradually take place with the liberation of free ammonia from the ammonium chloride. This is caused by the alkalinity of the potassium bicarbonate, which gradually changes into the carbonate. It is not a satisfactory prescription to dispense for this reason and the physician should be induced to leave out the potassium bicarbonate altogether.

No. 33 ℞ Fluidextracti Buchu f℥ii
Fluidextracti Uvæ Ursi f℥iiiss
Spiritus Æthylis Nitritis f℥ss
M. ft. sol.
Sig.—One teaspoonful three times a day.
Dr. F.

In this combination the ethyl nitrite is decomposed by the astringent principles present in the fluidextract of uva ursi. It takes many hours to complete the reaction. It is customary to warn the patient to release the stopper from time to time to relieve the presence of gas which may develop, and the stopper should not be tied down at the time of the delivery of this prescription. If the patient calls for it, warning should be given of the possibilities of the stopper being expelled or the bottle bursting if the stopper is not released within a comparatively short time. Damage suits have resulted from injury to expensive clothing when such warning was not given and the bottle burst before the patient had reached home.

No. 34 ℞ Quininæ Sulphatis gr.xl
Sodii Thiosulphatis ℥i
Acidi Sulphurici Aromatici f℥i
Aquæ Destillatæ q. s. ft. f℥iv
M. ft. sol.
Sig.—One teaspoonful three times a day.
Dr. Q.

This combination illustrates another type in which a gas is gradually evolved. The obvious thing to expect here is an odor of sulphur dioxide, as that gas is given off when either sulphites or thiosulphates are acidulated. The quinine sulphate in this case must have a modifying effect upon the reaction for the gas that is evolved in this case is the offensively smelling hydrogen sulphide, which makes the prescription disagreeable and impossible to take.

No. 35 ℞ Tincturæ Nucis Vomicæ f℥i
Acidi Nitrohydrochlorici f℥ss
M. ft. sol.
Sig.—Five drops, well diluted with water, to be taken before meals.
Dr. C.

Strongly alcoholic liquids are acted upon by strong acids with the formation of corresponding ethyl esters. These esters volatilize readily and in a tightly-stoppered bottle may generate enough pressure to cause an explosion. Several instances are on record when serious results have followed the dispensing of such a combination as this in a bottle that was tightly stoppered,

No. 36

℞ Potassii Permanganatis ℥ss
Glycerini f℥ii
M. ft. sol.
Sig.—Apply as directed.

Dr. D.

This is a dangerous combination which cannot be compounded without decomposition, and numerous instances are on record where violent explosion has resulted with serious results to the compounder.

No. 37

℞ Sodii Bicarbonatis gr. x
Hydrargyri Chloridi Mitis gr. xv
Extracti Cascaræ Sagradæ gr. xv
Misc. ft. pil. No. X
Sig.—One pill at night.

Dr. E.

A gas may be evolved from a prescription containing solid or semi-solid ingredients. In the above prescription the acid resins of the drug extracts act upon the sodium bicarbonate with the gradual liberation of carbon dioxide. which causes the pills to swell, sometimes to such an extent as to force the cover off the box.

No. 38

℞ Potassii Chloratis ℥i
Acidi Tannici ℥i
M. ft. chart.
Sig.—Dissolve in one pint of water and use as a gargle.

Dr. O.

Potassium chlorate should never be triturated with organic compounds nor with oxidizing agents, for fear of explosion. It is possible to pulverize these ingredients separately and mix them gently without danger.

5. **The development of heat or of cold**—A change in temperature frequently takes place in compounding a prescription. This may or may not be accompanied by chemical change and may be entirely without significance. When potassium iodide is dissolved in water to make a saturated solution, as is frequently directed, the phenomenon of cold is observed as the salt dissolves. On the other hand, when the analogous compound, sodium iodide, is dissolved in the same manner, the phenomenon of heat is observed. These are merely physical changes and are of no importance as affecting the integrity of the finished solution. The following prescription is an example of the production of heat where the order of mixing is of importance to avoid excessive reaction.

No. 39

℞ Iodi 5 Gm.
Alcoholis 50 cc.
Olei Terebinthini q. s. 100 cc.
M. ft. sol.
Sig.—Apply as directed.

Dr. V.

If the iodine is added to the oil of turpentine, a violent reaction ensues and the mixture may even catch fire. If the iodine is first dissolved in the alcohol and this solution gradually added to the oil of turpentine, the reaction will be very much moderated, although some heat may be developed.

6. **The exhibition of a change in color at the time of compounding or later**—This may show itself by decolorization of a previously colored mixture, by the development of color in solutions previously free from color, or by alteration of the color of a preparation.

No. 40

℞ Tinctura Ferri Chloridi f℥i
Acidi Phosphorici Diluti f℥i
M. ft. sol.
Sig.—Ten drops well diluted, to be taken before meals.
Dr. G.

In compounding this prescription, the golden yellow color of the tincture of ferric chloride will be entirely discharged and a colorless solution will result. This is due to the formation of ferric phosphate which is held in solution by the liberated hydrochloric acid.

No. 41

℞ Tinctura Iodi f℥i
Aquæ Ammoniæ f℥i
Aquæ f℥i
M. ft. sol.
Sig.—Apply as directed.
Dr. X.

In this case, not only is decolorization of the iodine brought about but the dangerously explosive compound, nitrogen iodide, is produced. Combinations of iodine and ammonia should always be cautiously handled for fear of producing this compound, which is one of the most unstable and violent explosives known to science.

No. 42

℞ Magnesii Carbonatis ℥i
Magnesii Sulphatis ℥i
Glycerini f℥ss
Infusi Rosæ Acidi aa f℥viii
M. ft. mist.
Sig.—One teaspoonful every three hours.
Dr. M.

The beautiful red color of the acid infusion of rose is changed to a brilliant green by the alkaline effect of the magnesium carbonate. Effervescence is also produced in compounding this preparation.

No. 43

℞ Antipyrini ℥ii
Spiritus Æthylis Nitritis f℥iv
Syrupi q. s. ad f℥iv
M. ft. sol.
Sig.—One teaspoonful every two hours until fever abates.
Dr. I.

This prescription has been the subject of much comment, and some years ago of much controversy. A color change is produced, usually a brilliant blue or green, but even a red color has been reported. The formation of the green color was at first believed to be associated with the production of a toxic substance. Investigation showed the new substance to be a "nitro" derivative of antipyrin without harmful effects, and it is customary to dispense the prescription as written, warning the patient, however, that a change in the color of the liquid may occur.

No. 44

℞ Potassii Chloratis ℥i
Tinctura Ferri Chloridi f℥i
Acidi Hydrochlorici f℥i
Antipyrini gr. xxx
Aquæ Destillatæ q. s. f℥viii
M. ft. sol.
Sig.—One teaspoonful every three hours.
Dr. S.

In this case the therapeutic effect of the antipyrin is negligible. The reason for its inclusion in some sections of the country where this combination is popular is the production of a beautiful red color which makes the preparation much more attractive looking.

No. 45

℞ Tincturæ Guaiaci f℥i
Mucilaginis Acaciæ f℥i
Aquæ Destillatæ q. s. f℥iv
M. ft. mist.
Sig.—One teaspoonful every three hours.
Dr. R.

Prescriptions containing tincture of guaiac are productive of much trouble. The physical incompatibility occasioned by the insolubility of the guaiac resins is an entirely separate problem and is frequently solved by the use of acacia as a suspending medium, although honey is considered more satisfactory, as the alcohol of the tincture of guaiac has a tendency to precipitate the gum from the mucilage of acacia and consequently diminishes its suspending qualities. In this particular case, a blue color reaction develops if fresh mucilage of acacia is used, which is due to the oxidase present in fresh acacia. Old mucilage of acacia on the other hand does not produce a blue color but produces a red brown color.

Guaiac also produces striking color reactions with oxidizing substances such as spirit of ethyl nitrite or with tincture of ferric chloride.

No. 46

℞ Sodii Salicylatis ℥ss
Glycerini f℥i
Olei Gaultheriæ mxx
Tincturæ Ferri Chloridi f℥ss
Syrupi f℥ii
M. ft. sol.
Sig.—One teaspoonful every four hours.
Dr. T.

The salicylates are noted for the characteristic purple or red color, produced by iron compounds. The shade and intensity of the color are dependent upon the dilution, and whether the mixture is alkaline or acid. All phenolic derivatives produce color reactions with compounds of iron, but as a rule there is no interference with the therapeutic action of the mixture. Liquor ferri salicylatis of the N. F. (page 730) is an example of an intentional combination of this kind.

Color reactions are sometimes produced in prescriptions which are in the form of powders or masses. Compound rhubarb powder is an example of a preparation in this class. When first prepared, it is of a light fawn color, but upon standing it absorbs moisture from the air, and the magnesium oxide, becoming partly hydrated, reacts with the resinous constituents of the rhubarb with the formation of a pink or red color.

No. 47

℞ Potassii Iodidi ℥v
Tincturæ Ferri Chloridi f℥ss
Aquæ Destillatæ q. s. ad f℥iv
M. ft. sol.
Sig.—One teaspoonful three times a day.
Dr. Y.

Iodine will be liberated by the oxidizing action of the ferric chloride. The color deepens gradually until eventually it is dark brown. The mixture is very irritating after it has stood for a few hours and should not be dispensed, but the physician should be notified of the condition and given an opportunity to make a change.

No. 48 ℞ Bismuthi Subnitratis ʒi
Potassii Hypophosphitis ʒss
Pepsinæ ʒi
M. ft. chart. No. XII
Sig.—One powder three times a day.
Dr. B.

In this prescription, the gradual absorption of moisture causes the gradual reduction of the bismuth compound with the development of color passing through yellow and brown to black, the latter condition indicating complete reduction to metallic bismuth.

7. **The liquefaction of solid ingredients**—This is sometimes due to the formation of a eutectic compound, in which the fusing point of the mixed ingredients is lower than that of any single one and also lower than the room temperature. An example of this kind is found in the following:

No. 49 ℞ Phenacetini gr.xv
Camphoræ gr.v
Phenylis Salicylatis gr.xv
M. ft. chart. No. X
Sig.—One every two hours.
Dr. Y.

Other examples of compounds likely to produce a similar effect when rubbed together are acetanilid, antipyrin, betanaphthol, menthol, resorcinol, thymol, phenol, etc.

The physical condition resulting from mixtures of these substances cannot be satisfactorily foretold, for it is partly dependent upon the substances themselves and partly upon the proportions in which they are mixed. For instance, one part of salol and two parts of menthol will make a dry mixture, one part of salol and one part of menthol will produce a damp powder, while two parts of salol and one part of menthol will yield a syrupy liquid. When this condition is encountered in prescription practice where powders or cachets are ordered, it is customary to add some absorbent powder to bring the mixture to the state of a dry powder before dispensing. Althea is the most satisfactory powder for this purpose.

An example in which the liquefaction is due to a different cause is seen in the following:

No. 50 ℞ Lithii Citratis gr.xxx
Sodii Phosphatis ʒi
M. ft. chart. No. X
Sig.—One powder morning and evening.
Dr. G.

In this case, the liquefaction is due to the liberation of the water of crystallization of the sodium phosphate, accompanied by chemical decomposition in which lithium phosphate and sodium citrate are produced. The remedy is to use an appropriate amount of exsiccated sodium phosphate in place of the hydrated salt.

8. **Development of poisonous constituents by chemical reaction, no visible change occurring.**

The most outstanding example of this kind is the following:

No. 51 ℞ Hydrargyri Chloridi Mitis gr.xx
Potassii Bromidi gr.xx
Sacchari Lactis gr.xx
M. ft. chart. No. X
Sig.—One every two hours until five doses have been taken.
Dr. C.

A reaction takes place between the mercurous chloride and the potassium bromide in which the mercurous chloride is decomposed with the formation of mercuric bromide and the liberation of free mercury, according to the following reaction:

$$2HgCl + 4KBr = Hg + HgBr_2 + 2KCl + 2KBr.$$

This combination should never be dispensed.

Several prescriptions have been reputed to develop toxic compounds in which investigation has shown the facts to be otherwise.

One of these is as follows:

Alleged incompatible prescription.

No. 52

℞ Liquor Hydrogenii Dioxidi
Glycerini aa f℥ii
Misce.
Sig.—Apply locally to throat with a brush.
Dr. S.

Statements have appeared in literature to the effect that this prescription developed oxalic acid by the oxidizing effect of the hydrogen peroxide upon the glycerin. This has been proved to be untrue; the mixture shows no oxalic acid even after being allowed to stand for several months under various conditions of light and temperature.

Another notable example is the following:

Alleged incompatible prescription.

No. 53

℞ Acidi Acetylsalicylici gr. xl
Quininæ Sulphatis gr. xl
M. ft. chart. No. XX
Sig.—One every two hours.
Dr. S.

It has been stated that the poisonous compound *quinotoxin* (also known as *quinicine*) is developed in combinations of quinine and acetylsalicylic acid. This possibility has been thoroughly investigated by such eminent authorities as Scoville and Sollmann, working independently with these ingredients in various proportions and in both solid and liquid combinations. The conclusions of both these investigators deny the dangerous character of this combination.

Still another instance is exemplified by the following:

No. 54

℞ Methenaminæ 8 Gm.
Sodii Biphosphatis 24 Gm.
Aquæ Destillatæ q. s. ad. 100 cc.
M. ft. sol.
Sig.—One teaspoonful every two hours.
Dr. S.

This solution upon standing has been observed to develop an odor of formaldehyde. The subject has been recently investigated by Snow, who finds negligible traces of formaldehyde when the solution is freshly prepared but less than is developed by the action of artificial gastric juice upon pure methenamine. If allowed to stand for some time, the amount of formaldehyde increases. It is imperative, therefore, that such a prescription be freshly prepared and the patient be warned against taking it if it has stood for some time.

The More Important Incompatibilities

Acacia—If alcohol or alcoholic solutions are added to a mucilage of acacia, the acacia, being insoluble, will be precipitated. Dilution with water, of either the mucilage or of the alcohol, will prevent precipitation.

Acacia mucilage is gelatinized by the solution and tincture of ferric chloride, solutions of ferric sulphate, ferric subsulphate, and iron and ammonium acetate, if they are added in concentrated form. A saturated solution of sodium borate and solution of lead subacetate likewise produce gelatinization. If the mucilage be diluted with several volumes of water or the addition of small amounts of glycerin or syrup, gelatinization may in most instances be prevented.

Acetanilid—Acetanilid possesses most of the incompatibilities of alkaloids.

When triturated with phenol, resorcinol, or thymol, a liquid or wet mass is produced; with chloral hydrate only dampness occurs.

When acetanilid is in solution with spirit of ethyl nitrite it produces a yellow color, changing to red in time. With tincture of ferric chloride a red color develops.

Acetozone—It hydrolyzes slowly when in aqueous solution, liberating oxygen. Its use depends upon this reaction and it is usually dispensed in 1 to 1000 solution. When heated or actively triturated, it decomposes.

Acetphenetidin—When mixed with chloral hydrate, it liquefies. Strong acids or alkalies decompose it. It produces a yellow color with spirit of ethyl nitrite.

Acetylsalicylic Acid (Aspirin)—It is decomposed by water and by alkalies, producing acetic and salicylic acids or their salts. Lime water causes a precipitate of calcium acetylsalicylate. Solutions of the alkaline acetates and citrates dissolve but slowly decompose it.

Adrenalin—Being a reducing agent, it is incompatible with all reducible substances.

Albumin Tannate (Tannalbin)—It is decomposed by alkalies.

Alcohol—Albumin, acacia (as has already been mentioned), and many chemical salts, in aqueous solutions, are precipitated by the addition of alcohol or alcoholic preparations, owing to their insolubility in hydroalcoholic solution.

Aloe and Aloin, in solution, are colored almost black with ferric chloride and red with spirit of ethyl nitrite, the intensity of color depending upon the degree of concentration.

Alumnol—It is reduced by contact with air and darkened. It is incompatible with salts of silver or other reducible salts.

Anethesin—It is decomposed by prolonged heating with water. Alkalies and their carbonates decompose it.

Antipyrin, triturated with crystals of phenol, produces a liquid which is odorless and is known as phenopyrin; when rubbed with chloral hydrate, a liquid is formed. A moist mass or a liquid (depending upon conditions) results from its trituration with sodium salicylate. A liquid results from its trituration with the following; acetanilid, pyrogallol, resorcinol, thymol, or ethyl carbamate. In solution with ferric chloride, a red color is developed.

Arsenic trioxide—When in solution, it is precipitated by ferric hydroxide or dialyzed iron as an insoluble arsenite.

Arsphenamine (Salvarsan, "606")—It is quickly decomposed in the air, producing arsenic compounds which are much more poisonous. Alkaline hydroxides or carbonates precipitate the base from an acid solution. It is not decomposed by acids.

Barbital (Veronal) Diethyl-barbituric Acid—When heated with sodium carbonate, ammonia is liberated. It darkens calomel when triturated with it.

Benzoates—The soluble benzoates are decomposed by strong acids when in solution, benzoic acid separating. The soluble benzoates precipitate ferric salts when in neutral or nearly neutral solutions.

Benzosol—Alkalies decompose it into guaiacol and benzoic acid.

Beta-eucaine Hydrochloride—Its aqueous solution is precipitated by alkaline hydroxides or carbonates. Mercuric chloride precipitates it from aqueous solution.

Beta-eucaine Lactate—Incompatible with alkalies and their carbonates and with most of the alkaloidal reagents.

Betanaphthol produces a damp powder or mass or a liquid when triturated with antipyrin, camphor, phenol, exalgin, menthol, or ethyl carbamate.

Betanaphthol Benzoate—It is incompatible with antipyrin, camphor, phenol, menthol, ferric chloride, and ethyl carbamate.

Bismuth Iodosubgallate (Airol)—It is incompatible with water, liberating iodine, and with mercuric chloride. It is decomposed by alkalies and acids. Moist air decomposes it, but it may be kept in glycerin, containing a little water, without decomposition.

Bismuth Tribromphenol—It is decomposed by alkalies, forming a bromide of the alkali. It may be heated to 120° C. without decomposition.

Borates—Sodium borate and other alkaline borates, being alkaline in reaction may precipitate an alkaloid from a solution of its salt. Sodium borate and other alkaline borates

precipitate salts of several of the metals when in neutral solutions, as mercuric chloride, silver nitrate, lead acetate, barium chloride, calcium chloride, alum, zinc sulphate, and ferric salts.

Bromides—The soluble bromides precipitate some of the alkaloids forming soluble compounds. This is true of strychnine, morphine, and codeine. Alkalinity of the salt may in some instances produce precipitation.

Calcium Betanaphtholsulphonate (*Asaprol*)—Light and air darken it and render it less soluble. Ferric chloride produces a blue color. It has the usual incompatibilities of calcium salts. It is decomposed and precipitated by mineral acids.

Colloidal Calomel (*Calomelol*)—It is precipitated from its aqueous suspension by acids.

Camphor, menthol, resorcinol, and *phenyl salicylate* (*salol*), when rubbed with each other in about equal proportions, or when mixed with about equal weights of phenol, chloral hydrate, betanaphthol, pyrogallol, thymol, or ethyl carbamate (urethane) will produce a soft mass or liquid.

Carbonates of the alkalies precipitate many alkaloids from solutions of their salts.

Chloralformamide (*Chloralamide*)—When mixed with antipyrin or menthol, it liquefies. Water or alkalies decompose it into chloral hydrate and formalmide. It reduces silver nitrate.

Chlorates—When triturated or heated with the following substances may cause an explosion: sulphur, tannic acid, sulphides, sulphites, cyanides, hyposulphites, hypophosphites, nitrites, iodine, phenol, charcoal, sugar, honey, glycerin, and many other oxidizable substances.

Chloretone (*Acetone-chloroform*)—Weak acids or alkalies decompose it. It liquefies when triturated with an equal weight of phenol, menthol, antipyrin, euphorin, or exalgin.

Chromates and Dichromates—The soluble chromates and dichromates precipitate salts of lead, silver, mercury, and bismuth when in aqueous solution.

Chromium trioxide—When added to strong alcohol, glycerin, ether, or volatile oils, or other substances that may be easily oxidized, is apt to cause fire or explosion.

Colloidal Silver (*Collargol, Cargentos*)—Continued boiling causes precipitation. It is not precipitated by alkalies. Saturated solutions of sodium chloride usually act as a precipitant, but not for cargentos, which is said to contain some casein. They should not be exposed to light or air longer than necessary, as they have the usual characteristics of silver salts.

Creosote in alcoholic solution produces a bluish-green color with ferric chloride in alcoholic solution.

Creosote Carbonate (*Cresolal*)—It is decomposed by alkaline hydroxides.

Cyanides—The alkaline cyanides may produce precipitates of an alkaloidal character from solutions of their salts.

Diuretin (*Sodio-theobromine Salicylate*), when triturated with phenol or chloral hydrate, forms a liquid.

Epicarin. (*Betanaphtholhydroxytoluic Acid*)—Exposure to air colors it red. Alkaline hydroxides and carbonates combine with it, forming in most cases, insoluble salts.

Epinephrine (*Adrenalin, Suprarenalin, Adnephrin, Supracapsulin*)—It is readily oxidized, becoming inert and of a pink to red color. It quickly reduces gold, silver, and mercuric salts. It is precipitated from acid solution by alkali hydroxides or carbonates. Iodine produces a pink color.

On the addition of ferric chloride to solution of epinephrine, an emerald-green color develops. It produces a pink color when combined with iodine. It reduces silver and gold salts in solution, producing a red liquid.

Ethyl Carbamate (*Urethane*)—Strong alkali liberates ammonia. With iodine and an alkali hydroxide or carbonate it yields iodoform.

Ethylene Diamine—It is strongly alkaline and has the same general incompatibilities as sodium hydroxide, decomposing many metallic and alkaloidal salts.

Ethylmorphine Hydrochloride (*Dionin*)—It is precipitated by the usual alkaloidal reagents and by strong alkalies and carbonates.

Europhen—It is incompatible with starch, the metallic oxides, mercuric salts, and the alkaline hydroxides and carbonates. It should not be exposed to light, heat, or damp air.

Exalgin (*Methyl Acetanilide*) produces a liquid or soft mass under conditions similar to those of camphor.

Ferropyrine—It is decomposed by alkaline hydroxides, carbonates, and bicarbonates.

Gallogen (*Ellagic Acid*)—It shows the general incompatibilities of the tannins with iron salts and gelatin and is decomposed by alkalies.

Gambir (*Catechu*), as well as many other substances containing large amounts of tannin, as *kino, krameria, hematoxylon, geranium,* and *oak bark,* produce precipitates similar to those of tannic acid.

Glycerin—When rubbed with dry oxidizing agents, as potassium permanganate, potassium chlorate, etc., it is apt to cause an explosion.

Gold and Sodium Chloride is a general alkaloidal precipitant, producing insoluble double compounds with most of the alkaloids.

Guaiac—The addition of oxidizing substances to an alcoholic solution of fresh guaiac resin will rapidly develop a blue color, changing to green and red; nitric acid, chromium trioxide, chlorine, potassium ferricyanide, potassium permanganate, ferric chloride, gold chloride, spirit of ethyl nitrite and others, will produce this effect. Mucilage of acacia, when fresh, also develops a blue color.

Guaiacol causes a similar color change with ferric chloride (see Creosote).

Guaiamar (*Glyceryl Guaiacolate*)—It is decomposed by alkali hydroxides and carbonates and by strong acids.

Hedonal—It is decomposed by alkaline hydroxides, carbonates, and bicarbonates, forming methylpropylcarbinol, ammonia, and carbon dioxide.

Holocaine Hydrochloride—It is precipitated from solution by most of the alkaloidal reagents. The alkali hydroxides or carbonates precipitate it from aqueous solution.

Hydriodic acid and the soluble iodides produce precipitates in aqueous solutions of lead and silver salts and with mercurous and mercuric compounds, the precipitate usually being soluble in an excess of either substance.

Hydrobromic acid and the soluble bromides produce precipitates with soluble lead, silver, and mercurous salts. The precipitate formed with mercuric compounds is soluble in an excess of either salt.

Hydrochloric acid and the soluble chlorides precipitate the soluble lead, silver, and mercurous salts, from their solutions, as chlorides.

Hydrochloric acid gives a red to violet color with an alcoholic solution of myrrh.

Hydrochloric acid—When added to a chlorate liberates chlorine (see Liquor Chlori Compositus N. F.).

Hydroxides—The fixed alkali hydroxides as well as ammonia water precipitate free alkaloids from solutions of almost all of the salts of alkaloids.

Hypophosphites—The alkali hypophosphites when added to solutions of ferric salts produce a precipitate of ferric hypophosphite, which is soluble in the presence of sufficient alkaline citrate.

Ichthargan (*Silver Ichthyol*)—It is precipitated by soluble chlorides. It should not be exposed to light.

Ichthyol—It is incompatible with acid and alkaline solutions, also with solutions of the carbonates and iodides, and with mercuric chloride and most alkaloidal salts. The salts of alkaloids are precipitated from solution by ichthyol, in a resin-like mass. Heat causes ichthyol to separate from a suppository mass.

Inorganic Acids, as well as *organic acids*, with the exception of hydrocyanic acid and hydrosulphuric acid (hydrogen sulphide), liberate carbon dioxide from carbonates or bicarbonates when in solution; carbonates are also decomposed by many of the acid salts of the metals.

Iodides—The soluble iodides form insoluble compounds with many alkaloids; the combination with strychnine is especially dangerous. Alkalinity of the salt may sometimes account for the precipitation.

Iodine is a precipitant for most of the salts of alkaloids. Iodine may combine with oil of turpentine with sufficient force to produce an explosion.

Iodo-casein—It is decomposed by alkalies.

Iodophenacetin (*Iodophenin*)—It is decomposed by water, iodine being liberated. Any substance having a strong affinity for iodine, such as the alkalies, will decompose it.

Lead Acetate is precipitated from solution by the soluble carbonates, sodium borate, soluble sulphates, bromides, iodides, chromates, sodium phosphate, and tannic acid.

Lennigallol (*Pyrogallol Triacetate*)—It is incompatible with alkalies, strong acids, and oxidizing agents.

Lycetol (*Dimethyl-piperazine Tartrate*)—It is incompatible with alkalies which liberate the insoluble base.

Lysidin (*Ethylene-ethenylamidine*)—Its incompatibilities are similar to ethylenediamine.

Mercuric Chloride (*Corrosive Sublimate*)—It is a general alkaloidal precipitant, producing insoluble compounds. Corrosive sublimate is reduced to calomel and then to metallic mercury by metallic zinc, copper, or iron when water is present. In alkaline mixtures the reduction occurs in the presence of the soluble arsenites, antimony and potassium tartrate, ferrous salts, and is also caused by light.

Mercuric Chloride is precipitated when in solution by the fixed alkaline hydroxides. The precipitate, if the alkali is in excess, is yellow mercuric oxide, as in the case of "yellow wash", in which lime water is the precipitant. Ammonia water and ammonium carbonate precipitate ammoniated mercury when added to solution of corrosive sublimate. It is also precipitated by potassium or sodium carbonate or bicarbonate and by sodium borate.

Mercuric Iodide (*red*) is reduced under conditions similar to those of corrosive mercuric chloride. Its incompatibilities are similar to those of corrosive mercuric chloride. The incompatibilities of red mercuric oxide in the ointment are similar to those of the yellow oxide.

Mercuric Oxide (*yellow*)—The ointment darkens if kept for some time, due to reduction to other oxides or metallic mercury. Reducing agents rubbed with it, will also produce this effect. Yellow mercuric oxide is reduced by cocaine hydrochloride, forming mercuric chloride.

Mercuric Potassium Iodide (Mayer's reagent) is a well-known alkaloidal precipitant, producing insoluble combinations with almost all of the alkaloids or their salts.

Mercuric Salicylate—Sodium hydroxides or sodium carbonate decompose it. It is rendered soluble by chlorides, bromides, iodides, and sodium salicylate.

Mercurous Chloride (*Calomel*)—A precipitate of black mercurous oxide results from the addition of potassium, sodium, or calcium hydroxides to calomel. The well-known "black wash" is an example of this reaction. Calomel is reduced to metallic mercury by nitrous compounds, as spirit of ethyl nitrite, and by the hypophosphites and in alkaline mixtures by arsenites and antimony and potassium tartrate.

Mercurous Iodide (*yellow*)—Its incompatibilities are similar to those of mild mercurous chloride. Yellow mercurous iodide is reduced to metallic mercury under conditions similar to those of calomel.

Colloidal Mercury—It is decomposed by acids, hydroxides, and the salts of many metals. It does not precipitate albumin. It reduces mercuric chloride.

Methenamine (*Hexamethylenamine, Urotropin, Formin*)—Mercuric chloride or tannic acid precipitates it from an aqueous solution. It is decomposed by hot water. Sodium salicylate, phosphate, or benzoate do not precipitate it from solution. It liquefies when rubbed with lithium carbonate or benzoate, sodium or phenyl salicylate, sodium benzoate or antipyrin. It liberates acetic acid from aspirin, followed by formaldehyde.

Methylthionine Hydrochloride (*Methylene Blue*) is precipitated from solution by potassium iodide or potassium dichromate.

Neoarsphenamine (*Neosalvarsan*)—It is quickly decomposed when in contact with the air, producing dangerously poisonous compounds. Mineral acids decompose it.

Nitric Acid—When mixed with strong sulphuric acid and glycerin it produces nitroglycerin, a powerful explosive; it also produces explosive compounds with cotton, or other forms of cellulose, and if mixed when concentrated with silver or mercuric nitrate and alcohol, explosive fulminate will be formed.

Orthoform, New—It is decomposed by heating with water. Ferric chloride produces a violet to black color. It is dissolved but decomposed by solutions of the alkali hydroxides and carbonates. It reduces silver nitrate and other oxidizable salts.

Pancreatic Ferments (*Diazyme Essence and Glycerole, Holadin, Panase, Pancreon, Trypsin, etc.*)—They are all incompatible with strong alcohol, acids, and alkalies. They readily lose their activity when in dilute solution.

Peroxides (*Dioxides*)—The metallic peroxides liberate oxygen when in aqueous solution. Acids liberate hydrogen dioxide. They readily oxidize organic substances or salts which are readily reduced.

Phenacetin (Acetphenetidin), when triturated with phenol or chloral hydrate will produce a liquid.

Phenocoll Hydrochloride—It is decomposed by the soluble hydroxides or carbonates precipitating the base. It is precipitated by most alkaloidal reagents. It reduces gold or silver salts.

Phenocoll Salicylate (*Salocoll*)—It has the usual incompatibilities of the salicylates. It liquefies when triturated with chloral hydrate.

Phenol causes a gelatinous precipitate when added to solutions of gelatin, albumin, etc.

Phenyl Salicylate in alcoholic solution produces a violet color with ferric chloride if the latter is in dilute solution.

Piperazine—Being strongly alkaline, it is incompatible with acetanilid, acetphenetidin, most alkaloidal salts, nitrites, metallic salts generally, and with picric and tannic acids. It reduces silver nitrate and other readily oxidizable salts. It produces a liquid or soft mass when triturated with chloral hydrate, acetanilid, phenol, acetphenetidin, and antipyrin.

Potassium Cyanide, when rubbed with potassium nitrate or chlorate is apt to produce a violent explosion.

Potassium Dichromate will precipitate many alkaloidal salts, as morphine, strychnine, quinine, atropine, codeine, and hydrastine, if their solutions are sufficiently concentrated.

Potassium Hypophosphite and other hypophosphites when rubbed with calomel cause it to turn dark at once from reduction to metallic mercury. Calomel is also said to be reduced in the presence of moisture by cocaine, pilocarpine, antipyrin (especially in the presence of sugar), cane sugar, and milk sugar. It has been suggested that some mercuric chloride is formed.

Potassium Nitrate produces readily oxidizable compounds, which may explode, if mixed with sulphur, charcoal, phosphorous, sugar, or sulphides.

Potassium Permanganate—When triturated with readily oxidizable substances, as sulphur, the hypophosphites, charcoal, sugar, glycerin, etc., is apt to occasion an explosion.

Potassium or Sodium Carbonates precipitate many soluble salts, producing insoluble carbonates, hydroxides, or oxides. Soluble salts of the following are so precipitated: silver, mercurous and mercuric compounds, ferrous and ferric iron, manganese, barium, strontium calcium, tin, aluminum, chromium, antimony, lead, nickel, copper, zinc, and magnesium.

Pyramidon (*Dimethylaminoantipyrin*)—Its incompatibilities are similar to those of antipyrin; oxidizing solutions and acacia produce colored solutions.

Quinine and Urea Hydrochloride—It is decomposed by the soluble alkaline hydroxides, alkaloidal quinine being precipitated.

Quinine Ethylcarbonate (*Euquinine*)—Its special values depend upon its being tasteless, but acids decompose it and develop a bitter taste.

Resorcinol—Solutions of resorcinol are colored violet by ferric chloride and by chlorinated lime or soda, the latter changing to yellow. Spirit of ethyl nitrite produces a dark red color.

Salicylates—The soluble salicylates, when added to an aqueous solution of quinine sulphate, produce insoluble quinine salicylate.

The mineral acids and some organic acids liberate the but slightly soluble salicylic acid when added to solutions of the soluble salicylates.

Salicylic Acid and Salicylates, including *Oil of Wintergreen*, produce a precipitate with ferric salts if in nearly neutral solutions, also produce a deep blue to violet-red color; the alkaline acetates and citrates, if present in sufficient amount, will prevent this precipitate.

Salicylic acid produces a damp powder or a liquid when rubbed with exalgin, lead acetate, sodium phosphate, or ethyl carbamate.

Saliformin (*Hexamethylenamine Salicylate*)—It is decomposed by alkaline hydroxides, carbonates, and by strong acids. It shows the general incompatibilities of the salicylates.

Salipyrine (*Antipyrin Salicylate*)—It is incompatible with acids, alkalies, and tannins.

Salophen—The alkaline hydroxides decompose it.

Saloquinine (*Quinine Salicylic Ester*)—It is precipitated from acid solution by most alkaloidal reagents. Ferric chloride colors its alcoholic solution reddish-violet.

Sidonal (*Piperazine Quinate*)—It shows the general incompatibilities of alkaloids.

Silver Casein (*Argonin*)—Its aqueous solution is precipitated by acids, but it is soluble in the presence of alkalies and sodium chloride. It is not effected by the usual silver reagents. It is precipitated by lead acetate, mercuric chloride, ferric chloride, zinc sulphate, phenol, alum, and tannic acid.

Silver Nitrate, with many organic substances, as glucose, aromatic oils, tartrate, creosote, etc., is oxidized, being changed to metallic silver, oftentimes with explosive violence.

Silver Nitrate is reduced to metallic silver by metallic zinc, copper, tin, mercury, or lead, by the soluble hypophosphites and sulphites, and in alkaline solution by arsenites, manganous and antimonous salts, and also by ferrous sulphate.

Silver Nitrate in aqueous solution is precipitated by the alkaline hydroxides, the alkali carbonates, the soluble chlorides, bromides, iodides, cyanides, sodium phosphate, chromates, soluble arsenites and arsenates, and by potassium permanganate if the solution is not too dilute. Tannic acid and the soluble citrates and salicylates also precipitate solutions of silver nitrate.

Silver Oxide produces an explosive mixture with many substances, as sulphur, tannic acid, creosote, and many organic substances.

Silver Protein (*Protargol*)—It is precipitated by most metallic salts, also by picric acid. It is decomposed by light and air and should be protected. Cocaine hydrochloride causes a precipitate which may be prevented by the addition of boric acid.

Silver Vitellin (*Argyrol*)—It yields a slight precipitate of silver chloride with sodium chloride or hydrochloric acid. It is incompatible with acids, most of the neutral or acid salts, and with alcohol, forming a precipitate. Mercuric chloride and ferric chloride decolorize it and produce a white precipitate. It is not precipitated by albumin or alkalies.

Sodium Benzoate—Quinine sulphate when not in too dilute solution is precipitated by sodium benzoate.

Sodium Thiosulphate (*Hyposulphite*) is decomposed by acids, when in aqueous solution; sulphur being precipitated and sulphur dioxide liberated.

Solution of Arsenous and Mercuric Iodides (Donovan's solution) is a general alkaloidal precipitant.

Solution of Hydrogen Dioxide mixed with Phenol darkens within a few hours, the phenol being oxidized. Solution of hydrogen dioxide reduces potassium permanganate and is itself decomposed; if sulphuric acid is present, oxygen is freely liberated. It is also decomposed

by the following, yielding oxygen; some organic substances, manganese dioxide, sodium sulphate, potassium bromide, potassium chloride, and charcoal.

Solution of Lead Subacetate (Goulard's extract), and *Lead Acetate* precipitate most of the alkaloids as well as other plant principles from their aqueous solution, forming an insoluble compound.

Solution of Potassium Arsenite (Fowler's solution).—The solution being alkaline from an excess of potassium bicarbonate may precipitate alkaloids.

Starch—Starch paste is colored blue by free iodine, the depth of color depending upon the concentration. This color is dissipated by heat, but returns upon cooling.

Stovaine—It is precipitated by the usual alkaloidal reagents. Even weak alkali decomposes it. Heat, even a boiling temperature, does not decompose it.

Styracol (*Guaiacol Cinnamate*)—It is decomposed by alkaline hydroxides.

Sublamine (*Mercuric Sulphate, Ethylenediamine*)—It should not be exposed to the air. It is incompatible with sodium chloride.

Sulphonal, when triturated with chloral hydrate produces a liquid.

Sulphonethylmethane (*Trional*)—It forms a soft mass when triturated with thymol, urethane, phenyl salicylate, and chloral hydrate.

Sulphonmethane (*Sulphonal*)—It is very stable, not being decomposed by acids, alkalies, or oxidizing agents. Rubbed with chloral hydrate, it liquefies.

Sulphuric Acid—When mixed with chlorates it produces an explosion.

Sulphuric Acid and Soluble Sulphates precipitate soluble salts of lead, barium, strontium, and calcium when in sufficiently concentrated solution.

Tannic Acid will produce a precipitate when added to solutions of gelatin, albumin, gluten, or starch. Tannic acid produces a dark blue-black color with solutions of most ferric salts, the depth of color depending upon the degree of concentration. The color of a solution of ferric phosphate is not changed by tannic acid. With ferrous salts, if pure, a white, gelatinous precipitate is first produced, which rapidly becomes blue through oxidation to ferric salts. Usually, the ferric salt is present and a blue colored precipitate is produced at once.

Tannic acid forms insoluble compounds with most of the alkaloids, and some glucosides and other plant principles.

Tannigen (*Diacetyl Tannin*)—It is decomposed by alkalies and salts of iron. It should not be exposed to heat or moisture.

Tannopin—It is decomposed by alkalies.

Theobromine Sodio-acetate—It is decomposed by most of the alkaloidal reagents, and by carbonated beverages, acids, and saccharine and mucilaginous liquids.

Theobromine Sodio-salicylate (*Diuretin*)—It is decomposed by acids, when in solution, theobromine and salicylic acid both being precipitated. It reduces salts of silver and mercury. Being alkaline, it shows the general incompatibilities of alkalies, also of theobromine and of salicylates.

Thigenol (*Sodium Sulpho-oleate*)—It is incompatible with mineral acids and also with acetic acid.

Trional, when triturated with chloral hydrate or phenyl salicylate, produces a liquid.

Tropacocaine Hydrochloride—It shows the general incompatibilities of alkaloids.

Validol (*Methyl Valerate*)—It is decomposed by alkalies.

Water—When alcohol has been used as the solvent for many substances, such as free alkaloids, glucosides, neutral or bitter principles, salicylic or benzoic acids, volatile oils, resins, oleoresins, balsams, or camphors, the addition of water or aqueous liquids to the alcoholic solutions will cause complete or partial separation of the dissolved substances, owing to their insolubility in hydro-alcoholic liquids; the amount of separation depending upon the degree of dilution.

CHAPTER XCVIII

EXTEMPORANEOUS SOLUTIONS AND MIXTURES

Official liquid preparations have already been considered in Part III, therefore this chapter will be confined to the extemporaneous compounding of liquids. It will soon be realized by the student that this branch of practical pharmacy involves some of the most intricate questions of physical and chemical science. The knowledge which he has heretofore acquired of the solubilities of solids in various solvents, simple and compound, the miscibility of liquids with one another, chemical decompositions, reactions between acid and alkaline salts, precipitation through single and double decomposition, etc., will often be of great service. This, coupled with practical experience, and with the exercise of original ingenuity, must be depended upon to meet the perplexing questions which continually arise at the prescription counter and in the preparation of other medicinal products.

Extemporaneous liquid preparations may be classified as follows: 1. *Solutions*, by which are meant liquid preparations containing dissolved solid substances. 2. *Mixtures*, liquids in which the solution is but partial, insoluble particles being held in suspension. 3. *Emulsions*, preparations containing oily or resinous substances mixed with water, through the medium of an emulsifying agent, to form homogeneous liquids. These will be considered *seriatim*, the latter being taken up in a separate chapter.

SOLUTIONS

The methods generally employed in making official and other solutions have been discussed in the preceding chapters, and it must be presumed that the reader is familiar with them. Most of the difficulties encountered in effecting solutions required by prescriptions arise from the lack of knowledge, on the part of prescribers, of the solubilities and of the physical and chemical characteristics of the medicinal agents which they order to be compounded. It is necessary, therefore, for the pharmacist to be well grounded in these particulars. It is also important that the pharmacist possess a broad knowledge of the therapeutics of drugs and chemicals, lest the addition of some apparently inert substance, intended to improve the preparation pharmaceutically, be injurious therapeutically.

Incompatibility—The subject of incompatibility must be thoroughly comprehended and, inasmuch as it occurs in solid preparations as well as liquids and is of far reaching importance, it has been considered at length and under a separate head (see Chapter XCVII).

COMPOUNDING EXTEMPORANEOUS SOLUTIONS

Use of Heat in Compounding Extemporaneous Solutions—As a general rule, it is not advantageous to aid the solution of a solid by heating it in contact with the solvent, except where the quantity of liquid is known to be in excess of what is required to form a solution, and such a liquid should never be dispensed until it has become cool. If the solid be crystalline, the excess will surely separate in crystals when the liquid cools, and the patient will become uneasy and suspicious, fearing lest some mistake has occurred. It frequently happens that more of a solid has been prescribed than can be dissolved in the amount of liquid desired; indeed, it is entirely too much to expect that every

practitioner should carry in his mind the exact solubilities of all the solids that he prescribes in the respective liquids in which he may wish to dissolve them. This gives the pharmacist another opportunity to use his knowledge and judgment, and the problem

When to filter is oftentimes perplexing, although one simple rule should govern the practice: *A solution may be filtered and dispensed as a transparent liquid when the removal of the excess does not interfere with the medicinal properties and action of the medicine, nor conflict with the obvious intention of the prescriber.*

Solutions of potassium chlorate, to be used as gargles, are good illustrations:

℞ Potassii Chlorat. ℥iv
Phenolis gtt. xv
Infus. Salviæ f℥vi.
Misce.
Sig.—Use as a gargle.

The quantity of salt is about double the amount necessary, and, as the solution is intended as a gargle to inflamed surfaces, the undissolved particles of potassium chlorate would probably act as irritants. They can be of no use in the solution if it is to be used directly as a gargle, and in this case filtration is admissible. On the other hand if the physician has directed its dilution with water before gargling, the potassium chlorate might dissolve. It is necessary to ascertain the intent of the doctor before acting in such a case.

The following prescription should not be filtered, and the pharmacist is compelled to rely solely upon his judgment and knowledge of the therapeutic action and properties of the ingredients:

℞ Magnesiæ Pond. ℥iss
Mass. Hydrarg. ℥ss
Sacch. Alb. ℥i
Sp. Ammon. Arom. f℥ii
Aq. Menth. Pip. f℥ii
Liq. Calc. Hydrox. f℥iii
Sig.—A tablespoonful every two hours.

The reasoning here would be direct and simple. The prescriber evidently intends this to be an alkaline cholagogue mixture, although the directions to "shake the bottle" have been omitted. Heavy magnesia and blue mass are both practically insoluble in the liquids, and if they are filtered or strained out the mixture is deprived of its most important constituents. It should be dispensed as a mixture and a "shake" label used.

Prescriptions containing chemicals in solution should be freed from minute particles of foreign matter so often present in powdered chemicals. This is particularly necessary when the liquid is intended as an eye wash or as eye drops. Aqueous liquids may be filtered, preferably through a "hard filter" in a small Buchner funnel (see Fig. 315). The ordinary filter paper does not readily free a solution from filaments, as these often come from the paper. A small pledget of absorbent cotton placed in the throat of the funnel before inserting the filter paper will be found of value as it collects the filaments from the filter. It is sometimes necessary to return the filtrate to the filter, repeatedly, before the solution is absolutely clear, unless a "hard filter" is used. Viscid liquids should be strained through fine-mesh gauze, which should be kept at the prescription counter cut into small squares to fit the funnel pictured in Fig. 285.

Aids in Effecting Solution—The use of solvents which are not directed in the prescription, for the purpose of effecting the complete solution of the ingre-

dients, requires probably the greatest amount of good judgment. The practice is one which is liable to great abuse, and a strict rule should be enforced that no addition is admissible under any circumstances except one which is absolutely demanded by necessity and which will in nowise impair the therapeutic effect. The prescriber should have reason to place implicit reliance upon the compounder and feel satisfied that the patient has received exactly what was ordered. Incompatible prescription No. 3 (see page 1630) is a good illustration of a case requiring an addition; a physician prescribed it as an application for dry, excoriated nipples. It is as follows:

℞ Phenol. Liq. f℥ii
Aquæ q. s. ad. f℥i
M. ft. sol.
Sig.—Solution of Carbolic Acid. Use with a camel's hair brush.

Dr. W.

Phenol or carbolic acid is not soluble in water in the proportions named, only about 1 part dissolving in 15 parts of water. The pharmacist dispensed the prescription just as it was written, with the excess of phenol in the bottom of the bottle. The patient inserted the camel's hair brush and permitted it to remain in the bottle, so that it reached the bottom and became saturated with the undissolved phenol. The application produced severe pain and alleged serious injury and became the ground for a civil suit for damages against the pharmacist, brought by the patient. If the pharmacist had added a small quantity of glycerin, all difficulty would have been avoided, and he could then have dispensed a perfect solution. It is hardly necessary to say that the physician should not have omitted prescribing the glycerin; but, as he failed to do so, it was the duty of a careful pharmacist to inform him of the facts, or, failing to find him, to supply the deficiency and subsequently notify him of the addition.

The order to be followed in mixing the ingredients is frequently very important, and many prescriptions which at first sight appear to contain incompatibles will be easily compounded by observing the proper order in mixing. As has been shown, precipitation frequently takes place when one liquid or solution is added to another, and this annoyance is much more liable to occur when concentrated solutions are brought together. Hence the dilution of the solution is recommended as one method of avoiding precipitation. An illustration is afforded in the following:

℞ Liq. Ammon. Acet. f℥iv
Acidi Acetici f℥i
Tr. Ferr. Chlor. f℥ss
Glycerini f℥ss
Mucil. Acac. ad. f℥viii
M. ft. sol.
Sig.—A teaspoonful every three hours.

If the tincture of ferric chloride is mixed with the acetic acid and glycerin and then added to the solution of ammonium acetate, and this solution mixed with the mucilage of acacia, no gelatinization will occur; but if the tincture of ferric chloride is first added to the mucilage, undiluted, a gelatinous precipitate will form, and, although the subsequent addition of the other ingredients will, in time, dissolve the precipitate, this time could be saved by following the proper order. See also incompatible prescription No. 29, page 1638.

The following rule should be insisted upon: *Whenever a difference in the appearance of a liquid is produced by a variation in the order of mixing, a memorandum noting the order, should be made upon the prescription at the time it is compounded, so that in case of renewal the same order may be followed.*

MIXTURES

Mixtures, properly speaking, are aqueous preparations intended for internal administration, containing some insoluble substances, frequently with viscid or sweet liquids to aid in suspending them. The official mixtures have been already noticed (see page 291). The term mixture, however, is indiscriminately applied in extemporaneous pharmacy and in prescriptions to aqueous solutions of all kinds. For instance, solution of potassium citrate is frequently termed "fever mixture", although it is a perfectly transparent solution.

CHAPTER XCIX

EMULSIONS AND EMULSIFICATIONS

An emulsion is a system in which there are two liquid phases, one of which is dispersed in the other as globules or droplets. The liquid which is broken up into globules is called the *dispersed phase* while the liquid surrounding the globules is called the *dispersing* (or *dispersion*) *medium*, or the *continuous phase*. The two liquids, which are immiscible or nearly so are sometimes referred to as the *internal phase* and the *external phase*, respectively.

For any two immiscible liquids such as A and B, two types of emulsions are theoretically possible, according to whether A is dispersed in B or B dispersed in A. Oil and water are typical liquids of which emulsions may be formed, therefore there may be *oil-in-water emulsions*, which is the type most commonly seen, exemplified by cod liver oil emulsion, or *water-in-oil emulsions*, exemplified by lime liniment or Carron oil.

When oil and water are shaken violently together an emulsion is temporarily formed, but upon allowing the system to stand, the globules coalesce and the liquids quickly separate, sometimes with a slight intermediate layer of emulsified material which requires a longer time for separation.

In order to prepare stable emulsions of either type a third substance is necessary, in addition to the two liquids. This third substance is known as the *emulsifier* or *emulsifying agent*.

In the cod liver oil emulsion previously referred to, the emulsifying agent is gum. In the lime liniment the emulsifying agent is the calcium soap formed in small amount by interaction between the lime water and the linseed oil.

Emulsifying agents are usually colloidal in character. Gums have long been used in pharmacy as emulsifying agents; egg yolk, and saponin, from quillaja, have also been used.

Gelatin, albumen, casein, agar, soap, and starch all have emulsifying properties in certain types of combinations. The efficiency of alkalies as emulsifying agents is dependent upon the extemporaneous formation of a soap when a saponifiable oil constitutes one phase of the system. Emulsification is a phenomenon of surface tension. In the subdivision of a substance into the minute globules necessary for the production of an emulsion, a large amount of surface energy is produced. Emulsifying agents are substances which lower the surface tension and thereby promote the stability of such dispersions.

It has been found also that substances which are themselves insoluble (thereby differing from all of the emulsifying agents named) are efficient emulsifying agents in certain combinations. Clays, silica, finely divided carbon, calcium sulphate, chalk, and even insoluble basic salts of certain metals have been used effectively in preparing emulsions of great stability.

The theory of emulsification is based upon three factors. First, the decreasing (by the agency of the emulsifying agent) of the interfacial surface tension so as to prevent ready coalescence of the globules. Second, the purely mechanical action of the emulsifying agent in keeping the globules apart by the formation of a film enclosing each one. Third, the conferring of an electric charge, possibly by ionic adsorption, which causes repulsion of the globules.

Emulsification is influenced by the amount of emulsifying agent; the ease of its adsorption at the interfacial layer, and the nature of the ionic dissociation and adsorption by the resultant film.

A marked increase in viscosity accompanies emulsification. Other things being equal the smaller the globules of the dispersed phase and the more thorough the emulsification, the higher the viscosity will be. This is the principle upon which homogenization is based. "Homogenized" milk or cream is milk or cream which has been subjected to enormous pressure while being forced through plates or disks, containing minute orifices, in a machine called a "homogenizer" or "viscolizer" (see Fig. 596). The purpose is to subdivide the fat globules so that they are very much more minute than in the natural product. The effect of homogenizing milk or cream is to produce a perfectly homogeneous liquid, which does not separate into layers by the influence of gravitation (no perceptible cream line will form upon homogenized milk), and in which the viscosity is at the same time greatly increased. Homogenized cream can neither be satisfactorily whipped nor churned to make butter. It finds its greatest commercial use in the ice cream industry.

The size of the globules in properly made emulsions is from 5 to 20 μ. By homogenization the size of the particles may be reduced to 1 or 2 μ.

The stability of emulsions is influenced by the size of the globules of the dispersed phase, *i.e.*, the thoroughness of the emulsification, and also by the presence or absence of certain electrolytes which have the property of breaking emulsions when present in certain concentration. This explains the separation of the oils in such preparations when chemical salts are added in dispensing. (See Chapter on Colloids for the influence of electrolytes upon colloidal dispersions.)

FIG. 590

Making an emulsion

The viscosity of emulsions depends upon the relative proportions of the two phases as well as the type of the emulsion. Some commercial emulsions are too thick to pour—example, mayonnaise, which is an oil-in-water emulsion usually containing about 90 per cent of oil; others are solid—example, butter, which is a water-in-oil emulsion containing less than 20 per cent of water.

Emulsification is therefore the art or practice of effecting the dispersion of one liquid in another in more or less permanent form, usually with the aid of a third substance known as the emulsifying agent.

The favorite emulsifying agent in pharmacy, from many years of empiric practice, is acacia. Drummond, Zilva, and Coward (J. Soc. Chem. Ind. 43, 236-8T (1924) found, however, that acacia and Irish moss emulsions of cod liver oil were reduced 50 per cent in vitamine A activity, probably due to oxidases, while tragacanth emulsions showed no appreciable deterioration.

Emulsification on the small scale is usually accomplished by the aid of the mortar and pestle, a shallow porcelain mortar being preferred (see Fig. 590). Some types of emulsions, notably those of volatile oils and liquids of low viscosity may be made by simple agitation in a bottle or other suitable container as in the official Emulsion of Oil of Turpentine, page 288.

On the larger scale emulsifying apparatus is employed. The general principle involved in all forms of such apparatus is the employment of stirrers, beaters, baffle plates, screw propellors or injectors for the effecting of the thorough agitation of the liquids in the presence of the emulsifying agent (see Figs. 562 to 567).

Emulsions on the large scale are usually made in separate batches, but continuous flow emulsifiers are now being introduced.

A distinction should here be made between the phenomenon of "breaking" or "cracking" of the emulsion, due to the coalescence of the dispersed phase, and that of "creaming" which is caused by the emulsified oil stratum separating because of differences in specific gravity. The latter type of separation is not a serious defect since shaking restores the uniformity of the mixture.

Emulsions are sometimes classified as *natural* or *prepared*. Milky plant juices—as rubber latex, milk, and yolk of egg are examples of natural emulsions while the pharmaceutical emulsions belong to the latter class.

Gum resin emulsions, as prepared from asafetida, myrrh, etc., are misnomers. They are not really emulsions but are colloidal suspensions.

Seed emulsions, as made by triturating oily seeds such as almond, are examples of prepared emulsions where no added emulsifying agent is required, the factors favorable for emulsification being found in the drug itself.

When called upon to prepare emulsions on the small scale, either extemporaneously or for stock, the pharmacist has a choice of two methods, both originally European and called the *English* and the *Continental methods* respectively. Both are equally useful and should be employed according to circumstances.

1. **The English Method**—In this mode of making emulsions the emulsifying agent, consisting of mucilage, yolk of egg, etc., is first placed in a dry mortar, and small quantities of the oil and water are gradually and alternately added at intervals. In this method the emulsifying agent is always aqueous. The pestle is rapidly and lightly rotated in the direction of the arrows (see Fig. 590), with the effect of dashing the oil into globules, which are at once enveloped by the viscid emulsifying agent. If the oil or water is added too rapidly at the beginning, or the mucilage has not been thick enough, the accident of *"cracking"* the emulsion occurs. This may be known by the "pearly" appearance assumed by the mixture, and on close examination the globules of unenveloped oil may be seen floating about. If the amount of water added, as the emulsification proceeds, is not sufficient, an excessive amount of air is incorporated and the mixture becomes too thick to pour freely and will not mix with water. The aim throughout should be to retain a thick creamy liquid which flows freely and yet is of sufficient viscosity to entangle the droplets of oil. If each stage of the process is successful, the emulsion presents, a smooth, opaque, glistening appearance like cream. Success depends largely upon the care exercised in forming the nucleus at the beginning, and this, therefore, should not be too hastily made. When an emulsion is "cracked", it need not be thrown away. It may be restored by placing an additional quantity of mucilage in a clean mortar and gradually adding the "cracked" emulsion to it, triturating after each addition.

The English method of making emulsions is the best to use in general prescription practice, where the proportions of gum, oily or resinous liquids, and water must necessarily vary. A thorough understanding of the application of the English emulsification method is essential for the dispensing and the manufacturing pharmacist.

Aqueous emulsifying agents require this process—such substances as glycerite of egg and mucilage of chondrus—and it is the only method applicable to many prescriptions. A typical formula is appended:

℞ Olei Morrhuæ f℥ii
Pulv. Acaciæ ℥ss
Aquæ q. s. ft. f℥iv.

Place the acacia, which should not be finely powdered, but granulated, in a mortar with one fluidounce of water. (Always add sufficient water at the beginning to dissolve the acacia, otherwise it forms a tough mass which it is difficult to dissolve.) This should be triturated until the mucilage is perfectly smooth and free from lumps. The oil should be added at first in quantities not greater than half a fluidrachm at a time, stirring rapidly with the pestle after each application, care being taken not to add a fresh portion of oil until the last has been thoroughly emulsified. When the liquid becomes too thick to be easily stirred, a fluidrachm of water should be mixed with it, and the gradual additions of oil continued until the whole quantity has been used. The larger quantity of water may be added rapidly, without risk, after the nucleus is once properly formed.

2. **The Continental Method**—This has the great merit of never failing to produce a good emulsion if the proper proportions are used to form the nucleus, and if the directions are strictly followed. The most satisfactory proportions for cod liver oil and for castor oil may be easily remembered. Half as much water is taken as of oil, and half as much gum as of water; or it may be expressed as oil, 4; water, 2; gum, 1. The four parts of oil must be placed in a dry mortar or emulsifier and one part of finely powdered acacia added to it, stirring with the pestle; when a uniform mixture is made, two parts of water are added, not gradually, but all at once, when, upon stirring, the emulsion is quickly made. An additional quantity of water may be added to this nucleus without risk. The explanation of making an emulsion by this method is, that the particles of gum, being insoluble in the oil and surrounded by it, are prevented from separating and dissolving in the water so as to form lumps; by stirring the mixture actively the water *gradually* dissolves the gum, the oil becomes incorporated at the same time, and a homogeneous mixture is produced, the quantities of oil, gum, and water being in exactly the right proportions to form an emulsion.

A combination of the Continental and English methods has certain advantages for cod liver oil. If the Continental method is used for about half of the oil, the remainder of the oil may be added to the nucleus formed, following the English method of emulsifying. This plan requires only half as much acacia as would be needed if the Continental method alone was followed and the resulting emulsion is a purer white, more fluid, and more readily poured than when made throughout by the Continental method.

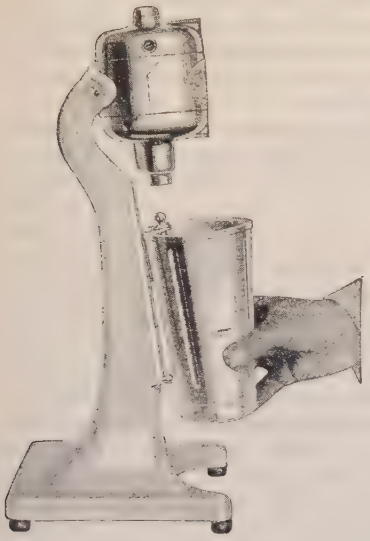
Some other oils require different proportions, for instance—oil of turpentine emulsion requires the following proportion: oil, 3; water, 2; acacia, 1. Liquid petrolatum emulsion may be made by the Continental method if the following proportion is taken: oil, 2; water, 2; acacia, 1.

It is important, when following the Continental method, to avoid all water or dampness in the mortar, bottle, or machine in preparing the oil and gum mixture. The fine powdering of the acacia is also essential for success and a thorough beating of the nucleus, when it first forms, adds to the whiteness and the perfection of the emulsion.

Emulsifiers—The small, soda fountain drink mixer, shown in Fig. 591, made by the Arnold Electric Company, is admirably adapted to the preparation of small quantities of emulsions at the prescription counter. In making large quantities of emulsions some mechanical device must be used to facilitate the rapid stirring and agitation necessary to form the nucleus. Fig. 592 represents an emulsion apparatus or egg beater made by the Whitall Tatum Company. The principle of action is so well shown here that a description is unnecessary.

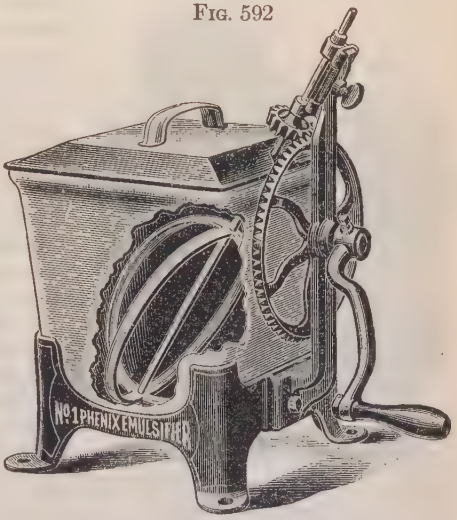
Fig. 593 shows the Clipper emulsifier made by the J. H. Day Company of Cincinnati. The tank is mounted on a strong frame, and can be easily tilted to remove the emulsion when finished; the agitators are shown in the fore-

Fig. 591



Drink mixer for emulsions

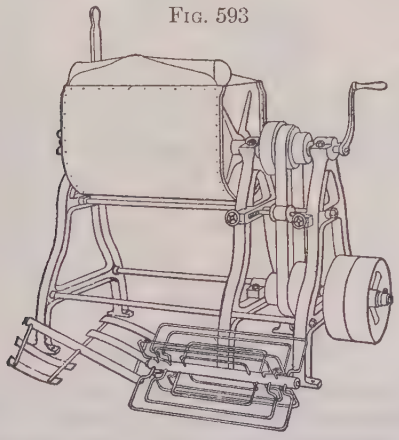
Fig. 592



Emulsifier

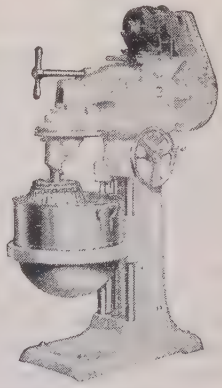
ground. With this machine a large quantity of emulsion can be made quickly. Similar machines are made by all manufacturers of pharmaceutical machinery and other machines offered for use in hotel kitchens such as that illustrated in

Fig. 593



Clipper emulsifier

Fig. 594



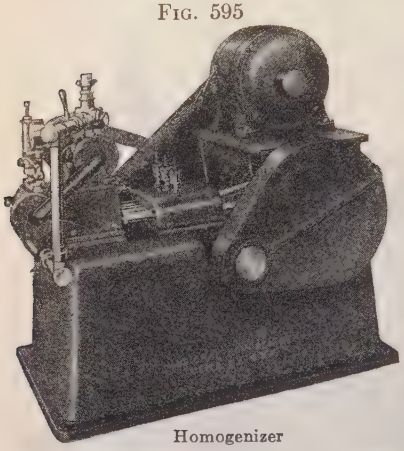
Mixing machine

Fig. 594 which is made by the Reed Machine Company are well suited to the making of emulsions, creams, tooth pastes and other mixtures.

The *homogenizer* or *viscolizer* is coming into frequent use by manufacturers in preparing stable pharmaceutical emulsions on the large scale, which it does to a degree with which the pharmacist, working with ordinary emulsifying

apparatus, can never hope to compete (see Figs. 595 and 596). In these machines the materials to be mixed or emulsified are forced under extremely high pressure between a revolving head and a fixed outer chamber. There is therefore both a direct impinging force and a rolling and grinding effect, in combination with high pressure, with the result that the particles of the mixture are broken into microscopic globules which remain in suspension almost indefinitely, forming a perfect emulsion.

FIG. 595

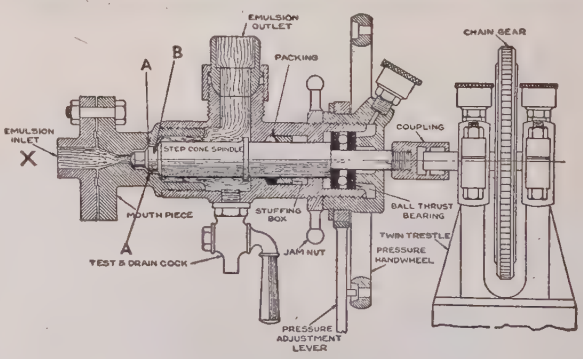


Homogenizer

Casein Emulsions—The use of casein as an emulsifier was developed by Léger, a Parisian pharmacist. He recommends a *saccharated casein*, which is used for emulsifying in a manner similar to powdered acacia. It is claimed that casein emulsions are more readily retained by the stomach, and that greater stability and perfection are secured through its use.

Saccharated casein is prepared by heating one gallon of cow's milk to 104° F., adding two fluidounces of ammonia water, allowing the whole to stand a day, and separating the lower milky liquid from the oily liquid on top. The milky liquid (*lactoserum*) is treated with acetic acid until the casein is precipitated. After washing the precipitate thoroughly with water at 104° F. it is collected on a muslin strainer and pressed; a weighed portion of the casein is dried and the percentage of moisture ascertained; the damp casein is then triturated with three and a half ounces of powdered sugar and eight parts of sodium bicarbonate for every one hundred parts of dry casein.

FIG. 596



Cross section of homogenizer

Prolonged trituration and the addition of more powdered sugar, until it amounts to nine parts in one hundred, result in the formation of a paste, which must now be dried by a gentle heat not above 86° to 90° F. After complete drying, it is powdered and sifted. To make a casein emulsion of a fixed oil, fifteen parts of the oil are gradually incorporated with a mucilage previously made with fifteen parts of saccharated casein and five parts of water. When a perfect emulsion is formed the other ingredients are added. Powdered casein is a commercial product today and is used for emulsifying oils.

Emulsifying Powders—A typical combination known as *emulsifying powder* is made by thoroughly mixing equal parts of finely powdered tragacanth, sugar, acacia and starch. Another combination consists of ten parts of tragacanth, with five parts each of acacia and gluten. About 4 Gm. of the powder should be used for each 30 cc. of oil, using the English method.

Condensed Milk—This substance has also been used as an emulsifying agent, the English method being followed. It does not, however, produce a stable emulsion.

Powdered Milk is a useful and efficient emulsifying agent being used like acacia but following the English method of emulsification. The emulsions, however, are not stable.

Chondrus Emulsions—Since acacia is subject to fluctuations in price and is often expensive, various substitutes have appeared which have been tried as emulsifying agents, one of the most successful being the gelatinous substance obtained from Irish moss. (See page 286.)

Tragacanth Emulsions—Small amounts of tragacanth, added to acacia or to gelatin solution (0.2 per cent) form excellent emulsions which do not quickly stratify.

Quillaja Emulsions—*Quillaja*, or *quillaya bark* (see page 1078), contains the principal saponin, a glucoside which is capable of emulsifying oils. This property, causing frothing in aqueous solutions, suggested the use of quillaja as an emulsifier. It has not come into extensive use, and care is necessary in employing it, as it is not without medicinal and irritating properties.

In applying the principle of emulsification to technical uses other emulsifying agents are employed, such as soap, gelatin, etc.

Preservation of Emulsions—While the official emulsions are supposed to be extemporaneous preparations, it is often necessary to make stock preparations in which decomposition will not occur. For this purpose the flavoring oils are often helpful, especially methyl salicylate, but it is usually desirable to add a preservative like sodium benzoate, one-tenth of one per cent or from 7 to 10 per cent of alcohol. The latter not only preserves the emulsion but helps to maintain a fluid consistence. As alcohol has a tendency to precipitate acacia or gum and therefore break the emulsion it should be added last and in small portions, shaking the emulsion after each addition.

Compound Emulsions—As a general rule, the addition of any alcoholic tinctures or other alcoholic preparations to emulsions destroys their homogeneity. When it is necessary to add them in compounding prescriptions, they should be diluted, if possible, with a portion of the water, and added after the emulsion is nearly finished. Alkaline solutions generally aid emulsification, by forming soaps with the resinous or oily liquids; volatile oils make better emulsions if they are first mixed with an equal volume of fixed oil.

CHAPTER C

THE DISPENSING OF LIQUIDS

EVERY convenience should be adopted to facilitate quick and accurate dispensing. The sink should be close to the prescription counter. A good draining surface for graduates to rest upon is made by fastening sheets of corrugated rubber (a piece of rubber matting) to the slightly inclined shelves above the sink. Fig. 461 shows an unusual arrangement of a sink and graduate rack, in the prescription department of Frank E. Morgan's pharmacy in Philadelphia.

In the Hynson, Westcott and Dunning prescription department, in their Baltimore store, an ideal plan has been adopted

FIG. 597

Lenox bottle brush

FIG. 598

"Practical" prescription bottle

FIG. 599

Diamond I prescription bottle

FIG. 600

Various sizes of Diamond I prescription bottles

whereby each dispenser is furnished with an ample supply of clean and dry graduates, mortars, spatulas, etc. When these are soiled they are placed on a shelf below the prescription counter until collected by a porter, who carries them to the rear of the store where there are special facilities for washing and drying apparatus. The clean apparatus is then redistributed for the use of the prescription clerks. This plan is adaptable only to the larger stores. A brush for quickly cleaning graduates should be accessible. The Lenox bottle brush, made by the Whitall Tatum Company (see Fig. 597), is a serviceable and generally applicable brush for this purpose. Needless to say that soap, a scour-

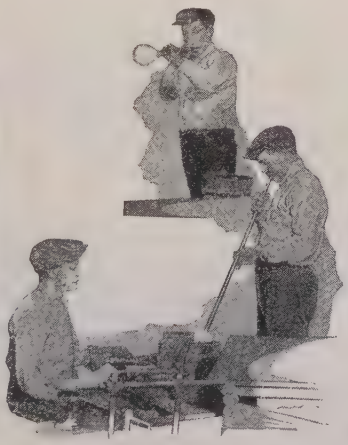
ing powder, lye solution and an acid, such as commercial hydrochloric acid, should be on hand when needed for cleaning bottles or mortars.

Bottles—The size and shape of the bottles used in dispensing liquids are largely matters of individual taste. Since the machine made bottle has almost entirely replaced the hand blown bottle in this country, the oval bottle has practically become the standard for the ordinary prescription as they afford proportionately more space for the label than either round or square bottles. Fig. 598 illustrates the machine made, "Practical" prescription bottle of Whitall Tatum Company and Figs. 599 and 600 show the "Diamond I" machine made prescription bottles of the Illinois Glass Company. Fig. 600 shows the variety of sizes made by machines, from a half-ounce to a quart, now being available. Fig. 601 illustrates a type of prescription bottle, fitted with a screw top, which are made by the Illinois Glass Company and are available in all sizes. The Owens Bottle Company are also large producers of machine-made prescription bottles.

FIG. 601

Screw cap prescription bottle

FIG. 602



The old method of blowing bottles

One of the notable improvements in the supply of prescription bottles, adopted by all of the large manufacturers, is the packing of bottles, which have been thoroughly washed and dried, in paste-

FIG. 603

The old method for finishing the necks of bottles, using a hand tool

board cartons. This avoids the great annoyance, so often experienced in former days, when the straw in which the bottles were packed, refused to leave the bottle during washing.

Figs. 602 and 603 illustrate the method whereby all glass bottles were blown until within a few years, when the bottle-blowing machine was perfected.

The glass mixture was melted in a furnace and when of proper consistence the glass blower picked up a mass of molten glass on the end of a long iron pipe, known as a blow pipe.

The amount of glass collected was determined only by the judgment and experience of the operator. The molten mass was manipulated by the bottle blower, alternately forcing air into it, through the pipe, and rolling it on a slab, until the globe of soft glass was ready to drop into the mold. This was then quickly closed, strong air pressure applied to force the glass into all parts of the mold, and, after withdrawal from the mold, broken free from the blow pipe. The neck was still to be finished, calling for reheating and shaping as shown in Fig. 603.

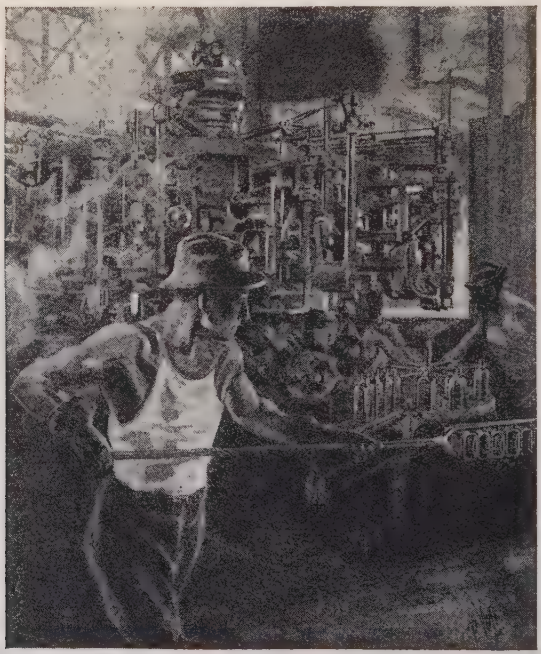
In the modern bottle-blowing machines the operation is entirely automatic

and much greater uniformity in weight of glass is secured which is reflected directly in accuracy of capacity. Furthermore, bottles are blown by this method at a great saving in cost.

This development in the bottle-blowing industry has been responsible for a tendency to adopt standard shapes for much glassware and it also lessens the use of bottles with the name of an individual pharmacist blown in the back, since the initial cost of the many molds needed by each machine is so great that the multiplying of styles becomes prohibitive.

In one machine a "vacuum" system (see Fig. 604) is employed to suck the glass into the blank mold. In the other (see Fig. 605), "gobs" of glass slide by gravity down a trough system, from a feeder attached to the furnace, into the

FIG. 604



The "vacuum" type bottle-blowing machine

blank molds of the machines below. In the first instance, the machine is taken to the glass; in the second, the glass is taken to the machine. Both "vacuum" and "gob" feed machines rotate while operating—the first continuously and the second intermittently.

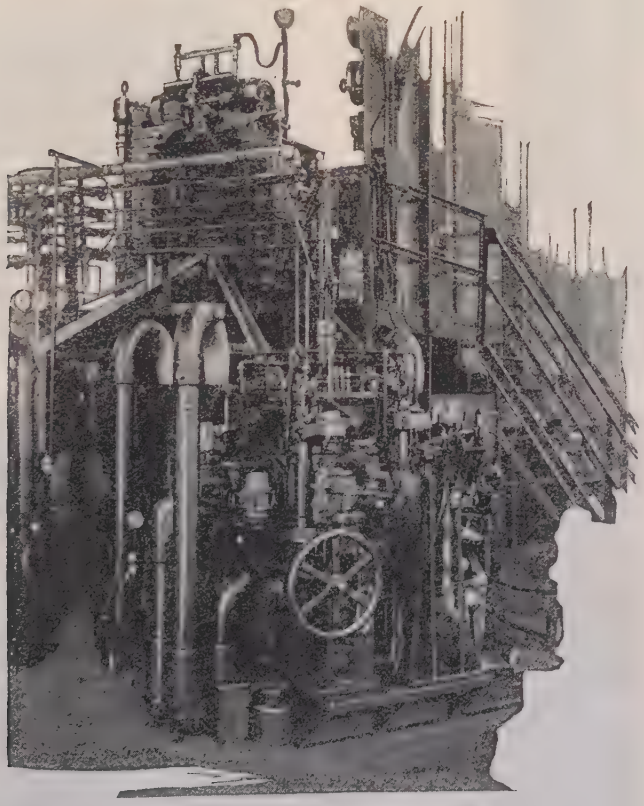
In the "vacuum" type of machine, when a bottle is blown, the glass is sucked up into the measuring blank, a metal tip is lowered which forms the "neck opening" or "finish". Then the blank mold gradually opens while the cylinder of glass is held firmly at the top by the neck ring device. The finishing mold slowly lifts up and closes on the white hot glass. Air is automatically admitted through the neck tip mechanism and the body of the bottle is blown.

This machine is made in various sizes—with six, ten or fifteen arms. The arms are all exactly alike, and each one is really a complete bottle-blowing machine. A ten-arm automatic when working on small ware will make a

revolution in ten seconds. In blowing gallon bottles, it turns more slowly, making a revolution in about forty seconds. In the operation of the huge carboy machine which stands twenty feet high and weighs over 240,000 pounds, a minute is required for each revolution.

Prescription bottles are now frequently made of amber glass, to protect the contents from the effects of the actinic rays of light. For poisonous liquids, or for liquids intended for external application, blue bottles studded at regular intervals with pyramidal points are used. These are designed to attract attention through their peculiar color and shape, and thus prevent

FIG. 605



The "gob" feed bottle-blowing machine

errors; the points render them easily distinguishable from ordinary bottles by the sense of touch, so that the patient can recognize a poisonous liquid in the dark. Fig. 606 shows the label side of this bottle.

For liquids to be administered in drop doses, bottles are provided with the stopper elongated into a dropper or, for solutions intended for the treatment of the eye, many pharmacists dispense a small, glass-stoppered bottle, fitted into a special pasteboard box having a compartment at the side in which an eye-dropper is placed.

For some prescriptions it is desirable to use glass-stoppered bottles and these should be available at every prescription counter.

Washing Bottles—The cleaning of bottles is generally a despised occupation. Where a large number of bottles of one kind and shape are to be washed, the machine shown in Fig. 607, known as the turntable rinser, may be used to advantage. The water is supplied automatically, and may be shut

Fig. 606

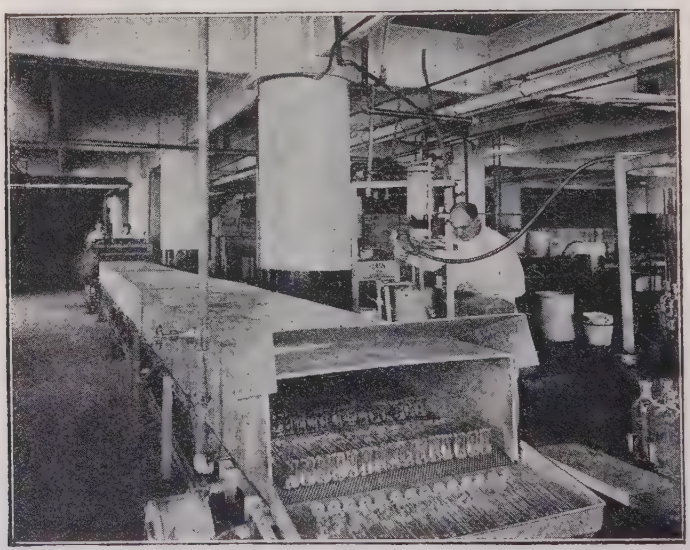
Poison bottle

Fig. 607

Turntable rinser

off by a quarter turn of the rinser; this permits continuous rinsing without undue waste of water. Much more elaborate machinery for washing and drying bottles is also available as illustrated in Fig. 608. This is marketed by the Illinois Glass Company.

Fig. 608



Bottle washing and drying machine

Bottle Fillers—Fig. 609 illustrates the "U. S. Santo" bottling outfit, made by the Illinois Glass Company. This is adapted for hand filling and on comparatively small operations. More elaborate outfits are of course available as illustrated in Figs. 610 and 611. These outfits are also sold by the Illinois

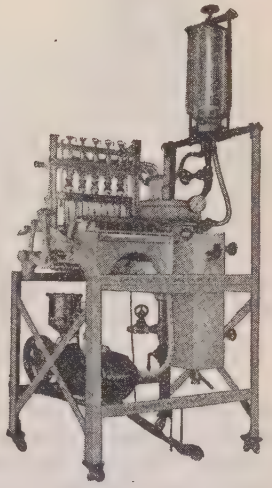
Glass Company. Fig. 612 illustrates a bottle-filling machine connected with a supply tank and filter.

Pouring Liquids—In pouring liquids from the dispensing bottles, it is

Fig. 609

"U. S. Santo" bottling outfit

Fig. 610



Bottle-filling machine

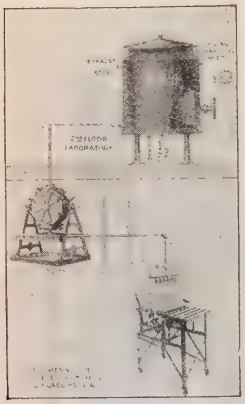
well to establish the habit of extracting the stopper with the left hand, holding it with the little finger. The graduate is held between the forefinger and thumb

Fig. 611

Bottle-filling machine

of the left hand, or, more securely, by allowing it to rest on the middle finger of the left hand, the forefinger and thumb grasping the graduate above the base, while the bottle is held in the right hand with the label uppermost and the liquid poured down the side of the graduate to avoid splashing (see Fig. 36).

FIG. 612



Supply filter, and bottle filler

FIG. 613

Graduate with hard rubber base

FIG. 614

Graduate (chipped and broken base)

FIG. 615

Dropping from shop bottle

Graduates are also used having a hard rubber base (see Fig. 613) as the base of an ordinary graduate is apt to be chipped or broken by accident (see Fig. 614). (See also graduates pages 52 and 53.)

Dropping Liquids—Fig. 615 shows the method of dropping liquids from

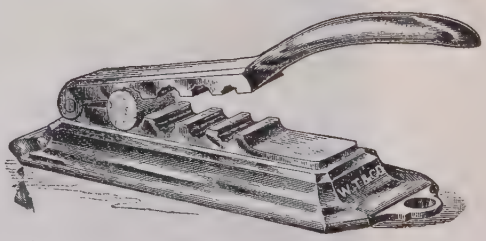
FIG. 617

Bottle with dropper

FIG. 616

Dropping bottle

FIG. 618



Cork press

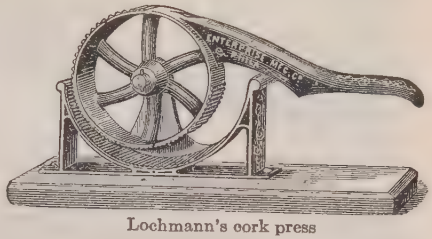
a dispensing bottle. The stopper is loosened, prevented from dropping out by holding it with the finger, and the bottle inclined so that the rate of dropping may be controlled. Fig. 616 shows a very convenient bottle for dispensing liquids which are to be administered by drops. The glass stopper has a deep conical depression extending nearly half way up the side, while the neck of the bottle is furnished with an aperture having a slightly projecting lip. When the stopper is turned so that the upper part of the depression is opposite the

little aperture in the side, the liquid may be dropped very uniformly. A corresponding depression on the opposite side of the stopper communicates with a little channel running down from the lip upon the opposite side of the bottle, so that air is supplied during the dropping. By turning the stopper half way around, both apertures in the neck of the bottle are closed. Bottles in which the stopper and a "dropper" are combined, are commonly used for eye waters (see Fig. 617). Frequently the eye lotion prescription will be dispensed

Fig. 619

French cork press

Fig. 620



Lochmann's cork press

with the bottle of solution on one side of a pasteboard box and a dropper in a separate apartment by its side.

Corks are indispensable for stoppering bottles. They should be selected with great care. There is a wide difference in price between the best quality and the common grades, but it is true economy to use only the best. Short corks, which, when inserted tightly, so as to secure the contents from leakage, do not project above the lip sufficiently to furnish a good grasp for the fingers when extracting them, should never be used for prescription bottles. Brittle, hard, or dry corks, which break off when the attempt is made to remove them, are an especial annoyance. To avoid this, corks should not be kept in a warm,

Fig. 621

Patent bottle cap

Fig. 622

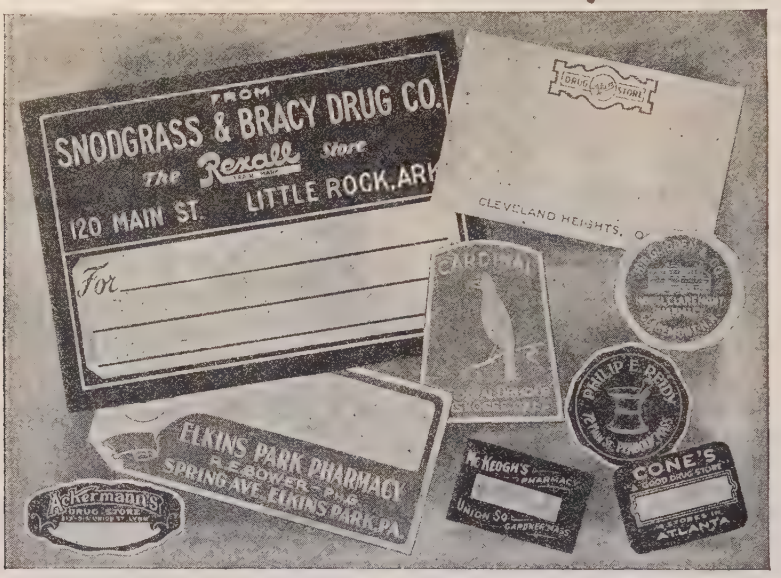
Bottle cap open

dry place, but if very dry, they should be moistened by dipping them in water for an instant, and then they should be well pressed. "Taper" corks are now invariably preferred to the "straight" form.

Pressing Corks—Fig. 618 shows a modern form of cork press which is largely used. The motion by which the pressure is effected is direct and simple. Pharmacists who incline to the grotesque in their tastes may prefer the kind shown in Fig. 619, but the practical dispenser will generally choose Lochmann's cork press (see Fig. 620), because the process of pressing the cork is more effectual, and there is less likelihood of breaking it or cracking the surface in this press than in any other, for the cork is revolved while the pressure is gradually increased. The press consists of a cast iron base, the upper portion of which is hemispherical, with the upper surface slightly corrugated; a corru-

gated cast iron wheel is placed upon an axle slightly out of the center of the curve of the base, so as to afford a gradually diminishing space between the curved surfaces. The wheel has a handle, which is raised when the tapered

Fig. 623



Typical seals and delivery taps

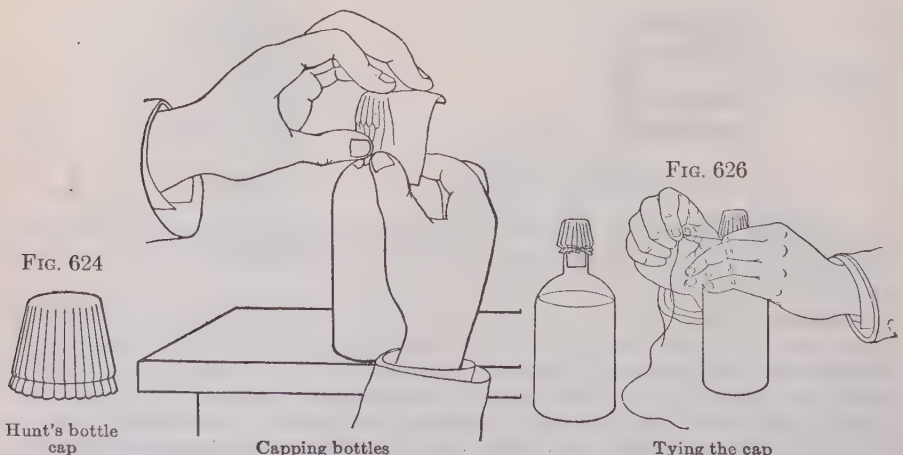
end of the cork is inserted between the surfaces; the handle is lowered, and the cork revolves while being pressed.

Many other stoppering devices have been offered, for economy or convenience. Figs. 427 and 428 show the special stoppers used for "citrate"

Fig. 625

Fig. 626

Fig. 624



Hunt's bottle cap

Capping bottles

Tying the cap

bottles, and Fig. 601 illustrates a very efficient stoppering cap which is screwed in place, and used for many stock preparations and to some extent for prescription filling.

Figs. 621 and 622 illustrate a stopper which is extensively employed in closing bottles of liquids, marketed by large pharmaceutical manufacturers, for such preparations as cough syrups, emulsions, etc.

Gummed Cork Tops—A finish may be given to corks by the use of "gummed cork tops". These are circular in form, made of paper, and the name of the pharmacist, or his monogram, is generally printed upon them in colors (see Fig. 623). These tops have largely supplanted the sealing wax finish so much used a few years ago.

Capping Bottles—The practice of capping prescription bottles with paper, kid, baudruche, or other material is most commendable, principally because of the feeling of security it gives to the patient that the contents of the bottle have not been tampered with after being dispensed. Hunt's bottle caps (see Fig. 624) are largely employed. These consist of fluted caps of colored paper, of various sizes, which are used by adjusting the proper sized cap to the corked bottle and tying it on. An equally neat effect may be secured, with a little practice, by capping a bottle with a piece of fancy paper, as shown in Figs. 625 and 626. The paper which must be of light weight and tough, as "parchment" or "bond" quality, is held in the center upon the cork by the forefinger of the left hand, while the flutes are made by "plaiting" them in with the forefinger and thumb of the right hand. It is then secured by tying with twine, a bow with short ends being preferred, because it is less likely to be interfered with by a messenger, on account of the difficulty of retying it.

If the string is tied in a knot it usually remains around the neck of the bottle after the cap is torn off and accumulates the medicine, especially if that is syrupy, producing an unsightly appearance. Sometimes the twine is tied in a knot with long ends and these are carried over the top of the cap and held in place with wax or a paper seal. A double loop of the string is frequently applied to a cap in such a manner that if either end is pulled it will untie. After tying, the "excess" of paper is trimmed off by using scissors with sharp points or the excess of paper may be turned up and trimmed off in such a manner that a ruffled effect is produced. Another method which is frequently employed for trimming the paper close to the string, is through the use of a sharp pocket knife. By pressing the cutting edges of the blade on the paper cap, against the neck of the bottle, the excess is quickly and neatly cut away.

CHAPTER CI

EXTEMPORANEOUS POWDERS

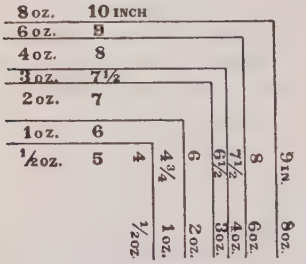
Pulveres—*Powders*

Powders—The official compound powders have been considered in Part III, page 478. In this chapter it is the intention to discuss powders which are prepared extemporaneously. This form of administration often furnishes a convenient means of supplying dosage forms of medicines which are not excessively bitter, nauseous, or otherwise offensive to the taste. Powders are not a proper dosage form for substances which are corrosive or deliquescent. Medicines which are to be given in large doses are not ordinarily administered in this form but there are exceptions and a very common prescription today is illustrated on page 1813 (No. 32111). Powders constitute one of the oldest dosage forms but are being largely replaced by capsules or tablets. It offers, however, distinct advantages in the administration of some drugs since their preparation permits the reduction of the material to a very fine state of subdivision, a physical condition which frequently intensifies the therapeutic activity. This is illustrated in the section on "Homeopathic Pharmacy", Part XII, and is a well-known factor in the efficiency of calomel and sodium bicarbonate mixtures and in Dover's powder.

DISPENSING OF POWDERS AND SOLIDS

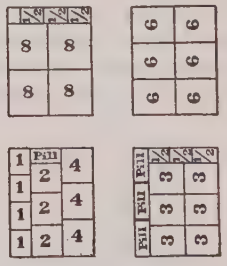
Many of the manipulations required in dispensing powders and solids, such as weighing, measuring, labeling, etc., have been described in previous

FIG. 627



Gauge for cutting paper

FIG. 628



Gauge for cutting paper

chapters; therefore only those operations which are peculiar to them, or which have not been considered, will be treated in this chapter.

Folding Packages—This is one of the first operations taught to the tyro. White paper, of good quality, should be used. It is most economical to buy the paper in quantity (several reams) and have it cut by the dealer into such sizes as the demands of the business require. Jacoby's gauge is useful in this connection; it is illustrated by Figs. 627 and 628. Fig. 627 represents the sizes of paper which are suitable for wrapping packages of the size indicated. In Fig. 628 the numbers indicate the method of *cutting a sheet of paper without waste.*

The cutting of large sheets of paper into wrapping sizes has largely been

abandoned although some pharmacists still retain cut paper at a convenient place near the prescription counter so that packages may be finished in the department. It is desirable to have large sheets of paper of good quality somewhere within reach of the wrapping counter, since large packages must sometimes be wrapped.

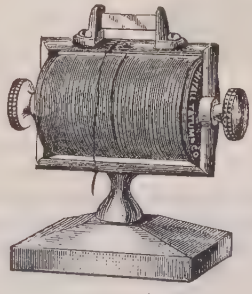
Rolls of Paper—The almost universal custom today is for wrapping paper to be kept on rolls. These are mounted on frames having a weighted knife, by which a piece of paper of the desired size can be easily and quickly torn off.

The selection of this paper is important since its quality and appearance will have much to do with the general impression made by the package leaving the drug store. A majority of pharmacists today still use what is called "white drug paper". Many other varieties are offered, frequently in assorted colors and often mottled. It is recommended, however, that the average pharmacist should continue to use pure white paper with red or blue twine. Occasionally, a firm will adopt an individual shade of paper and employ this exclusively, making that individual store distinctive. This as an advertising

Fig. 629

Paper package

Fig. 630



Twine reel

Fig. 631

Twine holder

policy may be justified if the color adopted is not objectionable, causing offense to those who carry the package.

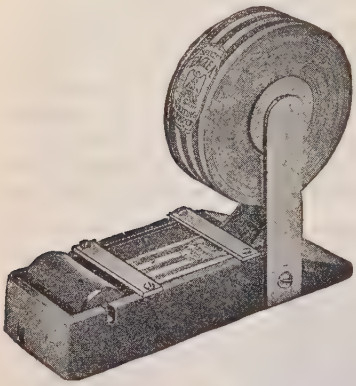
In folding a package, the proper size of paper is selected and laid upon a flat surface, the substance is deposited in the center, and the edge nearest the operator is laid against the opposite edge, and a fold made with the thumb and forefinger. The width of the package will depend upon the width of this fold. The end of the partly formed package on the left hand is now temporarily tucked in, so that the contents shall not fall out, and the package is lifted into an upright position, with the fold toward the operator; the open upper end is then neatly creased and folded into a wedge-shaped flap. The package is now reversed, and the first partly formed tuck is loosened and folded into a flap of the same size and shape as the one just made at the other end. The edges of the package are squared and gently pinched into shape, the label is pasted on so that the edge coincides with the edge of the fold, and the package is tied, as shown in Fig. 629. Packages of many of the largely sold household remedies, such as Epsom salt, compound licorice powder, etc., were prepared beforehand in this manner in the old-time pharmacy that they might be available for counter sales. It is almost the universal custom today, however, in preparing such drugs and chemicals for popular sale to enclose them in pasteboard cartons. This is of great convenience to the customer since they can be readily opened and closed and will frequently occupy a place in the medicine

closet. The old-fashioned drug store package when once opened was difficult to close and proved to be an unsatisfactory permanent container.

Twine—Fig. 630 shows a very convenient twine reel. A glass twine holder, made by the Whitall Tatum Company, is shown in Fig. 631.

The twine used in a drug store package should be of good quality and for small packages must be of light weight. A waxed, linen twine obtainable in a variety of colors, preferably dark blue or red, is sold under the name of "druggists twine". Spools (illustrated in Fig. 630) usually weigh about 4 ounces. Other twine is available but the characteristics described should be maintained. The soft "Sea Island twine", commonly used in other stores is not so desirable, at least for the wrapping of prescriptions, if appearance is to be a factor. Fig. 632 shows a roll of gummed paper, in strips, which is moistened by a wet pad as the paper is pulled off. This often replaces twine for the fastening of wrapping paper, especially for heavy packages. It is made by The Liberty Paper Company of New York.

Fig. 632



Gummed paper roll

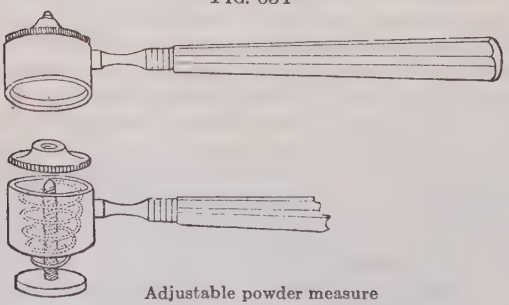
Fig. 633

Seidlitz powder measure

Measuring Powders—Where large quantities of powders having a uniform weight are needed, the powder measure shown in Fig. 633 may be used. This is made of hard wood, and consists of two ovoid cups of different sizes, joined like an egg cup. This measure is used in preparing seidlitz powders, the larger sized cup holding the requisite quantity for the alkaline mixture, the smaller cup being intended for the acid.

The measure should never be used without carefully testing its accuracy beforehand. This is done by heaping the powder upon a piece of glazed paper

Fig. 634



Adjustable powder measure

Fig. 635

Prescription sieve

and pressing the cup downward through the powder until its edge rests uniformly upon the paper. The edge of the cup is then placed upon the powder paper and slightly tapped, when the contents readily drop out. The weight should be noted, and the operation repeated several times, until the average weight is correctly determined. It will soon be possible, to regulate the pres-

sure and height of the powder that the variation from the proper weight will practically be negligible. This method should not be employed where great accuracy is necessary, and the measure should be repeatedly tested. Fig. 634 illustrates an adjustable measure for powders offered by Limousin, of Paris.

Fig. 635 shows a useful little covered sieve which may be found convenient for sifting small quantities of powders when required in compounding prescriptions. It is nickel plated and made in three parts.

Dividing and Folding Powders—The preparing of individual powders, sometimes known as *chartulæ*, at the prescription counter is a frequent one, and the practice of accurately dividing powders is one which must be quickly acquired. The best method of attaining proficiency in this respect is to weigh out a definite quantity of a powder (120 grains), and, after dividing it, with the use only of a spatula (see Figs. 636 and 637), into twelve portions, as nearly equal in quantity as can be judged by the eye, to then weigh each portion separately and note the weight, so that any deviation from the proper weight (10 grains) will be discovered. Through practice it will soon be realized that very accurate division may be secured. All the powder papers should be creased at once, by folding down a margin on the top, so that they shall be uniform. They should be placed regularly and as close to one another as is convenient. In Fig. 639 the usual arrangement is shown. Where the operator has not sufficient practice to trust to his judgment of the quantity for each powder, the whole quantity may be collected upon a smooth card, flattened into a rectangular shape, and divided with a spatula into the exact number

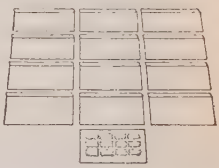
Fig. 636

Powder spatula

Fig. 637

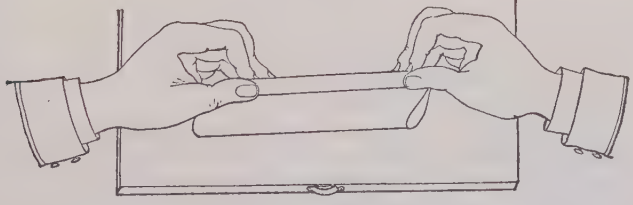
Powder spatula

Fig. 638



Arrangement for powder papers

Fig. 639



Folding the powder

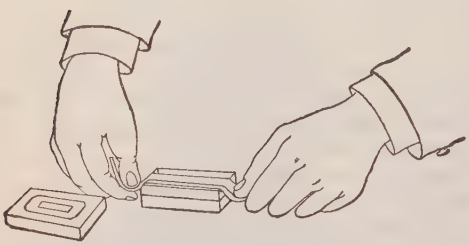
of equal portions required for the number of powder papers. Each portion may then be transferred to its appropriate paper from the card by the spatula. Some pharmacists insist upon the weighing of each powder to insure accuracy.

The operation of folding the powder is illustrated in Figs. 639, 640 and 641. The uncreased edge of the paper is brought over so that it lies exactly in the crease, and the fold turned down and folded over toward the operator, the depth of the fold determining the width of the powder.

When a number of powders are called for, it is best to dispense them in a shallow powder box (see Fig. 640). It is customary to use the sides of the box as a gauge. In the hands of an experienced operator neat results are easily obtained in this way, although the use of the powder folders shown in Figs. 642

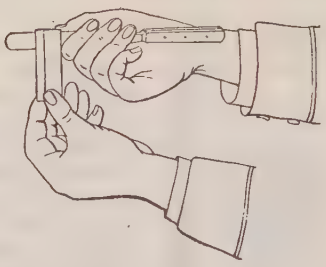
and 643 give a more uniform edge to the powders. A cheap gauge may be made by tacking a piece of tinned iron underneath a convenient shelf, so that a portion having a width slightly less than that of the powder box will project. A very true edge may be made by folding the powder over a spatula, as shown in Fig. 641. The custom so largely followed of flattening the folded powder with a spatula is objectionable since it has a tendency to pack the medicine and render it more difficult to mix with water for administration. The paper

Fig. 640



Making the end creases

Fig. 641



Creasing with a spatula

used for folding powders should be thin, glazed cap paper, and for deliquescent substances, parchment, waxed, or paraffined paper should be employed.

When paraffined powder papers are used they may be folded inside of the regular powder paper, with one operation. A very attractive addition to the powder paper is to have the name of the pharmacist printed on the unfolded paper in such a position that when folded it will appear uniformly on the edge of all powders. Powder papers, so printed, can be more readily folded with even ends than plain paper, since the printed edge serves as a guide in folding.

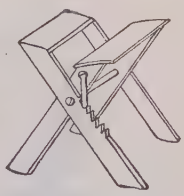
Another suggestion to add to the attractiveness of folded powders, is that proposed by John S. Trinsey, who dispenses powders which are held in place by a small strip of paper, pasted to the shoulders of the powder box. This narrow strip of paper, preferably carrying the name of the firm, acts as a seal to the powders, the protection to the customer being similar to that provided by a bottle cap when used on liquid prescriptions.

Fig. 642

Powder folder

There have been a number of devices offered during the last twenty-five years for the dividing of powders at the prescription counter, such as the "Michaels" powder divider, the "Diamond" powder divider, and the "Weill" powder divider, but these are no longer available commercially which is the best evidence that the pharmacist finds the actual weighing of each powder or the division by some other mechanical means, without the use of apparatus, entirely satisfactory. These older forms of apparatus were described and illustrated in Remington's "Practice of Pharmacy", 6th edition.

Fig. 643



Powder folder

Powder Boxes—A large variety of powder boxes are offered by various box manufacturers. On the older box the label was always pasted on the top but in many of the newer boxes, the name of the pharmacist is lithographed or embossed attractively upon the top of the box and the lid is hinged to avoid the mixing of lids when several boxes are in the same home. The label is

pasted inside the lid. This same principle applies to pill boxes. The shouldered box is still extensively used. Various pill and powder boxes, made by the Dennison Manufacturing Company, are illustrated in Figs. 644 and 645 and there are many other manufacturers.

FIG. 644

Pill and powder boxes with hinged lids

FIG. 645

Pill and powder boxes with slip lids

Cheaper slide boxes are also employed by some druggists but they are not well adapted for prescription use because of their lack of strength and unsatisfactory appearance.

CHAPTER CII

CAPSULES AND CACHETS

Gelatin Capsules

The capsulating of medicinal substances, both dry and liquid, in gelatin shells is one of the most largely used methods for the administering of medicines today. The gelatin capsule was invented by A. Mothes, a French pharmacist, in 1833.

Three distinct forms of capsules are used. One form is known as "*hard capsules*" and consists of two sections, one slipping over the other, completely surrounding the medicine. Their shape is illustrated in Fig. 646. These capsules are filled by either massing the material and rolling it into elongated pills for insertion into the capsules or by introducing the powdered material into the larger end of the capsule and subsequently slipping on the cap.

Another variety is known as "*soft capsules*". These consist of a soft globular shell of gelatin, containing sufficient glycerin to retain permanent flexibility. When manufactured for use by the prescription pharmacist and as obtained commercially, these shells are hermetically sealed to prevent the walls from collapsing. The end where they are to be opened for filling is also elongated so that when this is cut off sufficient gelatin is provided for the sealing. Soft elastic capsules are intended primarily for the administration of oily liquids.

A third form of gelatin capsules is known as "*pearls*". These are also used for oily liquids, although occasionally solid constituents are inserted into each pearl with the oil. Pearls are made only by the pharmaceutical manufacturer who must install special machinery. Their manufacture is described on page 1682.

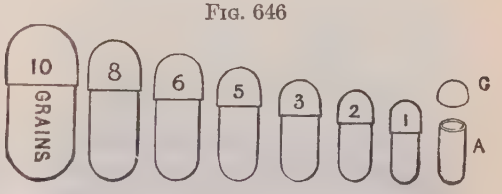
Capsules of all kinds are supplied in a variety of sizes. The hard, empty capsules (see Fig. 646) are numbered from 00, the largest size usually employed in prescription filling, to No. 5, which is the smallest, although special sizes are also obtainable. In Fig. 646 the approximate capacity in grains of these capsules is indicated although this will vary because of the density and weight or, in some other instances, the bulk and lightness of many substances used in medicine.

It is usually necessary for the dispenser to determine the size of the capsule needed for a given prescription through a test, although the skilled dispenser, having calculated the weight of the material to compose a single capsule, will often select the correct size immediately. If the material is powdered, the test will consist of the filling of the longer end of a capsule, which is believed to be the correct size, and closing it. It is then placed upon one of the scale pans and an empty capsule and the desired weights are placed on the opposite pan. If the material in the capsule proves to be too heavy a smaller size capsule must be taken and the test repeated. If the filled capsule is light, it is possible that more can be forced into it by increasing the pressure or, if necessary, some of the material may be placed in the cap. This, however, is not desirable as it tends to decrease the accuracy of subdivision and it is much better to select another size, the large end of which will exactly hold the correct quantity. No more accurate measurement could be devised than the large end of an empty capsule, as it is accurate to at least the one one-thousandth of an inch and a fairly uniform pressure can be applied.

Hard capsules are made largely from gelatin and sugar, the Pharmacopœia permitting gelatin for this purpose to contain 0.15 per cent of sulphur dioxide to prevent decomposition during their manufacture. They are made by very complicated and expensive machinery. Manganese bronze pins, set in plates, each plate carrying from 200 to 500 pins, are dipped into the gelatin solution, which must be maintained at a uniform temperature and of an exact degree of fluidity. If the gelatin solution varies in thickness it will correspondingly decrease or increase the thickness of the capsule and this is serious since a variation of not more than one one-thousandth of an inch is sufficient to make either a loose or a tight joint. When the pins have been withdrawn from the gelatin solution, a current of dry air is blown over them to make the gelatin "set". Then each capsule is trimmed to give it uniform length and they are thoroughly dried in closets through which a strong blast of air is forced. The finished capsule is finally stripped from the pins and assembled, the entire process being mechanical.

Filling Hard Capsules—For this operation several devices are employed. In the retail drug store for prescription filling, the usual plan is to mix the ingredients by trituration, reducing all to a fine powder; place this upon paper and press it to uniform thickness. Granular powders do not readily pack in the capsule but have a tendency to drop out. Crystalline substances, especially those which consist of a mass of filament-like crystals as the quinine salts, are not easily fitted into capsules unless powdered.

FIG. 646



Hard gelatin capsules showing capacity

The mass of powder is flattened so that the stratum of powder is not greater than about one-third the length of the capsule which is being filled. This avoids the soiling of the fingers and incidentally the soiling of the capsule. The capsule having been selected so that it will hold the required weight in the larger end, as already described, the cap is removed, held in the left hand, and the larger end pressed into the powder, repeatedly, until it is filled. The cap is then slipped into place and the weight tested. Experienced prescriptionists are finding it possible to hold two, three, or even more capsules in the hand at one time, remove the caps with the other hand, fill the larger ends at one operation and replace the caps. This greatly increases the rapidity of filling. No matter how carefully the capsule has been filled it should be wiped with clean cheesecloth or shaken with clean granulated sugar to remove any bitter or disagreeable medication which may have adhered to the outside. Remington's Practice of Pharmacy, Sixth Edition, illustrates some of the older capsule fillers. Such names as Whitfield, Eastman, Davenport, and Raymond are among those who devised such apparatus.

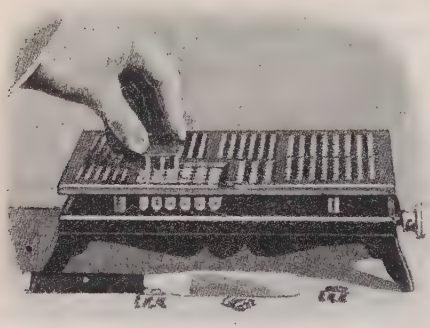
Dr. N. S. Davis, in the *J. A. M. A.*, suggests the use of a wax mass consisting of 1 part of beeswax and 3 parts of castor oil with which a number of deliquescent medicinal substances may be incorporated to advantage before inserting them in hard capsules.

He suggests the use of this in the massing of the iodides, in 10 to 12 grain doses, 1½ grains of the wax mass being used for each capsule. It is also possible to dispense guaiacol, and oil of santol, in 5 minim doses, mixed with about 1½ grains of the wax mass and even 2 or more grains of iodine, if well diluted with the mass, at least 5 grains being used for each grain of iodine.

The Ihrig capsule filler for powders is shown in Fig. 647, and consists of a stationary base with a square, polished, movable table containing perforations for holding the empty capsules; the table is raised and lowered by a thumb screw. The perforations are arranged in fields of sixty each for five sizes of capsules, and of fifty-six each for two sizes of capsules. The lower portion of the capsule should rest on the base at the beginning of the filling process, and the upper plate raised so that the top of the capsule is slightly below the surface of the upper plate. A metal bevelled square is next placed in proper position, as shown in Fig. 647, so as to exclude the perforations not in use from the capsules which are to be filled; the powder is then distributed over the capsules and pressed down by means of a metallic triple punch. When these are filled, the upper plate is lowered by turning the thumb screw, the cap adjusted, and the capsules are finished.

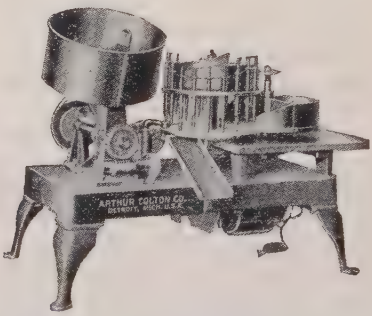
The Ihrig capsule filler is not now obtainable but has been so largely used that it was thought desirable to refer to it here. Numerous other devices have been used for capsule filling on a large scale; they are usually operated upon

Fig. 647



Ihrig capsule filler

Fig. 648



Colton capsule filler

the principles already explained. In the Colton capsule fillers one machine is semi-automatic, the operator removing and replacing the caps. Another machine of Colton (Fig. 648) automatically removes the caps, presses the larger end into the powder repeatedly, until filled, replaces the cap, and finally cleans the outside of the capsule. This machine will fill about 20,000 capsules per working day. Colton has also perfected a capsule filling machine which will fill from 70,000 to 90,000 capsules per working day. This machine is obtainable only on a royalty basis.

Fig. 649 illustrates a capsule filling machine which is now available through Sharp and Dohme of Baltimore. The capsules must be placed in the machine by hand but the upper plate carries a clamp which holds the caps and makes it possible to remove and replace them—mechanically.

The plate holding the larger capsule ends is perforated for three sizes, those most frequently used at the prescription counter, making a very useful apparatus for prescription filling.

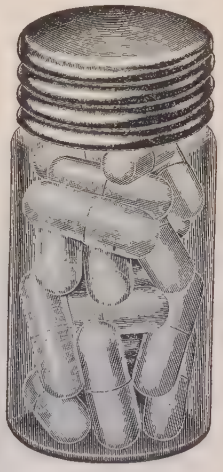
Hard capsules may also be filled with oils and this is the most frequent practice at the prescription counter when such liquids are prescribed. They are usually filled with the help of a medicine dropper, care being taken to avoid soiling the outside of the capsule. As a specific number of minims are usually specified as the content of each capsule, the first step is to determine

the equivalent number of drops. This is done by dropping the liquid from the dropper to be used, into a minim graduate, counting the drops which are equal to the corresponding minims. The cap is then removed, the number of drops of liquid introduced into the larger end, while holding it in the hand, and the cap must then be immediately replaced but in such a manner as to seal the capsule. In sealing hard capsules, which have thus been filled with liquids, the cap or larger end should be pressed upon a small mass of absorbent cotton in a pan or dish, the cotton being saturated with water of boiling temperature or with diluted alcohol. The cap, when placed upon the other end of the capsule must be given a rotary motion until it adheres. Care must be taken to avoid an excess of water or moistening it beyond about one-eighth of its length, else the cap will collapse. It should be remembered that gelatin is

Fig. 649

Sharp and Dohme capsule filler

Fig. 650



Screw cap homeopathic vial

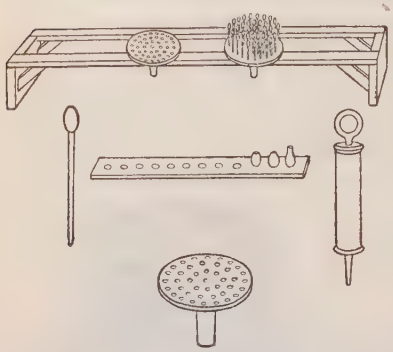
not soluble in cold water and therefore imperfect sealing results if hot water is not used.

Hard capsules are dispensed in pill boxes (see Figs. 644, 645 and 679) or in screw cap homeopathic vials, of which there are a large variety (see Fig. 650).

Soft Elastic Capsules—The soft capsule is made in much the same manner as the hard capsule only that the machines are less elaborate and much more of the work is by hand. Figs. 651 and 652 illustrate soft gelatin capsule molds of globular shape, characteristic of soft capsules, these are dipped in the gelatin solution. These molds must be slightly greased each time before they are dipped to insure the removal of the capsule from the pin. If the soft capsules are to be used immediately they need not be sealed until filled. These soft capsules, after cutting off the elongated tip, are placed in an upright position in holes in a board (see Fig. 651). They are then filled by the skilful use of a syringe, burette, or, on the small scale, with a medicine dropper. Great care must be taken that oil does not touch the edge of the capsule, since such an accident would render it impossible to seal the capsule. There is less danger of soiling the edge if the outside of the dropper or nozzle is wiped clean with absorbent cotton and then inserted entirely within the capsule before the oil is allowed to flow. If the attempt is made to drop the oil into the open-

ing of the capsule it is almost certain to touch the sealing edge and soil it. The final operation of sealing is accomplished by passing over the opening a small glass rod or brush, or preferably a loop of wire, carrying the warm glycerin-gelatin solution used for the sealing (see formula below). When using this solution it must not show a tendency to form a thread of gelatin as the sealing is attempted, otherwise the cap will be pulled off as the sealing tool is withdrawn. If too thick or sticky it can be readily restored to the proper consistence by stirring in sufficient warm water. When the capsules are sealed they are allowed to stand a few hours on the supporters to dry, and are then spread out on a sheet of white paper to detect any that may be imperfectly sealed. The properly filled capsules are then ready to be packed in boxes for the market.

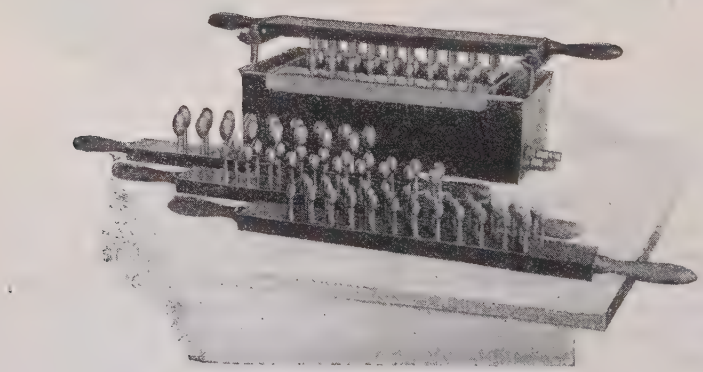
FIG. 651



Soft elastic capsule molds and filling rack

Pearls or Globules differ from hard gelatin capsules in shape, being globular, and in being usually smaller in size than soft elastic capsules. In addition, they show no air space, the gelatin shell being completely filled with the medicinal substance. Their preparation requires the use of special apparatus, and they cannot be profitably made on the small scale. The mixture of which the shell of the globule is composed consists generally of about the following formula: Gelatin, best grade, water-white, 10 pounds; acacia, 1 pound; glycerin, 1 gallon; water, 2 gallons. Heat the

FIG. 652



Soft elastic capsule molds

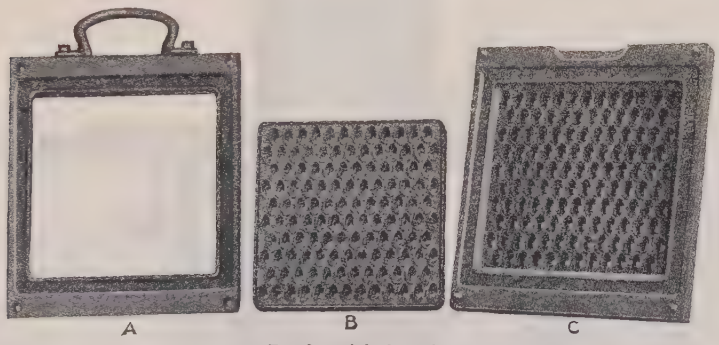
mixture on a water bath for twelve hours, maintaining the consistence by the addition of water as required, and then run onto iron plates, the surfaces of which have been amalgamated with mercury. This forms sheets of gelatin which should be about one-sixteenth of an inch in thickness.

A pair of molds which are termed upper and lower molds are needed (see Figs. 653, 654, and 655). When the lower mold is placed upon a level surface, a leaf of gelatin (see Fig. 656) should be laid over the entire face of the matrix, extending out and over the edges of the frame which has previously

been slightly heated on the warming table; the gelatin leaf thus placed will soon conform itself to the various corners and ledges found in the frame; this is now ready to receive the liquid, of which a measured quantity has been previously placed in a graduate. This should be poured upon the sheet of gelatin spread upon the lower half of the mold and when this is done, the upper gelatin leaf is placed upon the liquid surface by slightly rolling it over and across the liquid; this is done to exclude every particle of air. The upper mold is now placed over the lower, through the guidance of dowel pins, and the "flask" is now ready for compression. It is placed upon the table of a press, where it is slid into position by the medium of guiding grooves, pressure is applied, and the table rises until the sealing point is reached; the table then returns to its place of starting. The molds are now separated and the net containing the globules removed; the globules may be quickly extracted from the net, by catching it at opposite corners, and giving it a sudden stretching, repeating this at the remaining corners.

In order to make pearls or globules it is necessary to prepare the gelatin leaf or film very carefully, and of the required thickness. Fig. 656 shows

FIG. 653 FIG. 654 FIG. 655



Pearl or globule mold

Colton's leaf making machine, which consists of a jacketed copper tank in which the gelatin mixture is placed. This is supported on a grooved "warming" table, so constructed that receiving plates may slide smoothly upon it. The gelatin mixture is heated by turning on the steam to the copper tank, and the flow of the liquefied mixture upon the receiving plate is controlled by the faucet. Any excess is skimmed from the plate by an adjustable gauge, so that the thickness of the film or leaf can be fixed exactly. The film sets after cooling, and is placed in a seasoning kiln to secure the desired consistence for use in the pearl or globule mold.

Enteric Capsules—There has been considerable demand in recent years for capsules which will not dissolve in the stomach but which will deliver their medication in the intestinal tract. The substances usually dispensed in this manner are sodium and zinc phenolsulphonate, as intestinal antiseptics, sodium salicylate, sodium carbonate, potassium iodide, creosote, oil of sandalwood, etc. Such capsules are termed enteric and various plans have been suggested to accomplish this purpose. *Salol coating*, which has been used for the making of enteric pills, has also been applied to hard capsules, with a fair degree of success. The coating is applied in the manner described under pill coating (see page 1731), but greater care is necessary to secure a complete

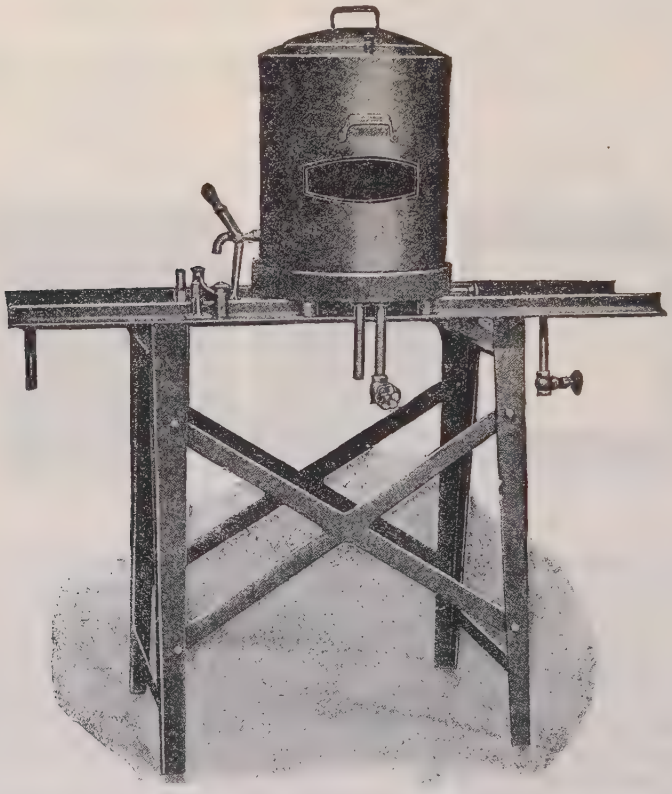
coating, especially on the ends of the capsules. The capsules being flexible and the coating very brittle, it is necessary to handle them with care to avoid cracking off the coating, and in dispensing it is best to pack them in cotton in a box or vial.

Another suggestion has been the incorporation of the medicinal substance in a mixture of solids and fats, the following type formula being suggested:

Medication	0.6 Gm.
Prepared suet	0.3 Gm.
Paraffin	0.15 Gm.

Melt the fatty substances, incorporate the finely powdered medication, and insert into capsules of proper size.

FIG. 656



Colton's pearl or globule leaf making machine

Yet another form is the so-called *glutoid capsules*. These are prepared by subjecting hard or soft capsules, containing the medication and carefully sealed, to the action of formaldehyde until they become insoluble in the stomach, but retain their solubility in the intestine. Excessive treatment will render them completely insoluble, and it has also been shown that the action of formaldehyde on gelatin is progressive, so that capsules so treated are apt to lose their solubility if kept too long. Scoville suggests their immersion for exactly thirty seconds in a one per cent solution of formaldehyde, drying and holding

for two weeks to allow the formaldehyde to act upon the gelatin, before dispensing. Such capsules have been found to remain enteric for at least a year, but if treated with stronger solutions or for a longer time they soon become insoluble. This process is adaptable for stock capsules. Capsules so treated should not dissolve within three hours when immersed in a 0.5 per cent solution of hydrochloric acid containing a little pepsin, the temperature being maintained between 37° and 38° C., but after resisting the above treatment they should dissolve within five hours when digested in a 0.5 per cent solution of monohydrated sodium carbonate, maintained at the temperature named above.

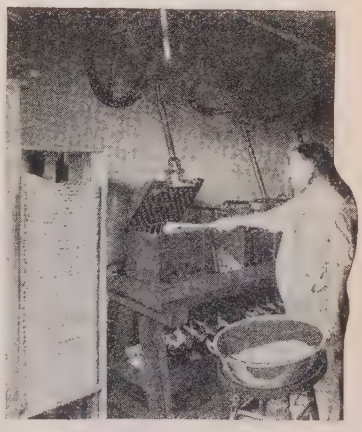
An ingenious means of proving that the capsules are enteric is to prepare a test capsule containing a small quantity of calcium sulphide and methylene blue and subject it to the same formaldehyde treatment as the other capsules. The test capsule is then swallowed and if the eructations caused by a draft of carbonated water, taken several hours later indicate by the odor or taste the liberation of sulphide in the stomach it may be considered as evidence that the capsule has not been sufficiently treated. If, on the other hand, the urine is not colored blue within a reasonable time the treatment has been too extended and the capsule has not dissolved in either the stomach or the intestine.

Cachets or Konseals

[Also known as Wafer Capsules, Chartulæ Amylaceæ, Capsulæ Amylaceæ]

The credit of bringing the *cachet*, or, as it is sometimes termed, *cachet de pain*, into use belongs to Limousin, of Paris. Wafers have been in use many years. Wafer sheet is made by pouring a mixture of flour and water upon hot greased plates, or between two hot, polished, revolving cylinders separated at a proper distance, so that the water is evaporated and a sheet of wafer produced. This is illustrated in Fig. 657.

Fig. 657



Manufacture of cachets

The properties of wafer sheet admirably fit it for administering nauseous powders. When dry, it is in non-adhesive, stiff, somewhat brittle sheets, slightly thicker than ordinary cardboard. It is tasteless, and harmless when taken into the stomach. When moistened with water, its character is entirely changed; it becomes soft, elastic, and slippery. Powders may be administered by Kollme's method, by floating a piece of wafer sheet upon water, and, when thoroughly softened, passing a tablespoon underneath and lifting it out, then depositing the powder in the center and folding over the corners so as to thoroughly enclose it. If water is then poured into the spoon, the concealed powder may be swallowed without any disagreeable taste being perceived.

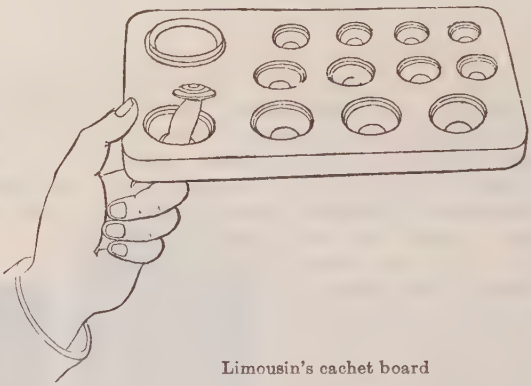
Little envelopes made of wafer sheet (Johann Schmidt's *Saccelli Amylacei*) can now be had which may be filled with bitter or nauseous powders, then sealed and moistened before swallowing; these are more convenient than the wafer sheet above described. The empty envelopes can be furnished to a patient, and he can transfer the powders from the papers which he has received from the pharmacist, and thus prepare each dose himself. The "saccelli" take up little room, and if the patient is traveling, they serve a useful purpose.

The cachet is an improvement on the above, because no more wafer sheet is used than is absolutely necessary to enclose the powder, and thus the bulk is diminished. Cachets are lenticular or spoon shaped disks of wafer sheet, of various sizes. The powder is deposited in the dry cachet, and the margin is moistened with water. An empty cachet of exactly the same size is placed

Fig. 658

Bottles for sealing cachets

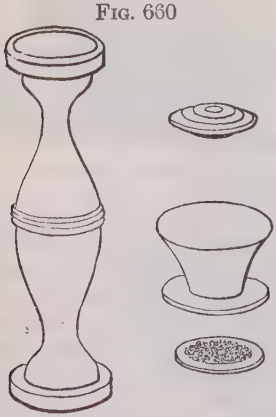
Fig. 659



Limousin's cachet board

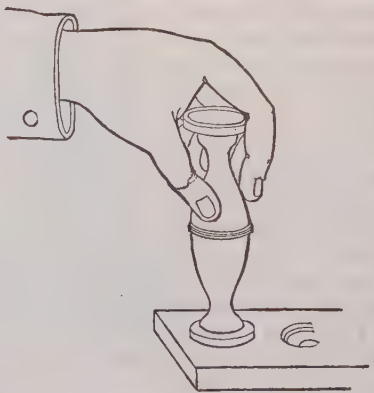
on top, with the convexity upward, and pressure is made upon the margin, with the effect of tightly sealing the cachet and enveloping the powder. Elaborate apparatus—the necessity for which, however, is not apparent—has been devised to effect the sealing of the cachets. The simplest method upon the small scale is as follows: Two bottles are provided (a one-ounce wide-mouthed

Fig. 660



Cachet wetter, cachet funnel, cachet containing powder and finished cachet

Fig. 661



Sealing the cachet

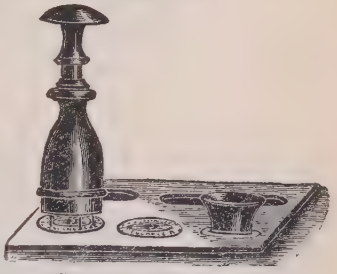
bottle for the middle sized cachet answers very well), and, one of the cachets being placed upon the lip of one bottle, the powder is carefully deposited in the center without soiling the outside edge; the margin of an empty cachet of the same size is then moistened by quickly passing it over a piece of wet felt, or it is pressed into a second bottle until held firmly and then inverted upon a piece of moistened filter paper.

It is then laid upon the cachet containing the powder and the lip of the other bottle is now applied to the cachet with sufficient pressure to seal it effectually.

The position of the bottles is shown in Fig. 658. Limousin's improved method is similar in principle, although, of course, more elaborate. A board, with depressed perforations for three sizes is shown in Fig. 659. Empty cachets are placed upon the depressions, and the powder is deposited in the center with the aid of the small powder funnel (see Fig. 660). The "wetter and presser" is shown to the left of the funnel; this is of two kinds of wood, joined in the middle—one end being hard, light colored, and highly polished, the other being dark colored and somewhat absorbent. The end of the latter is used to moisten the margin of the cachet by first placing it upon a piece of moist felt and then applying it to the cachet; an empty cachet is now laid upon the one containing the powder, and the "presser" end is applied with some force so as to seal the cachet (see Fig. 661); the sealed cachet is pushed up from below, as shown in Fig. 659.

A less expensive apparatus for filling and sealing cachets than that made by Limousin may be obtained from the German importing houses (see Fig. 662). A rectangular sheet of thick rubber cloth is perforated with twelve circular holes, each large enough to hold an empty cachet; the powder is deposited in the center of the cachet through a small funnel; the inner edge of an empty cachet is dampened by rubbing it for a moment upon a piece of cotton flannel moistened with water, the moistened cachet is laid upon the one containing the powder so as to enclose it, and the presser, which is armed at its base with three needles and has a spring in the handle, is applied so that the cachet is sealed, and when the spring is released the needles penetrate the edge of the finished cachet sufficiently so that it can be lifted and dropped into the box without touching it with the hands.

Fig. 662



German cachet apparatus

Limousin devised a powder measurer, the construction of which is shown in Fig. 634. The upper view shows the measurer closed, ready for use; the lower view shows how its capacity may be varied to suit the weight of the powder desired. This is done by turning the milled head, which revolves upon the screw which is attached to the disk forming the movable bottom of the cup. A coiled spring aids in pushing the disk outward when it is necessary to lessen the capacity, so that this can be regulated with great exactness. The value of this measurer lies in the fact that it can be used for delivering a more or less compact disk of powder in a cachet without soiling the edges of the latter, and when a large number of cachets of a definite weight are needed, *i.e.*, one gram guarana powders; it can be used as is the seidlitz powder measure (see Fig. 633).

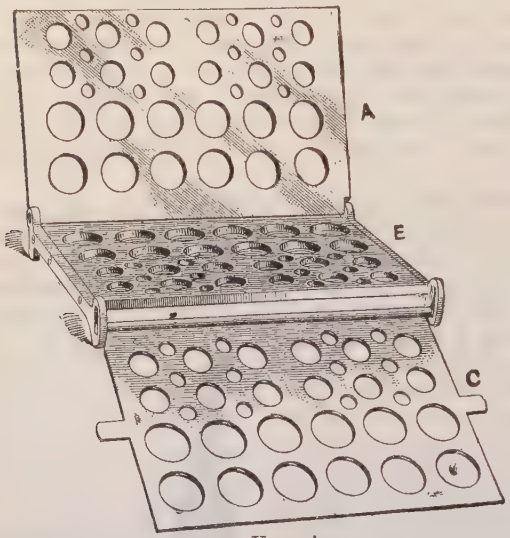
J. M. Grosvenor and Company, of Boston, have introduced an excellent apparatus for dispensing cachets. It is made in a very substantial manner, and consists of three nickeled metal plates hinged together as shown in Fig. 663. The cachets, which are termed "konseals", are made of thinner material than ordinary cachets, and the finished cachet is less bulky and neater in appearance.

The saucer shaped cachets are pressed with the fingers into the inner circles of plate E, and also into those on plate A; plate C is then laid upon plate E, and the medicated powder dropped through the funnel into the cachet. Large doses may be pressed with a thimble furnished for the purpose, and thus smaller cachets may be used than are possible in ordinary apparatus.

When the cachets are filled, the filling plate is lifted and a dampening

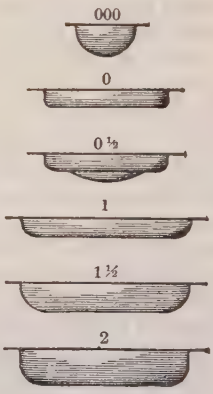
roller passed over the edges of the empty cachet in plate A. The latter is then closed over the bottom plate, and a slight pressure seals the cachet. On opening the apparatus the filled cachets may be easily removed by gently pushing out each one with the finger.

Fig. 663



Konseal apparatus

Fig. 664

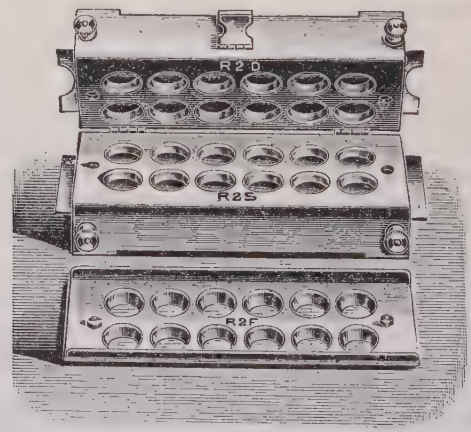


Konseals (exact size)

Fig. 664 shows the exact sizes of the wafer konseals. No. 000 permits the administration of a cachet not larger than a large sized pill.

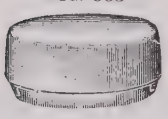
The name "konseals" was adopted by J. M. Grosvenor and Company, as

Fig. 666



Dry seal cachet apparatus

Fig. 665



Dry seal cachet

shorter and better adapted for prescription use than "Morstadt's cachets", which was their original name. They were contrived by Karl Morstadt, of Prague, Austria.

Fig. 665 shows Johann Schmidt's dry seal cachet. The advantage of this form is that there are no "flanges", as in the ordinary cachet. They are made of very thin, elastic wafer sheet; the manner of closing the dry seal cachet resembles that used for "empty" gelatin capsules. The "cap" fits over the body, and no moistening is required, as the pressure forces the cap tightly over the edge of the body containing the powder. The apparatus shown in Fig. 666 is similar in construction to the "konseal" apparatus above described.

It is greatly to be regretted that wafer capsules are not more frequently prescribed. They have many substantial advantages. The substance is rendered tasteless by their use, and yet is easily liberated in the stomach in a pulverulent condition, and this is well known to be the most favorable solid form for solution in the gastric fluids; the knack of swallowing them is easily acquired; the pharmacist has the great advantage of furnishing preparations which are not ready made and the purity of the ingredients can be personally vouched for.

CHAPTER CIII

MASSES, PILLS, AND TROCHES

Massæ—*Masses*

Official pill masses have been discussed in Part III on pages 487 and 488. Several masses are official because of their frequent use in prescriptions in compound pills. They, of course, represent the preliminary stages of pill making and are therefore considered at this point in the preliminary study of pills.

Fig. 667

Pill pestle

In the following pages, under the subject of *pills*, will be found an extensive discussion of the qualities which should be possessed by a pill mass. To secure this condition there must be an application of the principles there fully described. Among the most important factors is the selection of a suitable excipient (see page 1692). Another essential condition for the proper making of a pill mass is the thorough kneading of the mass. On a small scale this is accomplished by the use of a mortar and pestle.

The operator grasps the pill pestle in the hand so that the pestle head rests in the palm of the hand. It must, of course, be a short pill pestle with a flat head (see Fig. 667). He then raises the pestle but rests it against the flat side of the mortar. By now throwing his weight upon the pestle, which, of course, is resting on the mass, the pestle is caused to slide into the mortar but at the same time the mortar's edge is used as a fulcrum. This rends and twists the mass. By throwing the elbow as far as possible from the body and drawing it to the body as the pressure is applied to the pestle, a twisting motion is added which still further assists in kneading the mass. This is repeated until the proper degree of plasticity is attained. It is necessary, of course, to use the correct amount of the appropriate excipient to secure this end.

In making masses upon the large scale mechanical contrivances are necessary to secure a thorough admixture of the various ingredients. The first treatment is with a powerful mixer which thoroughly kneads the mass and incorporates the excipient. For final kneading, to secure the proper consistence the mass is then passed repeatedly through two smooth iron rollers, geared so that they may be made to approach or recede from each other, revolving in opposite directions and at slightly different rates of speed. These may be hollow, so that steam can be introduced inside and thus heated (some masses requiring such treatment). Fig. 668 illustrates Colton's pill mass mixer. This is made of iron and steel, and is capable of kneading a stiff mass.

The other form of mixer made by the J. H. Day Company is shown in Fig. 669. Two steel rollers, which can be set so as to revolve at different distances apart, are secured to a strong iron frame, the operator places the moistened materials that are to be mixed between the rollers, and by continually returning the mass which drops below, it is thoroughly kneaded.

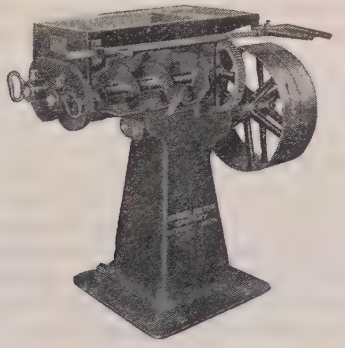
Pilulæ—*Pills*

Pills are small, solid bodies, of a globular, ovoid, or lenticular shape, which are intended to be swallowed and thereby produce medicinal action. Pills, once the most extensively used form of medication, have today been largely replaced by compressed tablets. Substances which are bitter or unpleasant to the taste, if not corrosive or deliquescent, can be administered in this form if the dose is not too large. The ease and rapidity with which pills can be administered, the length of time during which they retain their original activity, their compact form, and their absence of unpleasant taste when coated, are the principal reasons for their use.

The term *parvules* and *granules* has been applied to small sugar-coated pills. *Pellets*, *globules*, or *orbicules* are terms applied to small spheres of sugar, largely used in homeopathic medicine and usually saturated with an alcoholic tincture. A *bolus* is a large pill such as is used in veterinary medicine.

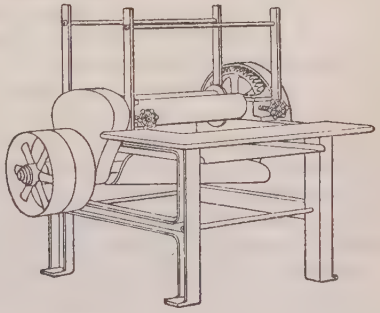
In order to give medicinal substances the requisite shape and consistence to form pills, they must be brought into a soft condition and made into a mass,

Fig. 668



Colton's mass mixer

Fig. 669



Pill mass rollers

generally by the aid of a volatile liquid. The subsequent evaporation of this liquid, or a portion of it, should produce but little change in the form of the pill. As previously stated (page 487), pill masses are sometimes kept in bulk and made into pills when occasion requires. By far the greatest number, however, are made extemporaneously, and the exercise of the knowledge and perception which are necessary in selecting the proper substance to form the mass constitutes one of the most important duties of the pharmacist. To be able always to select the proper excipient requires a thorough knowledge of the physical properties of all the articles of the materia medica which enter into the composition of pill masses.

Forming the Mass—The mass consists of two parts: 1. The active ingredients. 2. The excipient, or the substance used to form the mass and give it the proper consistence. The essential requirements of a pill mass are: 1. *Adhesiveness.* 2. *Firmness.* 3. *Plasticity.*

1. **Adhesiveness**—The mass must be sufficiently adhesive to retain its shape and yet be soft enough to be worked by the fingers or suitable apparatus into the desired form. To enable it to possess adhesiveness, a liquid is usually added to the powdered ingredients, and the selection of this liquid must always depend upon the physical character of the ingredients; in many cases

the latter possess sufficient adhesiveness in themselves if they are moistened with water, and hence the quality is *only developed*, not created, as in the case of powders containing extracts; others, again, are totally devoid of adhesiveness, and sticky substances, like gum, sugar, etc., must be added in sufficient quantity to supply the deficiency. Some substances may be made soft and adhesive by simply heating them, and they regain their original condition when allowed to cool.

2. **Firmness**—The mass must possess sufficient firmness to permit the pills to retain their shape. The condition of adhesiveness is usually dependent upon the addition of a liquid which dissolves *a small portion* of the solid ingredients, and this solution is adhesive enough to enable the mass to be made; but if too much liquid be added, the quality of firmness will be lost, and the pills either cannot be formed at all, or will subsequently run together in the box. The physical properties of the active ingredients of the pill must be thoroughly understood to judge of the proper quantity and kind of excipient to be used to give adhesiveness without losing firmness. The following general rule may serve to guide the operator: *Never employ an excipient alone which is a perfect solvent for the solid substances.* For instance, water should not be used *alone* for making pills of the *soluble* scaled iron salts; for, although the pills may apparently be firm enough when dispensed, they will be very apt in warm weather to run together in the box. If sufficient acacia be used with the water, they can be made to retain their shape.

3. **Plasticity**—The condition of plasticity is a natural result of the possession of a proper degree of adhesiveness and firmness. Many substances may be formed into a mass which will be either adhesive or firm, but unless these conditions are properly balanced, so that the mass can be quickly and easily formed into pills which will retain their shape without flattening, pills cannot be made successfully. Plasticity can generally be secured by thoroughly working or kneading the mass. In this connection see Fig. 669. The choice of excipient is usually left entirely to the pharmacist, and in making the selection care should be taken that, while the pharmaceutical requirements are fulfilled, the proper solubility or disintegrability of the pill in the stomach is not lost sight of.

Choice of the Excipient—An examination of the following list of excipients will probably convey a good idea of their uses. They are divided into two classes, liquid and solid. Liquid excipients are generally preferred, because they are more conveniently added to the powders:

List of Excipients

Liquid

Water	Used only when the ingredients of the pill possess sufficient adhesiveness to be developed by the water
Syrup	An excellent excipient when more adhesiveness is needed than can be afforded by the use of water
Syrup of Acacia	Better than syrup, because it is more adhesive, and can be used in smaller quantity. The objection to its use is that the pills made with it are apt to become very hard, and in some cases they may be practically insoluble in the liquids of the stomach. This excipient is admirably suited to the extemporaneous making of white pills of such alkaloids as strychnine sulphate. If the active ingredient is mixed with a small quantity of lactose it is possible to make a small firm pill which can be dispensed even within a short time, without adhering
Mucilage of Acacia	More adhesive than any of the preceding, but open to the same objection as syrup of acacia
Glycerin	Somewhat adhesive, but very valuable, because its hygroscopic properties prevent the pills made with it from becoming hard. It is rarely advisable to use it alone, however, as the surfaces of the pills often acquire a dampness which attracts the particles of dusting powder
Glucose	A very valuable excipient. It is colorless, very adhesive, and practically non-volatile at ordinary temperatures
Honey	May be used in place of glucose for dark colored masses, but quinine pills are not white when honey is used as the excipient

List of Excipients—*Liquid—Continued*

Extract of Malt	Has the advantages of glucose, but the disadvantage of honey in not being colorless
Glycerite of Starch	Possesses the merits of glycerin, with the adhesiveness of the starch jelly. Its thick consistence is sometimes an inconvenience
Glycerite of Tragacanth	Similar to glycerite of starch. Both of these glycerites find general use as excipients, especially the latter when adhesiveness is required
General Excipient	Suggested by Prof. J. P. Remington as combining the advantages of several of the above (see below)

Solid

Confection of Rose	Useful when a small quantity of an active ingredient is to be made into pills and dilution is necessary, as in pills of strychnine, podophyllin, etc. Its bulkiness is its principal disadvantage for general work
Crumb of Bread (Mica panis)	Valuable for very powerful liquids, like croton oil, volatile oils, etc.
Powdered Althæa	Gives adhesiveness, and is useful as an absorbent, but is bulky
Soap	A very valuable excipient for resinous substances. It increases their solubility, and forms an unexceptionable mass
Rosin Cerate	Valuable for oxidizable substances, resins, etc.
Cacao Butter	Used for pills of potassium permanganate and similiar substances
Petrolatum	Used for oxidizable substances like the two preceding excipients. If used judiciously a small quantity of petrolatum is a valuable aid in developing and retaining the mass character in pills

GENERAL EXCIPIENT FOR PILLS

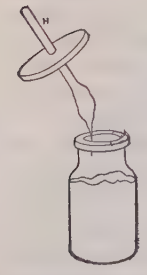
The following excipient is recommended as possessing several advantages. It is a colorless, permanent, very adhesive liquid; the pills made with it are small; and the proportion of glycerin is not large enough to make the surfaces of the pills hygroscopic in an ordinary atmosphere:

Glucose (syrupy)	**4 oz. av.**
Glycerin	**1 oz. av.**
Acacia (powdered)	**90 grains**
Benzoic Acid	**1 grain**

Dissolve the benzoic acid in the glycerin contained in a small tared capsule, add the acacia with stirring, and then the glucose, and allow the mixture to stand until the acacia is dissolved. A *moderate* heat may be applied to hasten solution. The benzoic acid is used as a preservative.

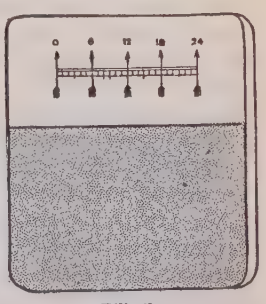
In Fig. 670 a simple but effective excipient bottle is shown. It is made from a plain wide-mouthed bottle; a piece of sheet rubber cloth, such as is used for making washers, is cut into a disk, slightly larger in diameter than the mouth of the bottle; a hole in the center permits the introduction of a round, slightly tapering wooden rod, *H*, or, if preferred, a solid glass rod. It is obvious that as the excipient is used the rod may be slipped down so as always to dip into the excipient a certain distance, and thus the quantity adhering to the end can be easily adjusted. One of the merits of this simple device is that all parts of it can be easily renewed and kept clean.

Fig. 670



Excipient bottle

Fig. 671



Pill tile

Dividing the Mass—Upon the small scale a pill tile may be used for this operation (see Fig. 671). These are usually made of queen's ware or porcelain, but the objection to this material is that some substances will penetrate through the little fissures in the tile and soil it. These are often very difficult to dislodge, and they usually give the tile a dirty appearance in spite of the most thorough washing. Porcelain pill tiles are also so smooth that the pill mass has a tendency to slip as it is rolled. A plate glass pill tile is now available and is far superior to those made from porcelain. They

have the scale graduated by an engraver's wheel, and a little over one-half of the surface ground so that the pill cylinder will not slip. This makes an unexceptionable surface. The pill mass is placed upon the tile and rolled into a cylinder, either with a smooth, flat board or a spatula. It is then placed upon the graduated scale and cut with the spatula into the desired number of pieces; these are afterwards rolled between the fingers into globular pills.

In rolling the pill mass into a cylinder, an ideal roller may be made from a board an inch thick and about 4 by 6 inches in size, having a 2 inch leather strap tacked to the sides so that the entire hand may be pushed beneath it. This gives a heavy, large, and flat surface which will quickly roll out the mass to a pill pipe of even diameter. When the pill pipe has been rolled to the proper length, it is placed over the scale on the pill tile and the place to cut each pill is marked with a spatula, making only a slight depression in the mass. When the pills have all been marked the pill pipe may be cut into the desired number of pills. If this plan is not followed and the individual pill cut without marking the others, the pill pipe will lose its shape and the resulting pills will be of varied sizes.

Fig. 672

Pill spatula

Fig. 672 shows a pill spatula; it has very little "spring", and the end is broad. It is useful in making a mass in a mortar as well as in rolling a pill cylinder. Ordinary steel ointment spatulas, which have the ends broken off or otherwise injured, can often be cut with a file, and the edge smoothed and made into serviceable pill spatulas.

Pill Machines are preferred in making larger quantities of pills; indeed, many pharmacists never use a pill tile, but divide and cut all pills with a machine. A collection of old pill machines well illustrates the development of this useful piece of apparatus. The first improvement over the use of a pill tile and spatula seems to have been the introduction of a cutter which consisted of a series of knives arranged to evenly cut the pill pipe to the desired number of pills. The Michael pill cutter and the Diamond pill cutter were such devices.

The development of the modern pill machine is traced through some of the older wooden machines still to be seen in historical collections. In these a board, having a raised edge of suitable height for the making of the pill pipe, is a separate part of the apparatus. The pill machine itself is much like the modern apparatus except that the grooves are made from hard wood. Such pill machines were very efficient since they possess that peculiar cohesive quality which causes the mass to "roll" under the impact of the cutter.

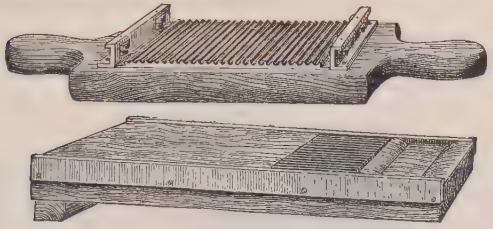
The next development in the wooden pill machine was the combination of the piping board with the cutter and shaper, practically the machine used today except for the introduction of brass cutters and shapers. The modern pill machine consists of two hardwood boards, one of which is encased in a metal frame (to prevent warping); a brass plate having hemispherical grooves is fastened to one end of the lower board, and a similar plate is adjusted to the upper board, which is furnished with handles at the end; brass guides are attached to the upper board, to cause the cutting surfaces of the grooves on both boards to correspond (see Fig. 673). The pill mass is rolled into a cylinder and laid upon the grooves of the lower board; the upper board is then applied so that the cutting surfaces correspond with those of the lower board, and, by a slight backward and forward motion, with downward pressure, the mass is divided and rolled into perfect pills.

When a smaller number of pills are needed than the full capacity of the cutters indicates, the cylinder is rolled out merely to the length necessary to

make the desired quantity. For general prescription filling, the available pill machine will frequently be found to be of such a size that pills cannot be made on it successfully. In this case, the machine can only be used as a cutter. Each pill machine is made to make a specific size pill and is so marked. This may be 1, 2, or 3 grain, or other sizes. When the pill to be made is the size for which the machine is intended, the skilled pharmacist can turn off perfect pills from the machine without shaping them with the hands.

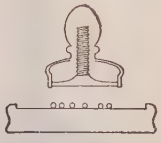
For making stock pills it is frequently possible to add an additional excipient or filler to insure the making of pills on the machine and this of course

Fig. 673



Pill machine

Fig. 674

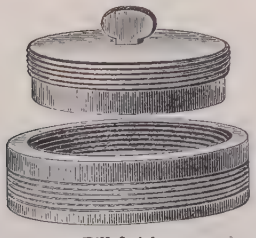


Pill finisher

is done by the manufacturer when pills are made in large quantities. If the pill pipe is of a diameter exactly corresponding to the height of the raised edge of the piping plate of the machine, it is a fair indication that pills can be made on the machine, assuming that the mass is in proper condition.

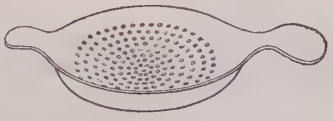
Dusting Powder—To prevent the pill cylinder from sticking to the board or tile, and to lessen the friction, some absorbent powder is dusted upon the surfaces. This may be rice flour, powdered magnesium carbonate, lycopodium, powdered althea, or powdered licorice root. Rice flour is preferable for white pills, because its presence is not easily recognized, and because the cylinder does not slip, as it usually does when lycopodium is used. Small, wide-mouthed

Fig. 675



Pill finisher

Fig. 676



Pill sifter

bottles, fitted with a tooth-powder bottle top, should be provided at the prescription counter for the several dusting powders most frequently employed.

Finishing the Pills—Many efforts have been made to supply effective mechanical devices for finishing pills, yet the fact remains that the pharmacist usually prefers to roll and finish them with his fingers. If a finisher is desired, a level surface having a raised rim may be used, and the pills enclosed and rotated by the adjustable pill finisher shown in Fig. 674, which is turned from hardwood.

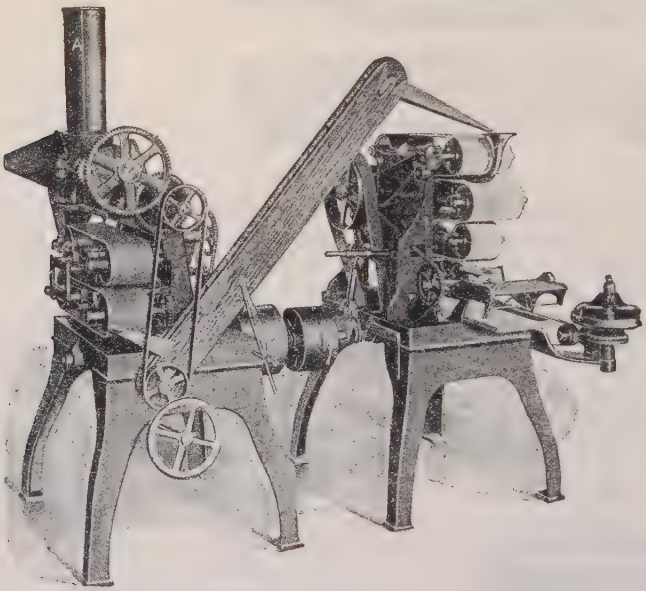
Fig. 675 shows another form of pill finisher which is made of metal. It is less satisfactory than the wooden finisher for its weight must be supported as it is used lest the pills be crushed.

In Fig. 676 is seen a pill sifter; it is made of horn or celluloid and perforated with holes. Pills which are moist are placed in a dusting powder, and when the surface moisture has been absorbed, they are thrown upon the sifter and shaken about gently until freed from adhering superfluous powder.

When large quantities of pills are made, they are usually dried by rolling them in some absorbent powder, spreading them out, and exposing them to dry air.

In Fig. 677 is shown a machine for making pills, manufactured by Arthur Colton, of Detroit. It is, of course, complicated; but when the great number of operations that are required in making pills is considered, the results achieved by this apparatus are marvelous. The illustration shows two

FIG. 677



Colton's modern pill plant

machines; the one on the left, called the ball making machine, makes the mass homogeneous, and delivers it covered with dusting powder in the shape of balls into the hopper of the machine on the right, which is known as the *automata*. As each ball is thus delivered to the piping belts of the automata, a series of operations immediately begins; as it rapidly advances through and toward its destination, it becomes elongated into a strip or pipe; it is rolled many hundred times about its own diameter, and a gentle pressure is given to it as it advances between the belts, sustained from two points of contact; when the pipe is finished, it will have passed through the entire pathway designed for piping, when it now drops on to revolving cutters, where it is divided into pieces of uniform size and weight; these pieces thus cut, drop on to a chute, which conveys them to the entrance of the pill rounding belts; when once drawn in, and between these belts, they are thoroughly rolled, each advancing forward, and by many hundreds side by side, as they go whirling through the automatic finisher; they are now hastened onward until they reach the separator, where a system of sorting is carried on, by which eventu-

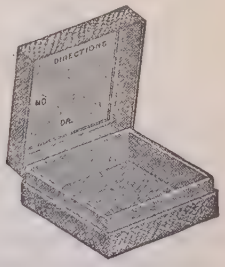
ally the perfect pills are retained, and the tailings are rejected. It is possible to make, with the No. 0 automatic pill machine, 864,000 two-grain pills in ten hours' time.

Pulverous Pills—The so-called *pulverous* or *friable pills* are made in a standard coating pan (see Fig. 703). No heat is required. As starters, either rape seed or sugar granules, which are sometimes known as imperials by confectioners, and are identical with the small granules dispensed by homeopathic pharmacists, are used. Of the two kinds of centers or starters, the sugar granule is frequently preferred, as it becomes indistinguishable from the pill when made. The rape seed, on the other hand, can be detected when the pill is broken open.

The starters are placed in the pan and an application of white paraffin oil is added; the powdered drug is then sifted or sprinkled on the oiled centers as they revolve. The powder adheres to the centers and successive applications of oil and powdered drug are added until the pills are built up to the desired size. It is necessary during the process to remove the pills from time to time and screen out the larger ones, putting back the smaller in the pan until they are all brought up to an even size. When the pills are built up to the proper size the oil can be removed by placing them in a drying closet on absorbent paper which will absorb the oil as it sweats out. Some manufacturers prefer to remove the oil by placing the pills in a bath of carbon tetrachloride, which dissolves the oil. Pulverous pills can be sugar or chocolate coated in the usual manner. The equipment consists of a standard coating pan and an assortment of perforated zinc screens. For the extensive production of pulverous pills special wooden tubs, four or five feet in diameter, are used in place of the standard coating pan. These tubs are mounted on the regular coating pan frames.

Dispensing Pills—Pills are usually dispensed in flat, circular or square boxes. These should be made so shallow that the pills cannot lie on top of one another. Square pill boxes (see Fig. 678) are preferred to round boxes for several reasons, the principal one being that a square label can be used. This can be trimmed more neatly and quickly than a round label, can be written upon by a typewriter more satisfactorily, and, in the opinion of many pharmacists of taste, looks better. A small quantity of dusting powder should be placed in the box to prevent the adhesion of freshly made pills. The use of the homeopathic vial, fitted with a screw top, is becoming so general for the dispensing of machine-made pills, tablets, and capsules that they are sometimes employed for freshly made pills. This is especially true of small granules, such as pills of strychnine sulphate. When dispensed in this way the fresh pills must be very firm so that they will not adhere.

Fig. 678



Hinged-lid pill box

Trochisci—*Troches*

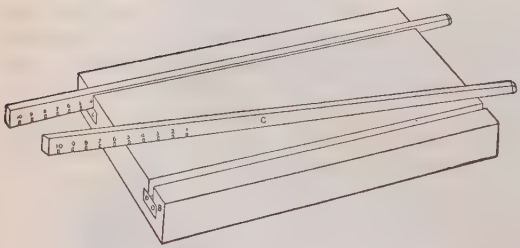
The official formulas for troches will be found on pages 498 to 499, in Part III. In this section under Magistral Pharmacy a general consideration will be given to the methods for preparing troches in a retail drug store or on a small scale by manufacturers. Special formulas for troches are also occasionally prescribed and are discussed here.

Troches, or lozenges, also known as pastilles and, when cylindrical or

rod shaped, as a *bacillules*, are solid, discoid or cylindrical masses, consisting chiefly of medicinal powders, sugar, and mucilage. They are intended to be used by placing them in the mouth and permitting them to remain until, through slow solution or disintegration, their purpose of mild medication is effected. It is obvious that very powerful or disagreeable remedies cannot be administered in this way. The formation of the "lozenge mass" is the most important part of the operation. The dry powders must be made into a tenacious mass which possesses sufficient plasticity to enable it to be rolled into a flat cake without crumbling. It must not retain moisture so long as to occasion too much delay in drying the troches, and the troches must not be brittle through want of sufficient adhesiveness. Mucilage of tragacanth has been found best to bring about the adhesion of the powders.

Making the Mass—The best method of making the mass is first to prepare the mucilage according to the formula, and, having mixed and sifted the powders, add sufficient mucilage to make a mass of the proper consistence.

Fig. 679



Slocum's lozenge board

Fig. 680

Lozenge punch

Fig. 681

Lozenge punch (steel cutter)

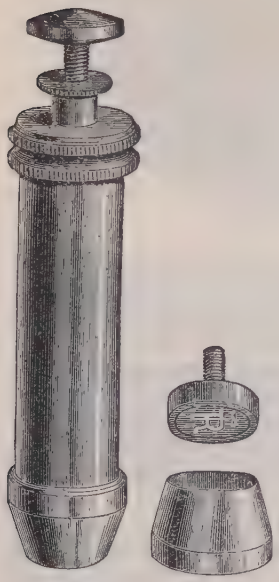
The quantity always depends upon the character of the powder. If the latter is absorbent, more mucilage is required than if the powder is made up largely of extracts. The usual method of mixing powdered tragacanth or acacia with the dry powders, and then trusting to the addition of the right proportion of water, is generally disappointing in the hands of the inexperienced, almost invariably producing too moist a mass. Upon the large scale the manufacturer employs a mixing machine to form the mass; upon the small scale the pharmacist uses the mortar and pestle.

Rolling the Mass—When the mass is made, it must be formed into a flat cake by placing it upon a hard, level, dusted surface and rolling it with a cylindrical roller. The thickness of the cake determines the weight of the lozenge, and hence it is more exact to have some means of adjusting the thickness. In Slocum's lozenge board (see Fig. 679) this is ingeniously effected by the use of tapering oak strips, *C*, which slide in inclined furrows; the handles of the strips are graduated, having saw kerfs at regular intervals; the brass plate, *B*, permits these to be accurately adjusted and held, so that both strips project uniformly above the board. By pushing both strips forward, greater thickness of the lozenge cake is secured.

Effort has been made in the N. F. to make troches of the uniform weight of 1 Gm. Although the amount of medication varies, sufficient filler is added to make up the necessary weight. This makes it possible for the manufacturer of troches to prepare a lozenge board of hard wood, and perfectly level, such as a "bread board", and permanently fasten upon it narrow strips of wood of the exact thickness of the troche. This can be determined by a trial in which the lozenge mass is rolled out upon the board and the lozenges punched out with the cutter when the mass is at varying thicknesses to determine the exact thickness which will produce a 1 Gm. troche, when made by the punch to be employed. Uniformity in thickness of troches also has the advantage of uniformity in the size of the box used for their sale.

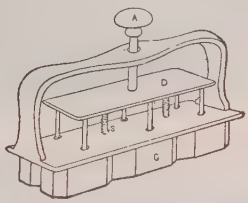
Cutting the Troches—Troches are cut by cylindrical or conical punches, often made of tinned iron, as shown in Fig. 680, but preferably of steel. Fig.

Fig. 682



Lozenge cutter, with die

Fig. 683



Lozenge cutter

Fig. 684

Lozenge cutter (end view)

Fig. 685

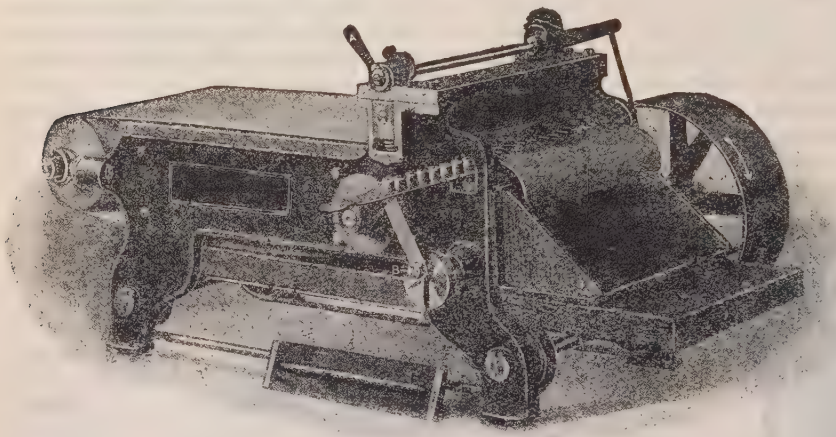
Lozenge cutter

681 shows a very good punch, having a hardened steel octagonal cutter, *C*, soldered to a hollow conical handle, *M*. Fig. 682 represents a very complete lozenge cutter with a circular die, which stamps a letter upon a lozenge in addition to cutting it. It is made very substantially, and is accompanied by a cutter and a die for oval lozenges. Fig. 683 shows an excellent cutter which accurately cuts six lozenges at once. It was devised by a Western pharmacist. Fig. 684 gives the end view. The cutter is placed upon the soft mass and pressed down until the edges touch the board. By pressing upon the handle, *A*, the lozenges are forced out of the cutters, the springs, *S*, causing the pushers to resume their original position. Fig. 685 illustrates a type of lozenge punch which was specially made and which is admirably suited to the preparation of lozenges on a comparatively large scale. It embodies the advantages of the single punch (see Fig. 680) in that troches as they are cut are forced into the

cylinders of the cutter until they are full when they may all be dumped upon a suitable drying tray without further handling.

Fig. 686 shows Colton's lozenge cutting machine. The mass, having been previously rolled into a flat cake of the desired thickness, is placed upon the moving rubber belt, which carries it forward to a finishing roller which gives

Fig. 686



Colton's lozenge cutting machine

it the necessary evenness of surface; it then passes under the tapering cutters, and the lozenges drop downward to a tray or receiver.

When troches have been made by the use of a punch they must be thoroughly dried before boxing, else they are likely to mold.

Extemporaneous Preparation of Troches—Troches are occasionally prescribed and may then be prepared advantageously by massing the material, rolling it into cylinder or "pill-pipe" and cutting into sections, approximately twice the length of the diameter. This readily provides uniformity in size and shape and is the most economic method for preparing troches extemporaneously. Prescription No. 32165, page 1817, illustrates this type. This shape of lozenge is known as a *bacillule*. Licorice lozenges are frequently of this type, and a popular lozenge of this shape was formerly known as Wister's lozenge.

CHAPTER CIV

TABLETS

Tabellæ—*Tablets*

This term in medicine and pharmacy is applied indiscriminately to a discoid or variously shaped form of medicine. These are further divided into several classes, determined by their method of manufacture or their use. These are described and discussed in the articles which follow.

Molded Tablets or Molded Tablet Triturates—Molded tablets, or tablet triturates, may be defined as small disk-like masses of medicinal powders, the basis usually consisting of powdered sugar of milk, or a mixture of sugar of milk and cane sugar. A tablet made from sugar of milk alone is too easily crushed so that usually a mixture consisting of sugar of milk, five parts, cane sugar, one part, is used. The powder is held together and the tablet retains its shape through the adhesion of the particles which is developed by the use of a volatile liquid like alcohol.

Tablet triturates originated with Dr. Robert M. Fuller, and neither process nor apparatus is patented. Since his first communication on the subject, in

Fig. 687

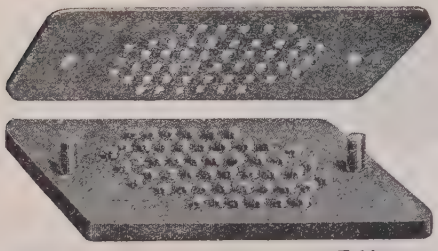
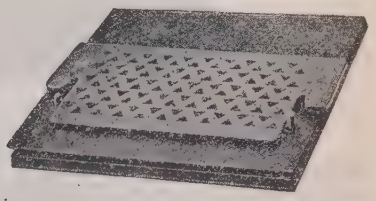


Fig. 688



Tablet triturate machines

1878, they have been largely manufactured, and pharmacists owe a debt to Doctor Fuller for voluntarily giving them a very neat and ingenious process whereby many medicines can be satisfactorily administered.

The tablet is made by pressing a paste into perforations made in a plate of hard rubber, metal, or other suitable material. These holes are of uniform diameter, and the plate must have a uniform thickness throughout. The number of holes in the plate is determined by their relative size, plates having been made with as many as three hundred perforations. The tablets weigh from half a grain to four grains according to the plate used.

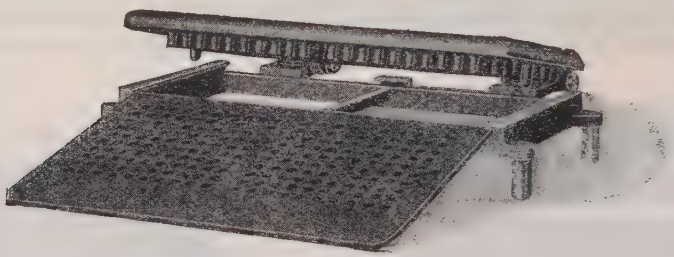
Preparation of Molded Tablets—In using the apparatus, the upper plate is placed upon a pill tile or plate of glass, and the paste is spread upon the upper surface and rubbed into the small holes with a spatula. When all of the holes are filled, the excess of paste is brushed from the surface, some of the dry triturate is dusted over both sides of the plate, and the latter set aside for a few minutes. The upper plate is then lifted over the lower plate and laid upon it so that the two long pegs enter the corresponding holes (see Fig. 687). Now, by pressing firmly but gently upon the upper plate the pegs are forced upward slowly until the plates come together and a tablet rests upon the

top of each peg; the apparatus is then set aside to permit the tablets to dry, when they are taken off, and the plates, after brushing, are ready for another operation. Fig. 688 shows another style of mold.

It will usually be found desirable to have several sets of plates, so that they may be worked continuously, the tablets drying upon one while another is being used for forming the tablets. The paste may be made by adding the medicating ingredient in fine powder to finely powdered sugar or sugar of milk and moistening it with alcohol or, in some instances, may be diluted with water containing a little syrup. Lactose or sugar of milk alone makes a tablet which is soft and easily crushed, but is the usual diluent used for molded hypodermic tablets. For other tablets it is customary, however, to employ as the diluent a mixture consisting of lactose or sugar of milk, five parts, cane sugar, one part. For oxidizable substances which are not intended to be dissolved, as for hypodermic use, kaolin or precipitated chalk have been used as diluents. In some rare cases a little powdered acacia may be needed, but care must be observed not to get the paste too tenacious nor too soft, as there may be difficulty in forcing the tablets out of the perforations, or they may take a long time to dry.

Tablets used for hypodermic medication may be advantageously made by

FIG. 689



Colton's No. 1 triturate machine

this process. Accurate adjustment of the ingredients and prolonged trituration, so that each tablet shall contain its due proportion of activity and thorough desiccation, are the important details in the manufacture of tablet triturates.

To avoid the development of mold on the tablets they must be thoroughly dried before bottling by spreading them on a frame covered with muslin, and exposing them to currents of warm air.

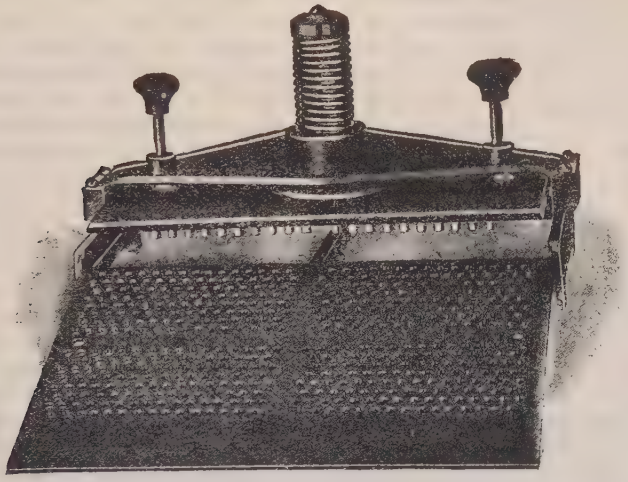
Developing a Formula—In developing a formula or deciding upon the amount of material required for a given number of tablets, the weight of the diluent which exactly fills all of the openings in the mold is determined by an experiment. This amount of diluent is then weighed and placed in a pile on the work counter, and by its side is placed the total amount of medication for the number of tablets made by the mold. A bulk of the diluent equal to the bulk of the medication is now withdrawn, the medication and remaining diluent are mixed by trituration and the resulting triturate moistened and forced into the openings in the molds. If they are not completely filled more diluent is added, its weight noted, and the formula then made up from the results of the experiment.

Figs. 689 and 690 show Colton's No. 1 and No. 2 triturate machines. Similar molds are made by the F. J. Stokes Company. Fig. 691 illustrates an automatic machine made by the Colton Company for the molding of tablets.

Many of the tablets sold today as tablet triturates are compressed on a

regular tablet machine (see page 699), being made in all respects like compressed tablets, excepting that the punches are made with flat faces to produce a tablet resembling the molded tablet. They, of course, represent the prin-

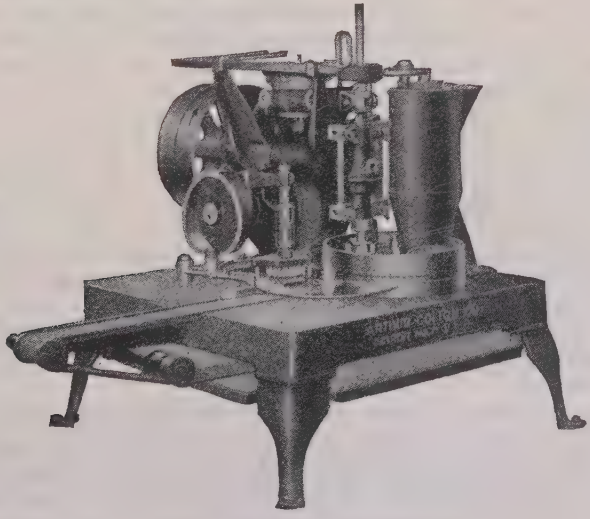
FIG. 690



Colton's No. 2 triturate machine

ciples of a triturate, *i.e.*, a small amount of medication and a diluent, uniformly mixed by trituration. It is less costly to make them on a compressing machine, if the apparatus is at hand, than by the molding process.

FIG. 691

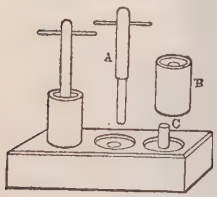


Colton's automatic triturate machine

Tablet triturates nave been made "in blank", that is, without medication. When medicating liquids have been added to them they are termed *tablet saturates*.

Compressed Pills, Troches, and Tablets—Compressed pills, troches, and tablets are forms of dosage medication, usually discoid in outline but also compressed into many other shapes to make them distinctive. They are made by subjecting dry, granular powders to a sufficient degree of pressure in suitable machines to cause them to cohere; the pressure may be effected by a blow from a mallet, or by means of a lever or combination of levers or, as is more usual, by automatic machines. To enable the pharmacist to prepare small quantities of his own compressed tablets, Joseph P. Remington devised, in 1875, the machine for making them shown in Fig. 692. It is made of cast steel. The base has two countersunk depressions, with a short post in the center of each; a lenticular depression is made in the upper surface of each post. A steel cylinder having a central aperture of the diameter of the post is placed in the depression, the proper quantity of powder is introduced, and the plunger, which has a corresponding lenticular depression on its lower surface, is placed on the powder and is struck a quick blow with a mallet; the powder is compressed, and the pill adheres to the cylinder; by removing the cylinder and holding it over a box and again tapping the plunger lightly, the pill is forced out, and falls into a box. While the molding of various forms of medication into tablets had been known for many years, William Brockedon, of England, was the first manufacturer to introduce this form of pill on a commercial scale. The records show that he was granted an English patent in 1843 for a machine to make pills and lozenges by pressure between dies. This machine, in principle, was much like the one illustrated in Fig. 662. In this country, Jacob Dunton, of Philadelphia, was the first to extend the process to a long line of pills, but subsequently John Wyeth and Brothers, and several others, prepared compressed pills and tablets upon an enormous scale, and they are made now by many manufacturers, both here and abroad. The tablets made by Burroughs, Wellcome and Company are known as *Tabloids*, which is a proprietary name and cannot be legally used by others.

Fig. 692



Hand tablet compressor

Preparation of Material—Most materials to be compressed require some simple treatment to insure proper operation of the tablet machine and a product of good appearance. Fine powder is objectionable for several reasons. First, it will not flow readily from the feeding device into the dies, producing wide variations in weight and density. Second, air is trapped in the tablets by the fine powder and causes the tablet to split or "cap". Third, the fine powder sifts down around the lower punches and blows up around the upper punches, necessitating frequent stops for cleaning the machine so that it will run properly.

Granulating—These faults are overcome by "granulating"—a process which changes the fine powder into small granules that are readily compressed into perfect tablets.

The general process of tablet making is practically the same in all cases, although details vary. The usual steps are pulverizing, sifting and mixing, granulating, drying, coarse grinding, lubricating, and flavoring. The finished granulation is then compressed. With some materials, one or more of these steps may be omitted. The machines used to perform these various operations will be discussed later.

There are a few materials which are already granular and need no treatment before compressing. Sodium bicarbonate in its commercial form is easily compressed into the so-called "soda mint tablets" if lubricated with 1 to

1.5 per cent of oil of peppermint before being run in the tablet machine. Other crystalline salts such as potassium chlorate, potassium permanganate, potassium nitrate and sodium, potassium, and ammonium chlorides, bromides, and iodides, also silver proteinate, methenamine, etc., need no treatment before compressing, other than sifting. Not all granular crystals will compress well. Granulated sugar is a familiar example of such material. The crystals are brittle and crack under pressure, producing broken and capped tablets; moreover, such material often sticks badly to the inside of the die. Tablets to be made from other substances than the few mentioned above or from combinations of several drugs and chemicals must be prepared in a granular form.

Many formulas for tablets call for not only chemical and vegetable drugs that merely have to be finely powdered and dried before mixing, but they very often call for tinctures, fluidextracts, volatile oils, hygroscopic materials, effervescent mixtures, and other ingredients that must be specially treated. A fluidextract or a tincture may be handled in several ways; it either may be concentrated to the consistence of a syrup and used as a moistening or granulating agent for the other ingredients, or it may be reduced to a solid extract, and, after being dried and powdered, added to the mixture. With oily extracts an absorbent is often necessary. For this purpose a substance such as magnesium carbonate is admirably adapted, 5 per cent of the weight of the extract usually sufficing. If the material is hygroscopic, dry starch or lactose added to the otherwise finished granulation after drying and just before compressing, will often counteract the effects of the moisture absorbed, if the material is not too hygroscopic. Some materials can be compressed successfully only on very dry days or in a room supplied with dehumidified air. If too much starch is added to the finished granulation, capped tablets may result. Volatile oils are added to the finished granulation immediately before compression. Under no circumstances should these volatile oils be added before drying. Materials which will react with organic bases may be mixed with inorganic substances such as talc or kaolin, if the material is not to be dissolved, or, if a soluble tablet is required, with dried and powdered sodium sulphate or magnesium sulphate. Mercuric chloride is usually diluted with an equal volume of sodium or ammonium chloride, which also greatly increases its solubility.

Diluents or Bases—Usually only a small percentage of a formula is active. The active ingredients are thoroughly mixed with inert substances called diluents or bases in order to increase the weight and size of the tablet. For this purpose powdered *sucrose* (cane sugar), *lactose* (milk sugar), corn starch, kaolin or mixtures of these materials, are used. Kaolin can be used to advantage as a base when mixed with corn starch and powdered sugar. In this mixture the starch acts as a disintegrator (see below), and the powdered sucrose as a "binder", so that an excellent tablet that will break down rapidly results. Sucrose may often be displaced as a base by a cheaper filler though it must be used in effervescing, alkaline, and antiseptic tablets, and in all tablets that should give a clear solution.

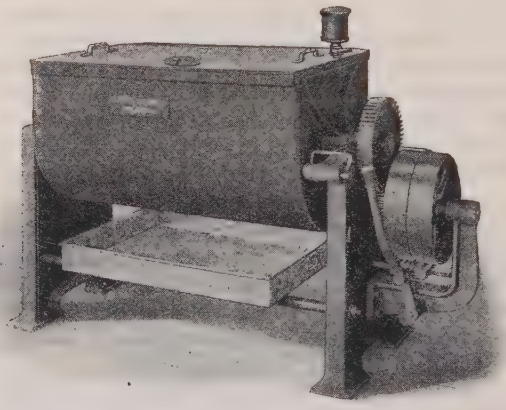
The various ingredients making up the formula should be thoroughly mixed and moistened with a granulating agent. Enough of the granulating solution is added to cause the fine particles to adhere, but not enough to form a damp mass. When only a small quantity of material is to be treated or when a poison or other very active ingredient is a part of the formula, the materials should be dampened and carefully triturated, using a mortar and pestle. In larger quantities the material is conveniently and efficiently handled in a granulating mixer as shown in Fig. 693. Water is the most common granu-

lating agent, either by itself or with a dissolved binder, although acetone, alcohol, or water, and alcohol mixtures are sometimes employed.

The maximum size of granules used depends on the size of the tablets. A large granule is more quickly and easily made. It is therefore preferable to use as large a granule as will fill nicely into the die of the machine. Ordinary pharmaceutical size tablets are usually made from a granulation that will pass through 12, 16 or 20 mesh sieve, depending on the size of the tablet to be made. It is usually entirely unnecessary to sift out the under size granules and "fines" as the large granules will insure proper flow. Moreover a large uniform granule does not make as smooth a tablet as a granulation containing some smaller granules and "fines".

Binders—Some materials, when granulated with water alone, fall to a powder when the water is removed. In such cases, a small amount of binder is required to hold the material in the granular form necessary for compression. These binders are added most frequently to the granulating agent and they

FIG. 693



Colton's granulation mixer and moistener

serve two purposes; they assist in making the granulation and they give the tablet the desired firmness. The usual binders are sugar syrup, starch paste, glucose, gelatin solution, and acacia or tragacanth mucilage, the choice depending on the use to which the tablet is to be put. Some of these binders may be added in a dry form to the other powdered materials before the addition of the granulating fluid, usually, however, they are added in solution. As a general rule, a binder in solution is twice as effective as one that is dry. Powdered sucrose dissolved in one or two parts of water is one of the most widely used binders in pharmaceutical work. This form of granulation should not be absolutely dry, for then the sucrose will crystallize and some of the binding property be lost. Glucose is an excellent binder and is somewhat stronger than sucrose. Care should be taken not to use it in too great an amount in medicinal tablets, as such tablets have been known to pass through the body without dissolving. Tablets containing glucose are also somewhat hygroscopic and do not keep well in humid weather or in warm countries. Starch paste and gelatin solution are both good binders and make hard tablets. The gums are very strong binders and usually require the use of a disintegrator.

Disintegrators—Most tablets must dissolve or break up in the mouth or stomach. This is accomplished by the use of a disintegrating agent. The

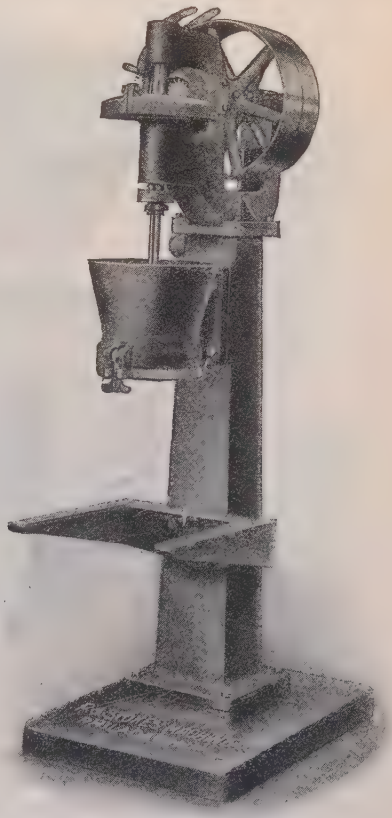
usual agent is powdered corn starch, which has a great affinity for water and swells when moistened, bursting the tablet apart. For rapid disintegration dry starch is added both to the original mixture and to the dry granules. Starch added to the original mixture before wetting it breaks up the separate granules, while three to five per cent of starch added to the finished granulation will separate the granules. Starch introduced as paste has very little if any disintegrating effect.

Drying and Grinding—After the various constituents of the formula have been thoroughly mixed and dampened with the granulating solution, the mixture is spread on shallow trays and placed in a drying closet through which warm air is circulated, or in a few special cases in a vacuum dryer. When sufficiently dry the material is ground to the desired size in a drug mill such as is illustrated in Fig. 694. Figs. 695 and 696 show types of granulating machines in use. Either device may be used to break up or shred the damp granulation to permit more rapid drying. The oscillating granulator is also used to break up lumps formed during the drying process. The oscillator produces less "fines" than the drug mill and should be used when making small monogramed tablets or hygroscopic mixtures. The old hand method of rubbing the damp granulation through a screen with a block of hard wood is seldom used except in cases when a mixture is difficult to manipulate in the

FIG. 694

Hance mill

FIG. 695

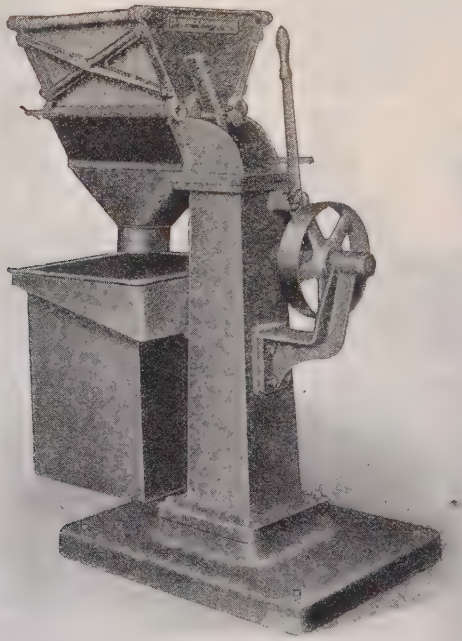


Stokes' granulator

oscillating granulator, or when the quantity to be made up into tablets is quite small.

Lubricants—In practice it has been found necessary to use some substance as a lubricant when the tablets are compressed, otherwise they are apt to stick to the punches or die and cause much annoyance. Finely powdered stearic acid is one of the most efficient of lubricants and may be used in practically all medicinal tablets where it is not objectionable on account of its insolubility or color. One-half of one per cent is usually sufficient to lubricate a well made granulation; seldom more than one per cent. Stearic acid gives excellent results when used to lubricate sugar granulations, or in tablets that are to dissolve slowly. Purified talc has also been extensively used for lubri-

FIG. 696



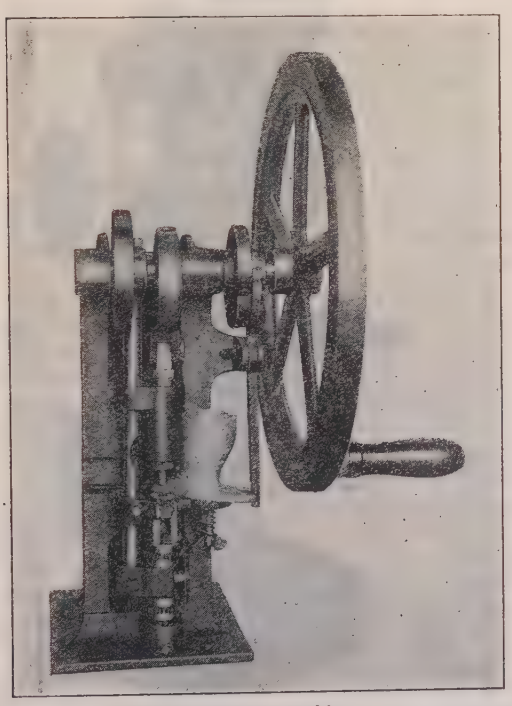
Colton's granulator

cating. From two to five per cent thoroughly mixed with the granules just before compressing is usually sufficient. Talc is not suitable for tablets which are to be dissolved to form a clear solution, nor is its use permitted under the Food and Drugs Act for confections, like mint tablets, or for foods. Boric acid is usually used for soluble tablets, from two to five per cent being required. Liquid petrolatum is largely employed as a lubricant for colored tablets. One or two per cent is added to the otherwise finished granulation and thoroughly mixed. Cacao butter (cocoa butter) and powdered soap have also been used as lubricants. In some cases when the sticking is only on the edges of the tablets and not on the faces, lubrication can be very nicely accomplished by placing a felt washer, soaked in liquid petrolatum, around the lower punch just below the die. Only an exceedingly minute quantity of oil is transmitted to the tablet.

Effervescent Mixtures—These can be handled in two ways. The acid and carbonate mixtures can be granulated separately. The dry granulations

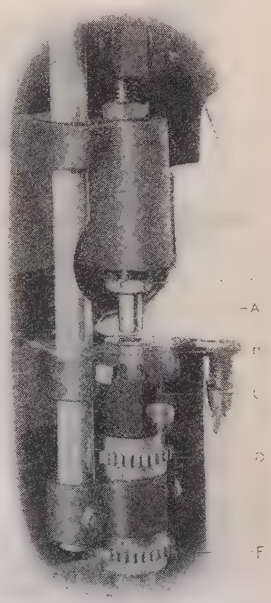
are then mixed and lubricated with three or four per cent of boric acid before compressing. Another method is to heat the whole mixture in a steam-jacketed pan until the water of crystallization in the citric acid causes the mass to fuse. The material should be stirred constantly during the heating process so that it will heat uniformly. As soon as all the fine particles adhere, the material is immediately screened and dried at a low temperature in an air dryer or in a vacuum dryer. The dry granules are lubricated with boric acid before compressing. If the mixture contains a high percentage of citric acid, it may be necessary to partly dry the acid before mixing, so that there will not be too much water set free in the fusing process. These granulations must be

Fig. 697



Eureka tablet machine

Fig. 698



Enlarged view of punches and die

lubricated before compression, using a soluble substance, since they are to produce a clear solution.

Compressing Machines—A variety of automatic machines are now in use for making compressed tablets. The simplest modern machine suitable for the pharmacist is the Eureka tablet machine made by the F. J. Stokes Machine Company, of Philadelphia. This machine, shown in Fig. 697, is entirely automatic and will make 100 accurate tablets per minute of the ordinary pharmaceutical sizes. Adjustments for weight and pressure are very easily made. The enlarged view, Fig. 698, shows the principle on which this machine and practically all single punch machines operate. "*A*" is the upper punch or compressor just leaving the die "*B*". The tablet is shown in the die after it has been compressed. This will be raised by the lower punch "*C*", to the surface, where the feed cup will eject it and fill the die with another

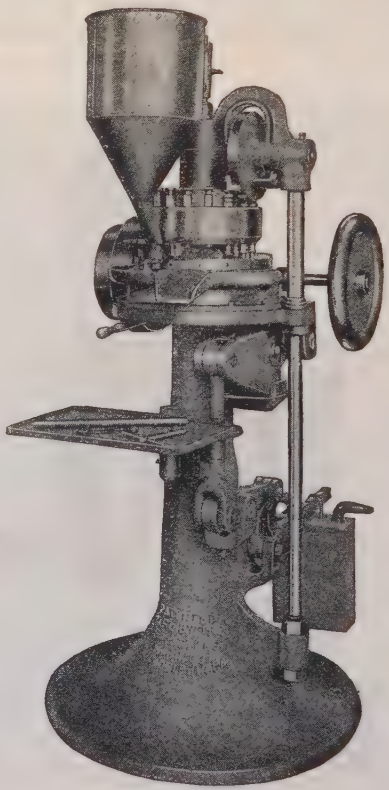
charge of material, upon which the operation will be repeated. "*D*" is the adjustment for regulating the lower punch so that it ejects the tablet properly. "*E*" is the adjustment for regulating the weight of the tablet, and "*F*" is the adjustment for controlling the pressure or density of the tablet.

Fig. 699 illustrates a power driven single punch machine that operates on the same principle as the Stokes' Eureka Machine described above. The F. J. Stokes' Machine Company of Philadelphia, and the A. H. Colton Company of Detroit build machines of this type and adjustments for weight and pressure are similar on both. A single punch machine will produce from 25,000 to

Fig. 699

Single punch tablet machine

Fig. 700



Stokes' rotary tablet machine

40,000 tablets per day. These machines are well suited to the smaller manufacturing pharmacist who handles a varied line of tablets. The machines can be quickly cleaned and easily changed to manufacture different sizes of tablets.

Compressing machines of the rotary type, illustrated in Fig. 700 are used when the required production is larger. By reducing the cost of manufacture they have revolutionized the tablet industry. A rotary machine will make from 200,000 to 500,000 tablets per day. Its method of operation is exceedingly simple. A head carrying a number of sets of punches and dies revolves continuously while the granular powder runs from the hopper, through a feed frame and into the dies. Compression takes place as the upper and lower punches pass between a pair of rolls. The tablet is then ejected. Operation is almost noiseless and without waste, and the smooth motion of the punches reduces to a minimum the tendency of the tablets to cap. Adjustments for

weight and pressure can be made without the use of tools while the machine is in operation. On the Stokes' Rotary Machine illustrated, a safety weight cushions each compression and relieves the machine of all shock and undue strain. The punches and dies can be readily removed for inspection and cleaning. By inserting different sets of punches and dies the same machine can be used for producing a great variety of sizes and shapes.

Punches and dies used in tablet compressing machines require attention and care for best results. They must be highly polished and kept free from rust and imperfections. When not in use they should be removed from the machine, thoroughly cleaned and then coated with petrolatum.

Adjusting the Punches and Dies of a Single Punch Machine—The correct adjustment of the punches and dies in the machine is an important part of the knowledge required for tablet manufacture. On the single punch type of machine the lower punch is first fastened in the socket, then the die put into place in the bed of the machine, and the set screw, holding it in position, tightly fastened. The upper punch is now slipped into place, the machine turned over so that the punch enters the die, and then it is fastened. If the upper punch is tightened in its socket, when not entered in the die, it may strike the side when the machine is turned over and injure both punch and die. Having fastened the die and punches, the lower punch is now adjusted so that when it rises to the highest point it will be exactly flush with the top of the die. If it rises above the face of the die, the shoe which throws off the tablets and afterwards feeds in the granulation, would strike it and injure the punch, and probably jam the machine. On the other hand, if the punch, when it rises to the highest point for the ejection of the tablet, remains below the face of the die, the mechanism which throws off the tablet will cut the tablet in half. The lower punch must next be adjusted so that the cup-like opening in the die, produced by the punch dropping to the lowest point, will hold exactly the weight of granulation required for each tablet. This is determined by weighing out the amount of granulation for one tablet, say three grains, dropping the punch to the lowest point and pouring in the granulation. It should exactly fill the opening and remain flush with the top of the die, corresponding to the condition when the granulation is deposited by the feeding mechanism passing over the die. If the granulation will not all enter the opening, the punch must be lowered, and, if the opening is not completely filled, the punch must be correspondingly raised. The next step is to regulate the pressure; this is determined by the position of the upper punch. The opening in the die is filled with the required weight of granulation and the machine is slowly turned over, by hand, until the upper punch compresses the tablet. If the punch is too low, the machine jams and the fly-wheel cannot be turned, while if too high the tablet will be soft. Its position is therefore adjusted until the tablet possesses that consistence which is recognized as giving the necessary firmness without extreme hardness. A tablet of proper consistence may be readily broken in half between the thumb and fingers, but will not break when dropped upon the floor. The feeding device is now put into place and the granulation poured into the hopper, and the machine started. The weight of the tablets should be carefully checked from time to time by taking the weight of a multiple of tablets, say ten or more.

As the tablet is thrown from the machine it is always accompanied with more or less powder or uncompressed granulation. Various plans have been proposed to free the tablets from this powder, the most common being the sifting of the tablets. A blast of air from a hand bellows or from a compressed air reservoir, applied to the surface of the tablets during the sifting process is

also helpful. Sometimes the tablet, as it leaves the machine, is made to slide down an inclined trough which is made partially of coarse sieve cloth; the powder is thus collected before the tablet reaches the container.

The adjustment of the punches on a rotary tablet machine is not readily described and those who are required to operate this type of machine must acquire the mechanical knowledge through actual experience with the machine. Nevertheless many of the principles just described also apply to the adjustment of punches on the rotary machine.

The following are typical formulas, illustrating many of the foregoing points. They are arranged as usually found on the formula cards of a manufacturing pharmaceutical firm.

Tablets of Acetanilid, 1 grain	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Acetanilid	1 gr.	1		
	Starch			6 2/3	
Granulate with 20 per cent gelatin solution					
Add					
	Starch			1 1/3	
Finished weight			1	8	

Make 1 1/2 gr. tablet, using 7/32 inch die

Tablets of Acetanilid and Sodium Salicylate Compound	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
✓	Acetanilid	2 1/2 gr.	2	8	
	Sodium Salicylate	1 3/4 gr.	1	12	
	Caffeine	1/4 gr.		4	
Granulate with 10 per cent acacia solution.					
	Sodium Bicarbonate	1 gr.	1		
Granulate with 10 per cent acacia solution					
Mix granulations					
Add					
	Starch			1	
	Talc			5	
	Methyl Salicylate			1 1/2	
Finished weight			6		

Make 6 gr. tablet, using 3/8 inch die

Tablets Acid Arsenous 1/30 grain	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Acid Arsenous	1/30 gr.			233
	Powd. Sugar	1 gr.	1		
	Starch			6	204
Granulate with 10 per cent acacia solution					
Add					
	Talc			1	
	Liquid Petrolatum				90
Finished weight			1	8	

Make 1 1/2 gr. tablet, using 7/32 inch die

Tablets Ammonium Salicylate Compound	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Ammonium Salicylate	2 gr.	2		
	Acetanilid	1 1/2 gr.	1	8	
	Dover's Powder	1/4 gr.			
	Use: Powd. Opium				175
	Use: Powd. Ipecac				175
	Caffeine	1/4 gr.		4	
	Powd. Sugar			8	88
Granulate with gelatin Solution					
	Powd. Camphor	1/2 gr.		8	
	Precip. Calcium Carbonate			4	
Granulate with 1/4 pint syrup					
Mix granulations					
Add					
	Starch			1	292
	Talc			3	150
	Liquid Petrolatum				96
Finished weight			5	8	

Make 5 1/2 gr. tablet, using 3/8 inch die

Tablets Acid Sodium Phosphate, 10 grain	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Sodium Biphosphate or Acid Sodium Phosphate	10 gr.	10		
Granulate with water Add					
	Boric Acid			8	
Finished weight			10	8	

Make 10 1/2 gr. tablet, using 7/16 inch die

Tablets Aspirin, 5 grain*	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Acetylsalicylic Acid or Aspirin	5 gr.	5		
	Powd. Starch			9	146
Granulate with Starch Paste					
Finished weight			6		

Make 6 gr. tablet, using 3/8 inch die

* Aspirin, granulated for compression, is also obtainable commercially

Tablets Atropine Sulphate, 1/100 grain	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Atropine Sulphate	1/100 gr.			70
	Lactose or Milk Sugar		1	5	367
Granulate with 5 per cent acacia solution Add					
	Talc			1	
	Starch			1	
Finished weight			1	8	

Make 1 1/2 gr. tablet, using 7/32 inch die

Tablets Alkaline Antiseptic	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Sodium Bicarbonate	5 gr.	5		
	Sodium Borate	5 gr.	5		
	Sodium Chloride	5 gr.	5		
	Sodium Benzoate	7/24 gr.		4	292
	Sodium Salicylate	7/24 gr.		4	292
	Tartaric Acid	1/4 gr.		4	
Mix and dry in drying closet					
Do not granulate					
Add					
	Boric Acid		1		
	Eucalyptol				204
	Thymol				204
	Menthol				102
	Methyl Salicylate				102
Finished weight			16	12	350

Make 16 4/5 gr. tablet, using 9/16 inch die

Tablets Aloe and Mastic	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Powd. Aloe	2 gr.	2		
	Powd. Mastic	1/2 gr.		8	
	Powd. Rose Leaves	1/2 gr.		8	
	Powd. Starch			2	
Granulate with alcohol					
Add					
	Talc			2	
	Liquid Petrolatum			1/2	
Finished weight			3	4	

Make 3 1/4 gr. tablet, using 5/16 inch die

Tablets Aloin, Belladonna, Strychnine, and Cascara	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Aloin	1/5 gr.		3	88
	Powd. Ext. Belladonna Leaves	1/8 gr.		2	
	Strychnine Sulphate	1/120 gr.			58
	Powd. Ext. Cascara Sagrada	1/2 gr.		8	
	Powd. Sugar			3	88
	Precipitated Calcium Carbonate			6	115
Granulate with diluted alcohol					
Add					
	Starch				175
	Talc				263
	Liquid Petrolatum				88
Finished weight			1	8	

Make 1 1/2 gr. tablet, using 1/4 inch die

Tablets Iron, Quinine, and Strychnine	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Reduced Iron	1/2 gr.		8	
	Quinine Sulphate	1/2 gr.		8	
	Strychnine Sulphate	1/120 gr.			58
	Powd. Sugar			4	233
Granulate with water					
Add					
	Talc				292
	Liquid Petrolatum				10
Finished weight			1	4	

Make 1 1/4 gr. tablet, using 7/32 inch die

Lozenges Ammonium Chloride Compound	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Ammonium Chloride	1/4 gr.		4	
	Codeine Sulphate	1/64 gr.			109
	Fluid-extract of Ipecac	1/5 min.		2	440
	Tincture of Belladonna	3/10 min		4	180
	Powd. Extract of Glycyrrhiza	1/2 gr.		8	
	Powd. Sugar		5	12	
Granulate with 10 per cent acacia solution					
Add					
	Stearic Acid			3	
	Starch			5	
	Oil of Anise				180
Finished weight			7		

Make 7 gr. lozenges, using 3/8 inch die

Tablets Soda Mint and Charcoal	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Sodium Bicarbonate	4 gr.	4		
	Charcoal	1 gr.	1		
Granulate with 25 per cent glucose solution					
Increase in weight				13	146
Add					
	Ammonium Carbonate			1	
	Oil of Peppermint				120
	Liquid Petrolatum				240
Finished weight			5	14	175

Make 5 9/10 gr. tablet, using 11/32 inch die

Tablets Calomel and Soda	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Mild Mercurous Chloride	1/4 gr.		4	
	Lactose or Milk Sugar			7	
Granulate with Starch paste					
	Sodium Bicarbonate	1 gr.	1		
Granulate with 10 per cent acacia solution					
Mix granulations					
Add					
	Talc			1	
	Liquid Petrolatum				120
Finished weight			1	12	

Make 1 3/4 gr. tablet, using 7/32 inch die

Tablets Pepsin and Capsicum Compound	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Pepsin (1-3000)	1/4 gr.			
	(Use Pepsin 1-10,000)			1	88
	Powd. Extract of Nux Vomica	1/4 gr.		4	
	Charcoal	1/4 gr.		4	
	Oleoresin of Capsicum	1/30 gr.			233
	Powd. Sugar			10	
	Powd. Starch			3	
Granulate with 25 per cent glucose solution					
Add					
	Talc				146
Finished weight			1	8	

Make 1 1/2 gr. tablet, using 1/4 inch die

Tablets Blaud's Mass, 5 grain	INGREDIENTS	In each tablet	In 7000 tablets		
			lb.	oz.	gr.
	Ferrous Sulphate (Dried and Powdered)		1	8	312
	Powd. Sugar		1	2	
	Powd. Starch			13	290
Granulate with 10 per cent acacia solution					
	Monohydrated Sodium Carbonate		1	2	54
	Powd. Starch			2	219
Granulate with 10 per cent acacia solution					
Mix granulations					
Add					
	Talc			3	
	Liquid Petrolatum				275
Finished weight			5		

Make 5 gr. tablet, using 3/8 inch die

CHAPTER CV

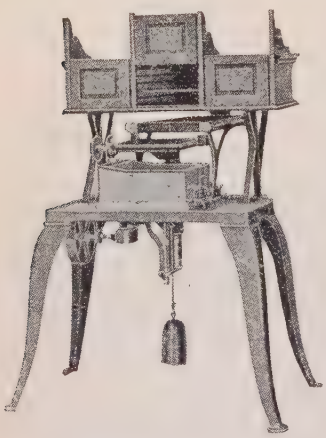
COATING PILLS AND TABLETS

Pills are coated with sugar, chocolate, gelatin, silver leaf, gold leaf, salol, and talcum or French chalk, etc., with the view of masking their taste or rendering them enteric.

Pills cannot be satisfactorily coated with sugar in the small way without much labor. This is not the case with gelatin coating. It is quite possible for the pharmacist to coat pills with gelatin and be able to dispense them in fifteen minutes.

Gelatin Coating—The coating of pills with gelatin is an old process. Formerly each pill was impaled upon a long needle, dipped into a solution of gelatin, and the end of the needle stuck into a cork to permit the coating to dry. This slow process was improved by Charles B. Allaire, who devised a machine for dipping a number of pills at once, and also one for stripping the needle bar. Since then many machines have been introduced for coating pills with gelatin, but all forms have been superseded by the form of coater made by Colton in which the pill is held upon a metal point with the aid of a vacuum.

Fig. 701



Gelatin coating machine

In Remington's "Practice of Pharmacy", 6th edition, some of the older forms of pill coaters are described such as those devised by Patch, Franciscus, Maynard, and Palethorpe.

The holding of the pill upon a metallic point by the aid of a vacuum was devised by J. B. Russell and the Colton machine (Fig. 701) is simply a perfection and adaptation of his patent.

The machine illustrated has the capacity to coat 50,000 pills in ten hours. A vacuum pump and tank is an essential part of the outfit, and it may be located in any convenient place. After the pills are made and seasoned they are ready for coating. The pill drawer is first stored with pills. The front of this drawer contains a feeding plate, registering with the dipping plate. The latter is now placed upon the vacuum jacket and clamped to place; the pill drawer is then pulled forward, which brings the feeder exactly in proximity with the dipping plate. The vacuum being on, the pills are carefully brushed upon the feeding plate, when every receptacle will be filled. The pills are held in place by the force of the suction supplied from the exhaust tank. The pill drawer is returned to its place, and the vacuum jacket (containing the dipping plate and pills) is now reversed for immersion. This done, the jacket is inverted to the first position and the vacuum shut off. The plate is released from its seat and then placed in the kiln to dry the pills, after which the operation is repeated, leaving but one plate (for the beginning of reverse operations). This is placed upon the vacuum jacket, precisely in the same manner as previously described. The plate is now taken from the drying kiln and placed securely upon the transferring apparatus; then, with the lever, the two are brought into close

contact, one above the other. The force of the vacuum acting through the perforations will immediately release the pills, transferring them instantly to the dipping plate on the jacket. The operator then proceeds to immerse the uncoated half of pills in the manner first described.

Pills may be coated with gelatin by cutting the pill cylinder to its center, placing in the cleft a piece of sewing silk, rolling it, dividing it into pills, dipping in gelatin solution, drying, and cutting apart.

Even this improved gelatin coating method is being today largely replaced by the sugar coating method in which gelatin is made a part of the mixture as has already been described. This possesses the advantage of greater speed and marked reduction in machinery and labor cost as compared with the dipping process.

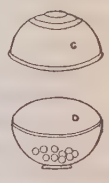
GELATIN COATING SOLUTION (FOR DIPPING)

Gelatin (best grade sheet gelatin)	2½	oz. av
Powdered boric acid	120	gr.
Mucilage of acacia	2	fl. oz.
Distilled water	7	fl. oz.

Macerate the gelatin with the water until it softens, dissolve it by heating on a water bath, and add the boric acid; then slowly add the mucilage of acacia, and strain the mixture. If sweetening is desired, a very small quantity of soluble gluside may be added.

Pearl Coating—This term is applied to the method of coating pills with finely powdered talc or French chalk; the process is similar to that used in silver coating (see below), by placing in a globular box (see Fig. 702) a mixture of very finely powdered talc and sugar, and, having covered the pills with the adhesive mixture, they are rotated until coated. A polish may be given to the surfaces by rotating the pills in a box coated on the inside with paraffin.

FIG. 702



Silver coater

Gold or Silver Coating—The coating of pills with gold and silver leaf dates from the eleventh century A.D., when it was introduced by *Avicenna*. Pills may be coated with gold or silver leaf by first placing a drop of syrup of acacia, or a small quantity of a thick mucilage of acacia, in a mortar, and, after carefully spreading it over the surface with the end of the finger, dropping in the pills, rotating them, with the aid of the finger if necessary, so that they shall be uniformly coated with a very thin layer of mucilage, and then dropping them into the gold or silver leaf contained in the coater. This is merely a smooth, globular box, made of horn or turned wood, opening in the middle (see Fig. 702). A tin ointment box or even a round pill box may be used in applying these coatings. When the pills are rotated, they soon become coated with the leaf, and are then ready to dispense. In the absence of a globular box a large sized pill box may be used. This process is also described in the N. F. V.

Other extemporaneous coatings suggested by the N. F. are as follows:

Extemporaneous Sugar Coating—Quickly roll the pills, freed from dusting powder, on a filter paper saturated with mucilage of acacia, until uniformly but superficially moist, then immediately transfer them to a porcelain dish containing a mixture of eight parts of powdered sucrose or lactose and two parts of powdered acacia, and rapidly rotate them until covered with a firm white coating.

Extemporaneous Chocolate Coating—Quickly roll the pills, freed from dusting powder, on a filter paper saturated with mucilage of acacia, until uniformly but superficially moist, shake them at once with powdered cocoa

until well coated, then immediately transfer them to a clean, warmed porcelain dish, and rapidly rotate them until a smooth coating is produced.

Tolu Coating—Drop the pills, freed from dusting powder, into a porcelain dish in which a thin layer of equal volumes of tincture of tolu and ether has been previously placed, and rotate them until thoroughly coated with the mixture. Turn them at once into another dish of the same kind and size, and rotate for a few moments to remove the excess of mixture, and while the pills are still shining, but not too moist, transfer them to a third dish, previously coated with a very thin film of oil, which has been applied by the tips of the fingers, and rotate them until dry. A second or third coating may be applied in the same manner, if necessary.

Stearic Acid Coating—The use of stearic acid as an enteric coating for pills has been suggested by William G. Toplis. The coating is applied by adding a saturated, ethereal solution of stearic acid to the pills, in a dish, and at the same time rotating the pills. The solution is added carefully, only a few drops at a time, until the coating is complete.

THE SUGAR COATING OF TABLETS AND PILLS

The following description of the process for coating pills and tablets with sugar and also with gelatin has been prepared by F. J. Stokes and is copied here with permission.

The process of coating tablets and pills has been surrounded with more or less secrecy and has in consequence been considered by those unfamiliar with it as quite difficult. It is in reality quite simple and can be mastered by anyone who uses ordinary judgment and common sense. The following instructions should be ample after a little experimenting, to enable anyone to undertake the work with assurance of success. There are several fundamentals to bear in mind which are set forth in the paragraph headed *General Precautions.*

Tablets were formerly coated by what is called the hot process, that is to say, they were placed in a revolving coating pan which had copper steam coils wound around the outside of the pan. This heated the pan and accelerated the drying of the syrup as it was applied to the tablets. A considerable portion of the syrup dried in a hard layer on the surface of the pan and was difficult to recover or was lost. It was later discovered, that by blowing air upon the pills or tablets, the drying took place about as rapidly, and little syrup was deposited on the surface of the pan. As a result the cold process, as it is termed, is now very generally used. In some cases warm air is used, which increases the rapidity of the drying. Warm air is not necessary, however, and many manufacturers use cold air rather than incur the expense of a heating box for heating the air. Steam-heated pans are preferred by some for sugar coating those compounds which contain bromides and other drugs which rapidly absorb moisture.

Equipment—The equipment of a coating department includes one or more coating pans, polishing pans, a fan blower, a syrup kettle or cooker, glass graduates, stirring rods, scales, dippers, workbench, drying closet, screens and containers for the stock solutions and powders.

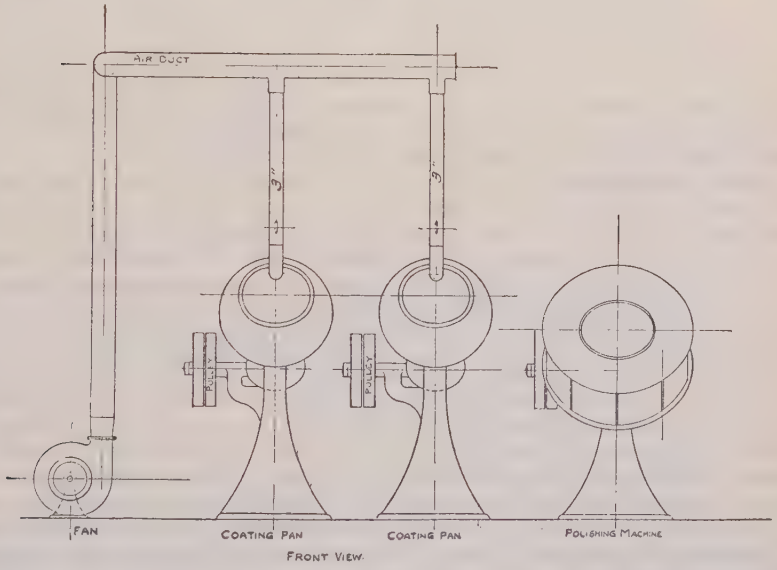
Coating Pans—These can be of copper or galvanized iron, the former being preferred on account of their shape (see Fig. 703). The galvanized iron pans have corners where the sections are fastened together, in which the tablets are apt to stick, and their rolling action is not quite as satisfactory as in the copper pans. The size of the pan depends on the quantity of tablets to be coated at an operation. Usually a number of pans are used so that different lots of tablets

may be coated simultaneously in various colors. The most popular sizes of coating pans are those having a diameter of 24, 30, or 36 inches. The capacity of the pan depends upon the size of the pills or tablets and the thickness of the coating desired. When the uncoated pills or tablets are first placed in the pan, they may seem small in comparison with its size, but when the coating has been finished, the volume of the tablets will be greatly increased. This should not be overlooked when starting to coat. In the table below is given the maximum capacity in one, three, and five grain tablets.

Pan	One grain	Three grain	Five grain
24 inch diameter	100,000	70,000	50,000
30 inch diameter	150,000	125,000	100,000
36 inch diameter	250,000	200,000	150,000

Polishing Machines—A cedar wash tub, about 3 feet in diameter and 16 inches deep, may advantageously replace the ordinary copper pan for

FIG. 703



Coating and polishing plant

polishing the coated pills or tablets. The roughly coated pills or tablets are placed in the tub and while rolling the polishing wax solution is added until the tablets are wet (about ½ fl. oz. of solution to 30,000 tablets). They are kept rolling until polished. The advantage of the wooden tub over the copper pan is that the tablets rolling in the metal tub become warm, thus melting the wax and making them hard to polish. With the wooden tub this does not happen. If a coating pan is used, it is generally lined with canvas. The canvas is cut so as to fit the pan and glued to it. As a coating pan is more expensive than a polishing machine, and as the labor involved in adapting the former for polishing is considerable, it is obvious that it is more economical to have a separate polishing machine or machines. One polisher is required for polishing white coatings, and can be used for no other color, as chocolate and colored coatings stain the canvas lining, and the color would come off and discolor sub-

sequent white lots. For the same reason one polisher is kept exclusively for chocolate coating and a third for polishing the various pink, blue, green, or yellow colors. As the polishing process requires only a relatively short time, as compared to the actual coating process, three polishing machines will handle the output from many coating pans. An inexpensive arrangement which is satisfactory for small production, is to insert into the mouth of a coating pan a cylindrical wooden tub, so shaped that it wedges in the opening of the pan. Several of these can be had at small expense, and a coating pan can be immediately converted into a polisher by inserting one into the pan. The polishing pans illustrated in Fig. 703 are also largely used.

Fan Blowers—The standard type of fan blower of sufficient size to supply an air blast to the pans is required; a 15-inch blower for one pan and an 18-inch blower for three or four pans. This fan can be placed on the floor, or hung from the ceiling. A pipe line is extended along the ceiling over the pans, and from this smaller pipes are extended down to the mouth of each pan. These drop pipes should be fitted with a damper so the air blast can be controlled, and they should end with a loose spout which can be removed when emptying the pan. The illustration in Fig. 703 shows this arrangement of the pipes in relation to the pan. The standard gutter spouting with elbows and fittings as supplied by tinsmiths can be used. As stated above, some coaters prefer to blow warm air to hasten the drying, especially in humid weather. For heating air a steam coil or gas heater is placed in a closet and the suction inlet of the blower connected with the closet; this will meet all requirements.

Cooking Apparatus—The stock gelatin solution and the syrup solution used for sugar coating tablets require heat in their preparation and application. A small steam-jacketed, copper kettle of three to five gallons capacity is very satisfactory for this purpose. A gas stove on the workbench with suitable agate double-boilers will answer, however. The steam-jacketed kettles or gas heaters should be conveniently situated, so that the operator, when dipping out solutions will not have to carry them far to the coating pans. The work bench should face the pans, and a suitable aisle should be arranged between it and the pans. A drying closet will be found of great convenience for drying the tablets before they are placed in the coating pan, and also for drying combinations which absorb moisture. A mortar and pestle are convenient for preparing colored solutions, and should be a part of the equipment, also pint and quart measures and glass stirring rods. The equipment is completed with a set of perforated sieves for separating the different sizes of tablets which may be coated in the same pan, at the same time. They are also useful for screening out broken tablets.

Preparation of Stock Solutions and Sub-Coating Powders—Before the operator can start the coating, the gelatin solution must be prepared for the under or sub-coating, and also the starch and sugar mixture, which is dusted on when forming the under or sub-coating. The syrup solution and stock colors for coloring the syrup must also be prepared. The following formulas for these solutions and powders give very satisfactory results. They are subject, however, to considerable variation, to suit the ideas of the operator after he has become experienced. There are rarely two coaters who use exactly the same formulas.

Gelatin Solution for Sub-Coating—This is prepared by dissolving 2 pounds avoirdupois of powdered or granulated gelatin and 24 pounds avoirdupois of granulated sugar in 2 gallons of warm water, mixing thoroughly and bringing to a slow boil. When thoroughly dissolved, strain, and put in a can or crock. Some coaters add to the above mixture 24 ounces avoirdupois of powdered

acacia. This is not necessary, however, and the solution is stickier and harder to handle than without the acacia. This solution will gelatinize when cold, but will always liquefy when heated, and should always be applied hot.

The following solution is recommended by L. T. Andrews who has had large experience in pill coating:

Gelatin	1 lb. av.
Acacia	1 lb. av.
Water	2 gallons

Allow the mixture to stand until the gelatin has softened, then dissolve by the aid of heat and add 25 pounds of granulated sugar to the hot solution. Again warm and stir until the sugar dissolves and strain through cheesecloth. This formula makes about 4 gallons, and as it sets to a stiff jelly it may be kept for some months. When needed, it must be liquefied on a water bath and used warm.

White Dusting Powder—This as used in connection with the gelatin solution for sub-coating is a mixture of 36 pounds of powdered sugar and 12 pounds of powdered starch, mixed thoroughly and screened through a No. 36 sieve. Some coaters prefer to add 2 pounds of powdered talc and 2 pounds of powdered acacia to the above. The talc assists materially in producing a smooth sub-coating.

Chocolate Dusting Powder—This, as used for sub-coating chocolate-coated tablets, is the same as white dusting powder with the addition of 6 pounds of powdered cocoa or powdered chocolate. This dusting powder is screened in the same manner as the white. The dusting powders, or "stock powders", as they are called, can be stored in galvanized or other suitable containers.

Mr. Andrews uses the following powders:

White Dusting Powder—	Precipitated Chalk	4 lbs.
	Pure White talc	1 lb.
	Starch	1 lb.

Mix, and pass through a No. 80 sieve.

Brown Dusting Powder—	Umber	1 oz. av.
	Powdered talc	3 lb. av.

Mix, and sift through a No. 80 sieve.

Starch Powder—	Corn starch	5 lb.
	Powdered talc	½ lb.

Mix, and pass through a No. 80 sieve.

Syrup used for coating after the sub-coating has been applied is composed of 30 pounds of granulated sugar dissolved in 3 gallons of water and brought approximately to the boiling point. The syrup is then strained through cheesecloth and when cool is ready to use. This syrup is used in this form for coating white coated tablets. It is applied cold in all cases.

Mr. Andrews uses the following syrup which is of special value in rounding the pills:

Granulated sugar	4 lbs.
Water	1½ pts.

Dissolve the sugar with the aid of heat and add the following which has been made into a paste:

Corn starch	3 oz. av.
Powdered talc	1 oz. av.
Water	8 fl. oz.

Mix thoroughly. Heat to boiling, strain through cheesecloth, and add sufficient water to make ½ gallon.

Coloring Solutions for Syrup—If the coating is to be colored, the syrup is tinted by adding to it coal-tar color prepared in the following manner: One ounce of color dissolved in one pint of hot water. The dye used must be one of the "Certified Food Colors", see page 841. These solutions which are afterward referred to as stock solutions, are usually prepared and kept ready for use.

Wax solution—The solution used for polishing is made by dissolving one ounce of carnauba wax in one pint of acetone. Beeswax may be used or preferably a mixture of 1 part of carnauba wax to 3 parts of beeswax.

Mr. Andrews suggests the following polishing wax:

White beeswax	1 lb. av.
Carnauba wax	2 oz. av.

Melt together, strain, and cool.

Polishing wax solution:

Dissolve 600 grains of the above polishing wax in 1 pint of high grade gasoline with the aid of heat. The solution must be used while warm as it precipitates on cooling.

Tablets—These should be compressed with high convex faces and with as thin an edge as possible, and at the same time conform to good proportions. Tablet punches are usually made with three degrees of concaved faces, called standard, deep, and extra-deep concave. The deep concave is preferable for most purposes, as it forms a satisfactory shape for either coated or uncoated tablets. The thinner the edge of the tablet the easier it is to cover it and the corners with the coating. The tablets should be screened to remove all dust and broken tablets before placing in the coating pans.

General Description of the Process—Before taking up in detail the various steps in coating tablets the process will be briefly explained. The tablets, after cleaning and removing defective ones, are placed in the coating pan and subjected to three to five coats, depending on the tablets. Each sub-coat consists first of the wetting of the tablets with the gelatin solution and, when partially dry, sprinkling with the dusting powder. By this means the tablets are rapidly filled out and rounded. Following the sub-coating the tablets are given a sufficient number of applications of the syrup to produce a hard, smooth finish, the last two or three syrup coats, which are known as the finishing coats, receiving special attention. The tablets are then polished with the wax solution.

It is easier to coat tablets white than any other color. Only a few syrup coats are required if the sub-coating has been properly done. Chocolate coating can be quickly done, as it also requires only a few syrup coats. Chocolate coating, however, may give the beginner some trouble to keep the colors uniform. This may occur if the finishing coats are allowed to dry too quickly. Colored coatings other than chocolate require a longer time to coat, due to the fact that the tint has to be developed slowly.

After becoming familiar with the technic of coating it will be found economical to coat two or possibly three sizes of tablets in the same pan at one operation. It is apparent that this can only be done when the tablets have sufficient difference in size to permit of their complete separation by screening after they are coated. When this practice is followed it is advisable to sub-coat the different batches separately, and then syrup-coat them together in the one pan. There are two reasons for sub-coating separately. One is to prevent the transfer of odor or powder from one formula to the other. The other is

that where large and small size tablets are sub-coated together the small tablets are apt to stick to the larger tablets. This tendency is greater in the sub-coating, due to the heavier gelatin solution which is used, than with the syrup coating.

The formulas given above and the detailed instruction which follows are the best practice so far obtained. They no doubt can be modified to advantage in special cases, as well as improved, and the intelligent coater should always endeavor to simplify the work wherever possible, if a satisfactory coating results.

As an illustration and to explain the processes more clearly, it is assumed that 70,000 three grain cascara sagrada tablets are being chocolate coated. Use a coating pan of 24 inch diameter, if available, as it will be easier to start with a pan which is in proportion to the size of the batch. A coating pan of 30 inch diameter, of course, may be used. It is difficult, however, to coat a very small quantity of tablets in a large pan, as they will have an increased tendency to stick to the pan after each application of gelatin solution and syrup, and require more stirring to overcome this and to prevent their sliding before they commence to roll properly.

While the beginner will of necessity have to start with a clean pan, it will be found later on that the sub-coating can be accomplished more readily by placing the tablets in a pan which is slightly encrusted with syrup from a previous coating. The reason is that the tablets, when moistened with the gelatin solution in a clean pan, will slide as one mass rather than roll, and will require much more stirring by hand to break up the mass and start them rolling than if the pan were already coated with syrup.

Sub-Coating—When the tablets are placed in the pan, the gelatin solution for sub-coating should be warm and conveniently located. Dip out one pint in an agate measure and have a scoop full of chocolate powder at hand. As the tablets revolve, pour the gelatin solution over the tablets, stirring them with the hand to distribute the solution. Keep stirring to make the tablets roll if possible, and when the gelatin has partially dried and is tacky, sprinkle on the chocolate dusting powder until there are no wet tablets showing. The chocolate powder can be sprinkled on by hand, and wet areas in the tablets can be sprinkled as they appear. The tablets will begin to roll freely as soon as the powder is dusted on. Avoid using an excess quantity of powder, as this will roll in the pan and affect the smoothness of the succeeding coat. Should excess powder accumulate it will appear at the back of the pan, and the powder and tablets at the back can be scooped out and separated, the tablets being put back in the pan. After the chocolate powder has been applied and taken up by the tablets, and not before, turn on the air blast until the coating is perfectly dry. This requires about fifteen minutes. The operator can test for dryness by scraping with the finger-nail or with a knife to see if it will powder off. Sometimes the tablets split or cap during the first sub-coating, and there are always a few tablets which stick together. It is advisable to rescreen tablets to insure the removal of such before applying the second sub-coating. Three or possibly four coats are applied to complete the sub-, or under-coating. This sub-coating is very important, as upon it largely depends the smoothness of the finished tablets.

Syrup Coating—After the tablets have been sub-coated, the chocolate syrup is applied. It is advisable to again screen the tablets to remove the broken ones, and if the pan is too rough from encrustation of sub-coating, it should be washed. The color of the chocolate sub-coating will be much lighter than the color of the finished tablets. Fewer coats of the chocolate syrup will be

required if the tablets are first given two light coats of chocolate syrup, having a double quantity of chocolate brown paste to intensify the color. Mix a pint of this intensified coloring syrup and apply it in two doses. It is difficult to state the exact amount of syrup a given quantity of tablets will take up; about one pint would be the proper quantity for each application of syrup to the quantity of tablets under consideration. The quantity of syrup, however, should be as much as the tablets will take up and not form into a mass so they do not roll. Pour this over the tablets as they revolve, distributing it as much as possible while pouring, and at the same time stirring with the hand until the syrup is evenly mixed and the tablets are rolling freely. Do not turn on the air blast until the tablets roll freely, and then blow air until dry, requiring approximately twenty minutes. There should be a distinct improvement in the smoothness of the coating after the first application of the chocolate syrup is added, and this improvement will become more pronounced as the applications are continued. After two coats of the darkened syrup, the operator can proceed with the standard chocolate syrup, applying as many coats as are needed to properly round the tablets, so the edges and corners are smooth and show a uniform color. From five to ten coats may be required to produce the necessary finish. If pin holes appear in the coating they can be filled in by allowing the syrup to dry more slowly, the theory being, the longer the coating remains in a plastic condition the more working it will receive by the rolling action of the tablets. The operator can tell from time to time how the tablets are smoothing up by breathing on several held in the hand close to the mouth. This test reproduces the color and luster which will be obtained after they are polished with the wax solution. If the tablets do not show up smooth and polished when so tested, probably no amount of polishing will materially improve their appearance. This practice of breathing on the tablets is unquestionably to be condemned from a hygienic standpoint, but there seems no other way for the beginner to get a quick line on the results. It is imperative that these few test tablets be discarded.

Finishing Coating—The tablets are now ready for finishing. If the pan is rough it should be washed out and dried. Give the tablets a light application—say, 3 or 4 ounces—of chocolate syrup, with the color, however, cut down two-thirds in quantity. The chocolate paste does not enter into solution with the syrup, as is the case with the aniline colors, and by reducing the amount of the chocolate brown paste in the three finishing coats, a harder surface is produced which takes a better polish. These finishing coats should be allowed to dry without the air blast. On the third or last coat, just before the tablets are dry, stop the pan and cover the opening with a cloth. By doing this the tablets will dry more slowly and retain a better and more uniform color than if they were revolved. It will be well to turn the coating pan a half revolution by hand from time to time to expose a fresh surface of the tablets. If this is not done, those tablets which are on top will dry a lighter color than those below. It will take about two hours to dry the tablets in a stationary basin. The operator may be able to use an air blast for the final drying, but the pan must be stationary, except when revolved by hand in order to expose a fresh surface or it is liable to produce uneven colors.

Polishing—The tablets should now be ready for polishing and are transferred to a polishing pan. While revolving in the polisher, pour two ounces of wax solution over the tablets. A wide-mouth bottle with a shaker top makes a suitable container for the wax solution. Two or three shakes of the solution should be sufficient. Stir the tablets with the hand in order to distribute the solution thoroughly through the tablets. Allow the tablets to revolve until

the solvent has evaporated and then dust on from a shaker a small amount of talcum powder. The talcum is usually applied with the ordinary commercial shaker talcum box, and only two or three shakes are necessary. The luster, or polish, should appear immediately. It may be improved by a second or possibly a third application of wax solution and talcum. Leave the tablets in the polisher for fifteen or twenty minutes, or longer if desired. When removed from the polisher the tablets should be spread on trays and dried before placing in the containers.

White Coating—Tablets are white coated in the same way as they are chocolate coated with the exception that white dusting powder is used in place of the chocolate dusting powder when sub-coating. Plain syrup is used for the coating and finishing. Some coaters, in order to get quick results by reducing the number of applications of syrup, load their syrup by mixing with it an additional quantity of powdered sugar. This sugar does not enter into solution and the mixture is made just as heavy as it is possible to pour and distribute over the tablets. By controlling the air blast this coating can be made smooth, and the finishing coats may be applied, using the standard syrup.

Colored Coatings—When tablets are to be coated blue, green, yellow, or red, the same general method applies as described. The sub-coating is applied with white dusting powder, and syrup for the coating and finishing is tinted with the properly colored solution, the tint being intensified as the coating progresses. In other words, the first two or three coats are made by applying syrup of a light tint, the next three coats with syrup of a darker tint, and so on to the end. If the operator attempted to apply syrup tinted to the finished color from the beginning, the result would be a blotchy color, probably due to the fact that the sub-coating, being absorbent, would take up the color unevenly. As an example: take 100,000 tablets of strychnine, each weighing 1 grain and coat them red. Use a 24 inch pan, and, after the tablets have been sub-coated white, apply a syrup which has been colored in the proportion of 1 ounce of stock red coloring solution to one gallon of syrup. Give the tablets two or three coats and then intensify the tint of the syrup by adding more red in the proportion of 2 ounces of stock color to the gallon of syrup. After several coats the color is again intensified by again doubling the proportion of color in the syrup. Always retain some sample tablets of the proper color to be used in matching a new lot. With a little experience the operator can intensify the color of the syrup by judging its color with the eye and without resorting to measuring the exact proportion. When the desired shade and finish have been obtained the air blast should be taken off and the tablets given three or four applications of colored syrup in the manner described for chocolate coating. The pan should be stopped just before the final coat is dry, as explained above. The method for coating tablets in other colors is identical.

When pills are coated with a syrup containing umber and no chocolate, they must not be called "chocolate-covered" or "chocolate-coated". They should be designated "sugar-coated brown".

Special Treatment for Coating Tablets which Absorb Moisture—Some tablets, owing to their contents, require great care in coating to prevent the water in the gelatin solution from penetrating the tablet rather than evaporating. Such a result would prove disastrous, as this moisture, no matter how well the finished coating appeared on the outside, would eventually work out through the coating, discoloring it and producing unsatisfactory results. It is therefore very important that when coating sodium salicylate, and combinations containing iodides, bromides, and other compounds having an affinity for water that care should be exercised to prevent the water "drying

in". There are several methods in use. A small amount of oil applied to the outside of the tablets before applying the gelatin solution is one method. Too much oil must not be used or it will discolor the coating. If a dough is made by adding sufficient starch to a tablespoonful of raw linseed oil and the dough kneaded into a ball, and the ball allowed to roll with the tablets, they will absorb the oil from the dough. The ball will shortly break down and the powdered starch, after the oil has been absorbed by the tablets, will appear in the back of the pan. After this preparation the tablets can be sub-coated in the regular way. Another method is to apply the stock gelatin solution, but in place of the stock dusting powder to apply powdered calcined magnesia. It is advisable to apply an excess of this to be sure of absorbing the moisture in the gelatin solution. Another method, similar to the above, is to substitute powdered acacia as a dusting powder after the gelatin solution has been applied. When the three or four sub-coatings have been applied, the tablets should be dropped in trays of hot powdered starch and dried for a few hours. The application of the coating can then proceed as usual. It is important to have the tablets dry at the start and also to dry them thoroughly after sub-coating to eliminate any moisture which may have dried in.

Re-Coating Tablets—While it is not anticipated that the operator will have bad luck, this may occur occasionally and it will be necessary to re-coat the tablets to prevent loss. If this becomes necessary place the tablets in a dish pan, cover them with water, and stir them with the hand until the edges of the tablets begin to appear. Then pour off the water and cover the tablets with denatured alcohol to absorb the water. Drain off the alcohol, shake the tablets well in a sieve to remove the alcohol, and then put them in a coating pan and revolve under the air blast. When dry they can be re-coated. It may be that the tablets will wash off irregularly and some will be larger than others. If this is noticeable, remove the larger tablets by screening and rewash them in water to reduce their size, or place the smaller ones in the coating pan and give them an extra coat to bring up to the size of the larger tablets.

Time Required for Coating—This depends upon the skill of the operator and as experience in applying the sub-coating increases, few syrup coats are required. It is also evident that if the operator is able to load the syrup with free powdered sugar, the coatings will build up more rapidly and fewer will be required. Some coaters turn out a batch of the ordinary run of tablets in five hours, while others require a day or possibly more. Speed in coating, however, is not the chief end to be gained; it is more important that the coatings be permanent, that they will not break off, and will not discolor due to moisture in the tablets working out through the coating.

General Precautions—Each coat must be perfectly dry before putting on the next application, whether sub-coating or syrup, otherwise the moisture will dry in and will result in a cracked or discolored coating. Always screen the tablets after the first two applications of sub-coating to remove broken tablets. If these are not removed they will stick to the tablets and produce an unsatisfactory result. When the coating pan gets rough inside from too much syrup drying on it, wash it out and the tablets will coat much better. When making white coating, keep away from chocolate coating, as the dust will fly from one pan to another and the white coating will be specked. Be sure the hands are clean and not stained with chocolate or other colors.

Sugarless Coating—This is recommended for tablets or pills to be shipped to tropical climates, and is made by applying gelatin solution instead of syrup. The process is quite similar to that of sub-coating, in that a dry powder of chalk or starch is added to the tablets after they have received an application

of gelatin solution. The dusting powder should contain some powdered tragacanth. The coating is finished with several applications of the gelatin solution alone. This coating cannot be polished with wax, but after the tablets have been allowed to roll in the pan for a few hours a very high luster can be obtained by giving the tablets a coat of very thin solution of tolu, denatured alcohol being used as a thinner.

Method for Preparing Homeopathic Globules or Granules—Place five pounds of XXXX sugar in a 24 inch copper coating pan, having steam coils about the outside for heating. A hot-air blast, however, could be used successfully in place of the steam coil. To the sugar add slowly a hot syrup of about 35° B. density. This syrup can be approximated by dissolving two pounds of sugar in one pint of boiling water.

The syrup is slowly added to the powdered sugar as it revolves in the pan until the globules start to form. If too much syrup is added large globules will form instead of small ones; the small ones are the more difficult to produce. Alternate applications of powdered sugar and syrup are added as the globules form and dry out. It will be necessary to remove the larger globules by screening, the small globules being put back in the coating pan. Those of the correct size are set aside on a tray for further drying, and those which are too large melted down into syrup.

The operator will have to keep stirring the sugar in order to break it up and to separate the globules as they form. The formation of too large granules can be overcome by adding less syrup or making it slightly lighter in density.

Enteric Pills—A number of substances have been employed for the purpose of coating pills, so as to enable them to pass through the acid juices of the stomach and be dissolved in the alkaline intestinal fluids; such pills are called *enteric pills*. It is proposed to use these coatings for four classes of medicine: 1. Medicines that can by prolonged contact cause irritation to the mucous membrane of the stomach—arsenic, salicylic acid, creosote, chrysarobin, quinine compounds, copaiba, cubebs, ferruginous preparations, and especially ferric chloride, opium, mercurial preparations, mercuric iodide and chloride, phosphorus, and all the tænifuge preparations. 2. Medicines that can injure the digestion by forming insoluble precipitates with pepsin and peptones—tannin, alum, lead acetate, preparations of bismuth, silver nitrate, corrosive sublimate, etc. 3. Medicines that are rendered inactive or decomposed by the gastric juice—alkali, bile, soap, calcium sulphide, iron sulphide, pancreatin, etc. 4. Medicines which should arrive in the intestines as concentrated as possible—kousso, santonin, extract of male fern, and alkali. For the purpose of making enteric pills several substances have been proposed, chiefly salol (phenyl salicylate), keratin, and stearic acid. The employment of keratin has been discredited and its use largely discontinued, and stearic acid has not been thoroughly tested so that salol is chiefly depended upon for the making of enteric pills. (See also Enteric Capsules, page 1683.)

Salol Coating—The N. F. V. directions for salol coating are given on page 1732, and, with a little practice, have been found to be satisfactory at the prescription counter. The most important point is to learn the exact time in the cooling of the salol, at which to add the pills. If it is too hot, the coating does not adhere to the pills, but cools on the side of the dish; and if too hot, when the second or third coating is being applied, it melts off the previous coating. On the other hand, if too cool and already crystallizing, it forms small nodules on the pill and an irregular coating results.

The rotating of the pan or dish containing the melted salol should be started before the pills are added and continued, without interruption, until

the coating is hard, which, if the temperature is right, should require only a few seconds. The N. F. directions are as follows:

Drop the pills, carefully freed from dusting powder, into an enameled or porcelain dish, preferably with a flat bottom and straight sides, containing enough phenyl salicylate [approximately 1 gr. (0.06 Gm.) to every 2 gr. (0.12 Gm.) pill], previously just melted by the heat of a water bath and allowed to cool so that on passing the hand along the bottom of the dish there is scarcely any warmth felt, yet the salt remains completely melted. Start the dish to rotating before adding the pills and continue rotation until the pills are coated and the phenyl salicylate has congealed. Repeat this process twice, each time reducing the amount of phenyl salicylate about one-half. Finally, apply a finishing coat by using only sufficient phenyl salicylate to barely coat the dish when melted, repeating the operation as before.

Keratin Coating—Keratin is made from corneous animal substances, like horn, quills, hoofs, etc., by steeping these in an acid solution of pepsin or acetic acid, and dissolving the residue in ammonia water and evaporating the solution. The coating is applied like sugar coating, but is rarely used today, since its solution, even in the intestinal tract, is quite uncertain.

CHAPTER CVI

SUPPOSITORIES

Suppositoria—*Suppositories*

Suppositories are solid bodies intended for insertion into the rectum, urethra, or vagina to produce medicinal action. A urethral suppository is also known under the name *bougie*, or *bacillum*, or *cereolus*. When for insertion into the nasal passages a similarly shaped suppository is called a *buginarium*. The usual form of suppositories is more or less conical, with a rounded apex (see Figs. 704 and 705). A variety of shapes will be noticed. The smaller are for rectal use and the Pharmacopœia directs that the adult *rectal suppository* shall weigh about 2 Gm. (30 grains) if made from oil of theobroma, or 4 Gm. (60 grains) if made from glycerinated gelatin. The *infant rectal* suppository is usually about one-half this weight. The larger, more or less globular form, represent *vaginal suppositories*, and officially shall weigh about 4 Gm. (30 grains) if made with oil of theobroma, or about 10 Gm. (150 grains) if made from glycerinated gelatin. The pencil-shaped suppositories represent *urethral* types, which, if made from glycerinated gelatin, are to weigh about 2 Gm. (30 grains) and be 7 cm. (2½ inches) long for female use, or weigh about 4 Gm. (60 grains), and measure 14 cm. (5 inches) if for a male urethral suppository. If a urethral suppository is made from oil of theobroma it should weigh about one-half the above quantity. Three types of suppositories, with respect to the vehicle or base used, are recognized; first, those prepared with *oil of theobroma* or cacao butter (more commonly called cocoa butter), as the diluent and vehicle, and which quickly melt to an oily fluid at the temperature of the body. The second type is prepared with a mixture of equal parts of glycerin and gelatin, known as *glycerinated gelatin* (see page 524), as the diluent and vehicle. This type of suppositories does not melt at the body temperature but slowly dissolves in the secretions of the mucous membrane. They are usually employed to provide a continuous medicating or germicidal action. The third type, represented by glycerin suppositories, or soap suppositories shaped from castile soap, is not expected to melt or dissolve but to perform its function largely mechanically, producing some irritation. Their chief value is as a stimulation to peristalsis, through their presence in the rectum and they are largely used for small children to produce a movement of the bowel, thus avoiding the use of a laxative.

Oil of theobroma is an ideal vehicle or base for suppositories intended to melt when inserted into the rectum or other body cavity. It was first suggested in this connection in 1852 by Alfred B. Taylor, of Philadelphia. It is a bland, non-irritating oil, pressed from ground cacao beans, and possessing the remarkable quality of maintaining its firmness, even exceptional hardness for a fatty substance, to within a few degrees of the body temperature, when it readily melts to a liquid, without passing through an appreciable softening stage. The melting point of oil of theobroma is from 30° to 35° C. (86° to 95° F.) (see also page 1040).

It is rarely necessary to raise the melting point of cacao butter by the addition of wax, spermaceti, etc., except in the warmest summer weather, or when phenol, camphor, chloral hydrate, the volatile oils, or similar substances form the medicating ingredients.

Oil of Theobroma Suppositories—To prepare suppositories with oil of theobroma as the vehicle or base, three methods are available in most phar-

FIG. 704

Shapes of suppositories (exact size) (Colton)

macies. The first is known as "hand made or rolled", the second, "molded", and the third, "machine made or pressed".

The details of these several processes follow:

Rolled or hand made suppositories represent the simplest process providing the climate or weather conditions make it applicable. In warm countries or

in hot summer weather one of the other methods should be used. This process possesses an advantage over the molding process in that no complications arise from the use of heat and no provision need be made for excess material, since the entire mass is divided into the desired number of suppositories.

The following general process may be employed:

The cacao butter is scraped or grated and usually kept on hand ready for use. The grater illustrated on page 156, Fig. 226, is especially well suited for this purpose.

Take the prescribed quantity of the medicinal substance and a sufficient quantity of grated *oil of theobroma*. Reduce the medicating ingredients to a fine powder, or, if composed of extracts, soften them with water and rub until

FIG. 705

Shapes of suppositories (exact size) (Colton)

a smooth paste is formed; the correct amount of grated oil of theobroma is then added, and a mass resembling a pill mass is made by thoroughly incorporating the ingredients with a pestle, usually with the aid of a small amount of expressed oil of almond, petrolatum, or best of all, wool fat. When the mass has become plastic under the vigorous kneading of the pestle it is quickly cut loose from the mortar with a spatula, pressed into a roughly-shaped mass in the center of the mortar and then transferred with the spatula, to the palm of the hand, which has been well dusted with an absorbent powder. By a quick, rotary movement, from the palm of the other hand, the mass is rolled to a ball which is immediately dropped to the well-dusted pill tile. Here a suppository cylinder is formed by rolling the mass upon the tile with a flat board, partially aided by the palm of the hand, if weather conditions permit. The length of the cylinder usually corresponds to about four spaces on the pill tile for each suppository, thus making the piece, when cut, practically a finished suppository except for the sharpening of the point. When the cylinder has been cut into the proper number of pieces with a spatula, the conical shape

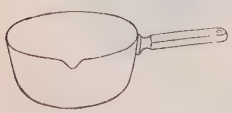
is given it by rolling *one end* upon the tile with a spatula, or in some cases even by shaping it with the fingers, so as to produce a rounded point. In warm weather it is necessary to use lycopodium, talc, starch, or a similar absorbent powder freely. With practice, excellent rolled suppositories can be made. This method has the substantial merit of requiring very little apparatus, but considerable skill is needed to produce suppositories equalling in finish those which are molded (see below).

One of the most rapid and efficient methods for shaping the finished suppository when the hand process is followed, is to roughly point the cylindrical section, which has been cut for an individual suppository, and force it quickly and with considerable pressure, applied by a spatula, or a roller board, into a cold suppository mold which has been well dusted with talc or lycopodium. Remove each suppository and again dust the mold before shaping the next one.

Molded Suppositories—If the suppositories are to be molded, calculate the amount of oil of theobroma required to make suppositories of the desired weight, taking into consideration the weight of the medicine to be incorporated, and also planning for enough additional medication and also oil of theobroma for at least one extra suppository. This is necessary to provide for the waste in pouring the suppositories; some mass always sticking to the dipper and other excess portions are usually being cut from the top of the mold and must be provided for.

Having finely powdered the medicinal ingredients, if vegetable drugs or chemicals, and having softened extracts when present, weigh the total amount of oil of theobroma needed and melt it in a dipper with a gentle heat. A porcelain casserole (see Fig. 706) is the best vessel in which to melt the oil of theobroma which must always be warmed on a water bath of lukewarm water. Incorporate the medicinal substances intimately with about an equal weight of the melted oil of theobroma, on an ointment slab, using a spatula and, when uniformly mixed, transfer the uniform mixture to the remainder of the melted oil of theobroma, which has been cooled to the correct temperature, which is almost that of the solidifying point. Stir until all is again uniformly melted and pour at once.

Fig. 706



Casserole

Pouring the Mass—The melted mass should be poured into the chilled mold from the dipper, which is usually held in the right hand. It should be vigorously stirred with a spatula immediately before the pouring begins; indeed, when heavy powders are directed, the stirring must not cease during the pouring, or the last suppositories will contain a larger proportion of the heavy powder than those which were first made. In pouring, each opening in the mold may be exactly and uniformly filled or the openings may all be overflowed so that the tops run together on the mold. In the latter case allow the molds to stand on the counter until the mass on top has solidified, then cut off the excess with a spatula. The molds are then placed on ice and when sufficiently hardened the suppository will be found to have contracted slightly so that light pressure on the base of each suppository will cause it to loosen in the mold and readily drop out when the mold is opened. If the suppository does not readily drop from the mold after they are opened, apply a quick, firm pressure with the thumb, first to the base and if this does not free it try pressing the point. Never apply continued pressure. It will melt the suppository. It is also desirable to cool the thumb, by placing it on the ice for a moment, before giving the quick, firm pressure. The novice almost invariably

makes the mistake of opening the divided molds too soon (before the limit of contraction is reached); the suppository sticks to the mold, and splitting ensues.

Some pharmacists prefer to use a lubricant in the molds to facilitate the removal of the suppositories. Lycopodium and also a 6 per cent solution of castile soap or of soft soap, in 70 per cent alcohol are used. The soap solution is best applied by twisting cotton on a match stick and using just sufficient solution to moisten the walls of the mold. The alcohol must evaporate before pouring the mass. Lycopodium is considered by some to be objectionable because of its alleged irritation to mucous membrane.

The beginner often fails when starting with the fusion method due to the use of too much heat. When it is to be remembered that an oil of theobroma suppository mass melts at the temperature of the body and that the least possible heat should be used, the dispenser soon learns to keep away from a direct flame entirely and only use a lukewarm water bath.

Many combinations are decomposed or separated from the base by overheating. This is notably the case with ichthyol or with mixtures of astringent drugs and vegetable extracts, such as lead acetate or tannic acid with the extracts of opium, belladonna, stramonium, etc.

Ingredients which soften Oil of Theobroma—Suppositories containing chloral hydrate, phenol, or other substances which soften the vehicle, should have the melting point of the oil of theobroma slightly raised by the addition of from 10 to 15 per cent of spermaceti, but the melting point must not be above 37° C. (98.6° F.).

Other difficulties in molding suppositories are easily overcome by the exercise of judgment and knowledge of physical laws. A defect frequently seen in the finished cacao butter suppository is that the surface is not always perfectly smooth. This may arise from several causes. Sometimes ridges are seen traversing the suppository; these are usually produced by overcautiousness, the operator pausing in pouring the melted mass into the mold, then pouring in a little more, then pausing again, and so on. On taking out the suppository, a ridge will be found at each spot where a pause was made. The remedy for this is to keep on pouring steadily when this part of the process is reached. Other defects are pitting, causing an imperfection in points of the suppositories. This pitting is usually caused by drops of water which have not been shaken out of the mold before pouring in the melted mass. Still another defect is a depression in the center of the base of each suppository. This is due to not overflowing the molds so as to leave an excess of mass upon the top and it is intensified by pouring the mass when too warm. In all cases there should be a little more mass than will fill the molds; after cooling the excess may be cut off.

If strong heat is used upon an extract mixture ready to be molded, water is evaporated, the extract separates in small masses, and, like a bad emulsion, the mass is "cracked". The remedy is to pour it at once upon an ointment slab or tile, add a little water, and rub it until the original condition is regained. However, as has already been emphasized, the mass containing the medicating ingredients should not be heated directly. Heat should be applied only to the oil of theobroma.

The shape of the suppository marked "15", in Fig. 704, was devised by Henry S. Wellcome, of London. It is intended to prevent the expulsion of the suppository after insertion and is a notable improvement over the conical type.

Glycerinated Gelatin Suppositories—The basic material from which suppositories are made is official (see page 524). They are used chiefly for

vaginal suppositories and are mostly healing or germicidal. Boroglycerin, ichthyol, zinc oxide, and bismuth subnitrate, are typical forms of medication. They may be made by mixing the medicinal substance, if solid and soluble, in water or glycerin, or if a miscible liquid, with a little water, and adding sufficient glycerin to make the weight of the mixture one-half that of the finished mass; then thoroughly incorporate it with an equal weight of melted glycerinated gelatin, and pour it at once into suitable molds which have been greased with a small quantity of petrolatum. Cool the molds thoroughly before removing the suppositories. Molds for urethral suppositories should be warmed sufficiently before pouring the mass to facilitate the proper filling of the mold. Suppositories having a firmer consistence may be prepared by substituting mucilage of acacia for a portion of the water or glycerin.

If the medicinal substance is insoluble in water or glycerin, thoroughly levigate it in a warm mortar with a sufficient quantity of glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted glycerinated gelatin, and pour it into suitable molds as above directed. With bulky powders about one-half of the glycerin may be replaced with water before levigation.

Glycerinated gelatin suppositories should be protected against the effects of heat, moisture and dry air by keeping them in tightly-closed containers in a cool place.

Suppository Molds—Many forms are in use.

Individual molds are those which were first employed but they have been largely replaced by more efficient forms. Fig. 707 illustrates the type. The difficulty of quickly and easily removing the suppositories, the trouble in cleaning them, and the liability of losing or misplacing them, constitute the most serious drawbacks to the use of this form.

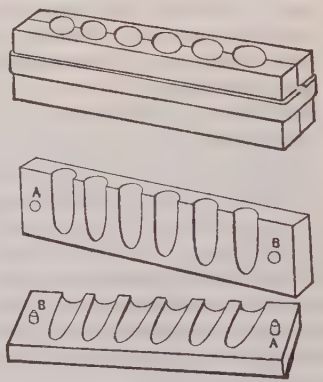
Individual molds for vaginal suppositories may be obtained and are of value in the prescription department.

The earliest form of divided mold is illustrated in Fig. 708. An elastic band holds the

Fig. 707

Individual suppository molds

Fig. 708



Divided suppository molds

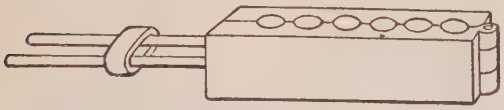
sections together but the hinged mold is better and has almost entirely replaced it.

Round molds were at one time used. The See's mold and also Blackman's were well known forms but they are almost entirely replaced today by hinged molds.

One of the simplest forms of the hinged mold is seen in Fig. 709. This opens at the end. Another form of hinged mold, largely used today, is constructed so that two different sizes of suppositories may be made in it (see Fig. 710). Fig. 711 illustrates a very serviceable English mold, recommended by Mr. Henry B. Brady, of Newcastle-on-Tyne. It differs from others in being hinged at the bottom. It is held together by two screw catches,

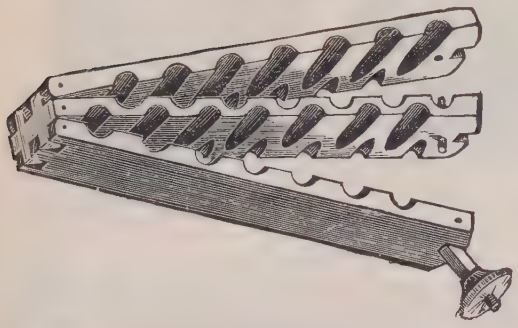
one at each end. Fig. 712 shows the usual manner of chilling suppository molds. It is desirable to place the mold on a piece of thin paper and then on the ice, to avoid the seepage of water into the molds. Fig. 713 shows

Fig. 709



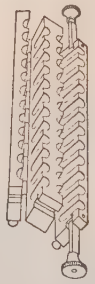
Hinged suppository mold

Fig. 710



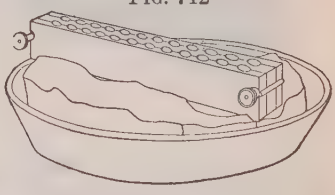
Two-size suppository mold

Fig. 711



Brady's suppository mold

Fig. 712



Brady's suppository mold on ice

Colton's mold for making glycerin suppositories. The manner of using it is similar to that of the preceding molds. It makes a double pointed suppository, as shown in the illustration. Molds for making gelatin suppositories

Fig. 713

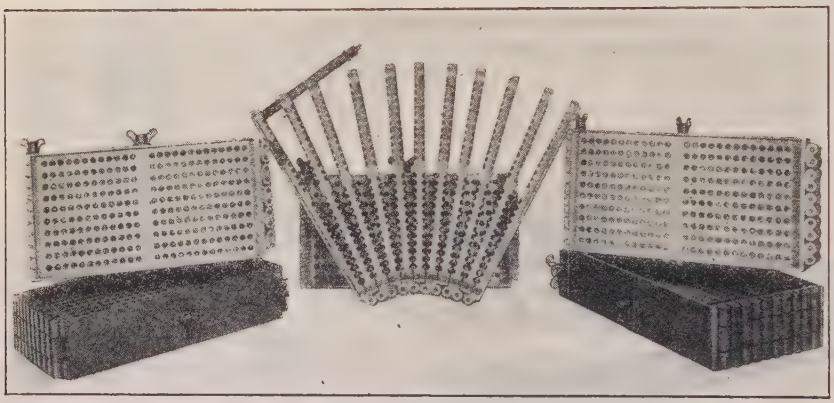
Colton's glycerin suppository mold

with a rounded end, as shown in Fig. 713, are also made by Arthur Colton, of Detroit. In Fig. 714 is shown the Stokes' suppository mold for making a large number of suppositories at one filling.

Compressed Suppositories—The compression method for making oil of theobroma suppositories is now used in many pharmacies. Some of the earlier types such as Knowlson's, Archibald's and the "Rapid Fire" suppository machine have been replaced by the machines illustrated.

A small compression machine for making individual suppositories is illustrated in Fig. 715. This is sold by the William S. Merrell Company. The

FIG. 714



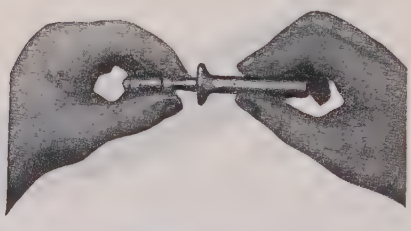
Stokes' suppository molds

mass is prepared as already described and the machine used in the mortar like a pestle. The material is forced into the suppository-shaped mold in the end and, when full, the suppository is removed by twisting out the metal collar which brings the suppository with it. The top of the machine is so

FIG. 715

Filling Merrell suppository mold

FIG. 716



Ejecting suppository from Merrell mold

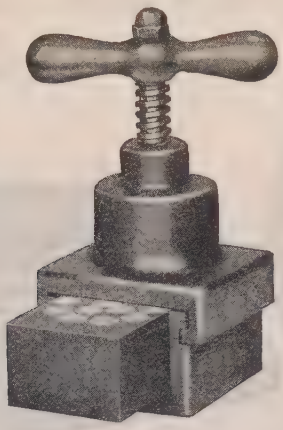
shaped that it can now be used to push the finished suppository from the collar (see Fig. 716). Then the collar is slipped back into place and the next suppository made.

The Applebaum Suppository Machine (see Fig. 717), manufactured by the Druggists' Appliance Manufacturing Company, is made of aluminum and is furnished with molds for infant and adult rectal suppositories and also for vaginal suppositories. The plunger is turned to the highest point and the prepared mass packed in the cylinder. Then the desired mold is slipped into

place and the handle turned down until the molds are filled. The plunger is then released and the mold taken out and opened.

The Whitall Tatum Company furnish the machine shown in Fig. 718. It consists of a cylinder, which can be removed to receive the charge of

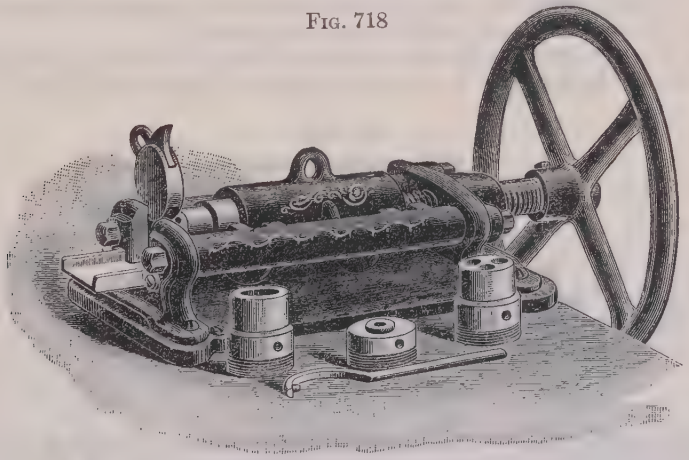
FIG. 717



Applebaum suppository machine

suppository mass, the proper mold having been previously screwed into place. The cylinder is then returned to its position, and, the gate having been closed, pressure is made by turning the wheel. The gate being then lifted, a slight pressure suffices to force out the suppositories. Repeating the operation,

FIG. 718



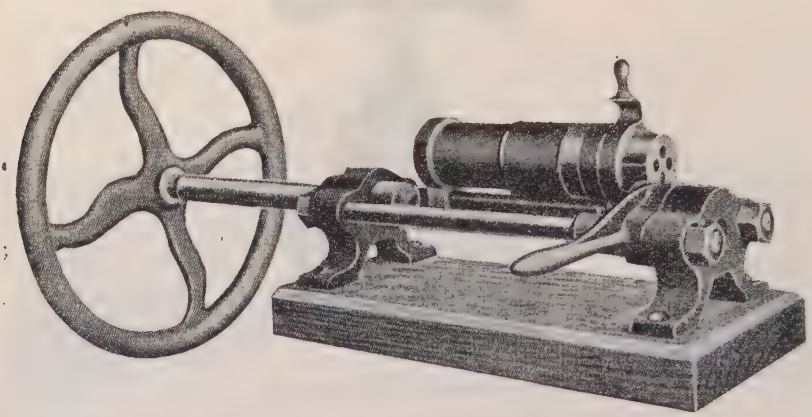
Whitall Tatum suppository machine

it is obvious that the machine will turn out suppositories as long as any mass remains in the cylinder. Brass dies and a tube are furnished to make 15 grain, 30 grain, vaginal, urethral, or nasal suppositories. Urethral or nasal suppositories are made by screwing on the proper die and then pressing the mass through it. A long rod-like suppository is thus forced out, which may be cut into suitable lengths.

Similar suppository machines are also sold by Arthur Colton and by the F. J. Stokes Company (see Fig. 719).

In making *ichthyol suppositories* by compression, the addition of 5 per cent of heavy magnesia will be found helpful in the making of a firm mass. At least 10 per cent of ichthyol may be incorporated by this method. By evaporating the ichthyol carefully larger amounts can also be incorporated.

Fig. 719

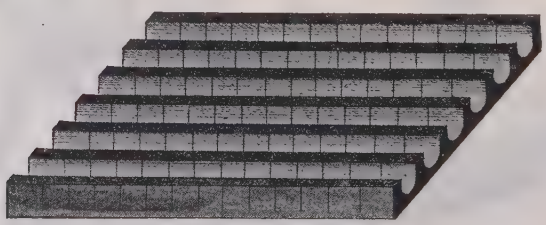


Colton's suppository machine

Nicolaus Drugocin, a prescription pharmacist associated with Leonard A. Seltzer, of Detroit, devised an outfit for preparing rectal suppositories by the use of a urethral mold, in a compression suppository machine, which delivers a continuous pencil shaped rod of suppository mass.

This rod or cylinder is cut into lengths of about 15 inches, and each one is laid in one of the troughs in the special board illustrated in Fig. 720. The

Fig. 720



Board for cutting suppositories

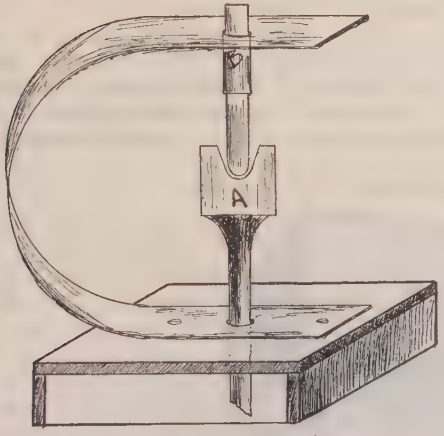
cylinders are now cut into uniform lengths by running a spatula through the kerfs, and the resulting short cylinder is rounded at one end, forming a suppository. The piece of apparatus (Fig. 721) is used by Mr. Drugocin for shaping the point. The cylinder is slipped into *B* and the cone "*A*" is made to spin rapidly by attaching a belt from a small motor, until the rounded point forms.

Fig. 722 shows Colton's power suppository machine. It is adapted for making suppositories upon a large scale, one hundred suppositories being made at a time. It is fitted with a device for cooling the mass in hot weather,

the cylinder in which the mass is placed being surrounded with a jacket for holding iced water.

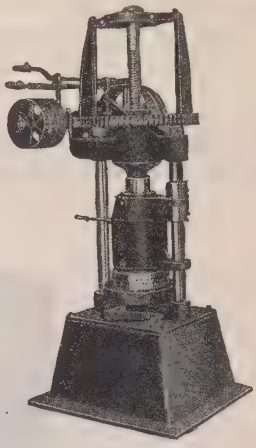
Suppositories are sometimes introduced into the rectum with difficulty.

FIG. 721



Shaping suppository point

FIG. 722

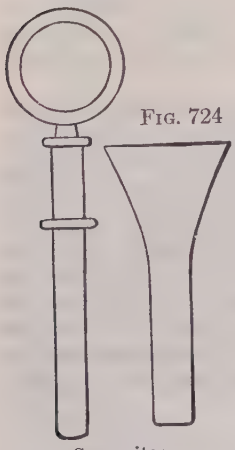


Colton's power suppository machine

Figs. 723 and 724 show a suppositor to aid in their insertion. The tube is made of hard metal, and has a funnel shaped top (Fig. 724). The suppository is dropped into the tube (which should be slightly oiled), point downward, and

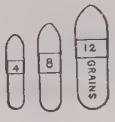
FIG. 723

FIG. 724



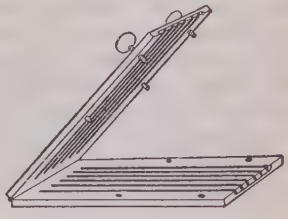
Suppositor

FIG. 725



Suppository capsules

FIG. 726



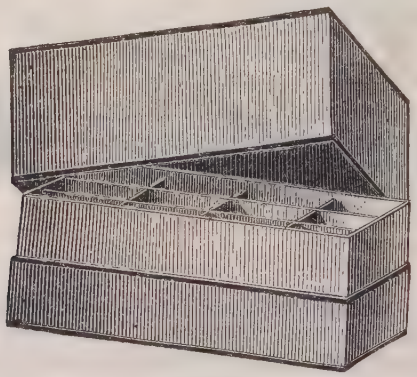
Bougie mold

the tube is carefully inserted into the rectum. The piston (Fig. 723) is now applied to the end of the suppository, which is gently pushed into the rectum, the tube being then withdrawn. A similar device, made of hard rubber, is sometimes used for the insertion of urethral suppositories.

Suppository Capsules—Dr. F. E. Stewart has suggested the employment of gelatin shells with conical caps, to be used as suppositories. The medicating ingredients are inserted in the lower portion. The upper margin is then moistened with water, and the cap inserted. Before introducing them into the rectum they should be wet with sufficient water to enable them to slip in easily (see Fig. 725).

Urethral Suppositories or Bougies, are preferably made of gelatin, owing to the difficulty of introducing into the urethra those made from cacao butter, on account of their brittleness. They may be made by melting together three parts of gelatin, one part of glycerin, and one part of distilled water, by weight, then adding the desired medicament and drawing the mass into a glass tube of suitable size, which has been previously oiled by sucking a small quantity of

FIG. 727.



Suppository box

oil into it and allowing it to run out. After cooling, the mass is pushed out by means of an oiled rod, and cut into pieces of suitable length. These should be rolled in lycopodium to prevent adhesion. Fig. 726 shows a bougie mold for making them in quantity.

Dispensing Suppositories—In order to prevent injury to the surface of suppositories in handling them with warm fingers, it is advisable to place the finger tips for a few moments upon ice until they are chilled, before placing the suppositories in the box. The latter is preferably furnished with partitions (see Fig. 727). In the absence of this special box, the suppositories should be protected by a layer of cotton or each suppository may be tightly wrapped with paraffin paper or with tin foil, with the end twisted. If properly applied the paper, and especially the tin foil, forms a temporary mold about the suppository and it cannot readily collapse, even in warm weather. When the suppository is to be used it may be held by the twisted end, dropped into ice water until thoroughly chilled, the wrapping removed, and the suppository inserted.

CHAPTER CVII

SOLID EXTEMPORANEOUS PREPARATIONS USED EXTERNALLY

Cerates, Ointments, and Pastes

Unguenta—*Ointments*

Ointments are fatty preparations, of a softer consistence than cerates, intended to be applied to the skin by inunction. The medicating ingredients are combined with a vehicle of lard, petrolatum, wool fat, or similar substance. Ointments are made in several ways: 1. By fusion. 2. By incorporation. 3. By chemical reaction. The official formulas for ointments will be found on pages 502 to 511.

1. **By Fusion**—In making ointments in this way, care must be observed not to apply sufficient heat to burn the constituents. Cerates and ointments may be strained through flannel or muslin to separate mechanical impurities, or some may be filtered. (See page 205.)

2. **By Incorporation**—The method of making ointments by incorporation is more frequently used than any other. The medicating ingredients used are nearly always insoluble in the basis, and it is necessary, therefore, to reduce them to a fine state of division in order to facilitate their absorption or medicinal action. The usual mode of procedure is to place the fatty basis upon an ointment slab, and the medicating substance close by. The latter, if in fine powder, is first mixed with a *small portion* of the basis by rubbing both backward and forward with the blade of a spatula until the mixture is perfectly smooth. It is then a very simple operation to dilute this small quantity of concentrated ointment by incorporating it with the rest of the basis, by using the spatula in the same way. If extracts are to be incorporated, they are softened by adding a little water or diluted alcohol, until a smooth paste is made, which is then worked into the basis with a spatula. Many other medicinal ingredients beside extracts may be rubbed with a liquid to aid their incorporation with the fatty vehicle. These fall into four general classes as follows: 1. Those cases in which the liquid dissolves the medicament and then combines with the fat as when menthol is dissolved in a little liquid petrolatum and then mixed with the base. 2. It may be that the liquid will not dissolve the medicine and is only miscible with certain fatty vehicles. This was illustrated in the former method for making ointment of yellow mercuric oxide when the oxide was rubbed with water and this mixed with wool fat. 3. In another case the liquid may dissolve the added medication, be miscible only with certain fatty bases, as when cocaine hydrochloride is dissolved in water and then incorporated with wool fat or a wool fat mixture. 4. In a fourth case the liquid may but form a paste which may be uniformly incorporated with the fat. The softening of vegetable extracts is an illustration.

Ointment Slabs—An excellent ointment slab is made by setting a plate of ground glass in a wooden frame or slide or even better by securing a piece of skylight glass, about two feet square and over an inch in thickness and having one surface ground until smooth. Such a slab was suggested by Samuel L. Hilton, of Washington, D. C., and has been to him and others a great source of satisfaction in making ointments at the prescription counter both because of its unusual size and also because of its weight which holds it firmly in

place while rubbing the ointment. Ointments are sometimes made in a mortar with the pestle; but this method is less convenient.

In incorporating ointments containing substances which act on steel, rubber spatulas may be used (see Figs. 217 and 218). When large quantities of ointments are required to be made by incorporation, the usual custom is to use a power-driven paint mill in which the ointment, which has been roughly mixed, is subjected to continuous rubbing between iron disks for an extended period, it gradually working its way to the outer edge of the disks, from which it is scraped. Fig. 727a illustrates a Stokes ointment mill. Ointments are sometimes made on a large scale in pot mills (see Fig. 230).

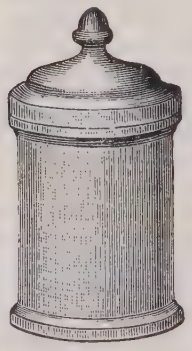
3. **By Chemical Reaction**—The only official ointment that is made by chemical reaction is the ointment of mercuric nitrate. In this, the olein of the lard is converted into elaidin through the action of heat and nitric acid; solution of mercuric nitrate is then incorporated with the elaidin vehicle.

Maxims to be Observed in Making or Dispensing Ointments—1. They should never be dispensed if they have the slightest taint of rancidity. 2. They

Fig. 727a

Ointment mill

Fig. 729



Ointment jar (amber glass)

Fig. 728

Porcelain jar

Fig. 730

Ointment pot

Fig. 731

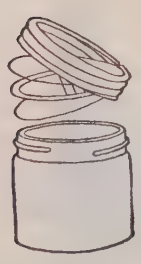
Ointment pot

should always be smooth and free from grittiness or irritating particles. 3. Ointments containing free acid, iodine, or tannin should not be rubbed with an iron or steel spatula, on account of the chemical action on the metal. 4. In removing the ointment from a stock jar always scrape it from the surface. Never dig into it, as holes left in the surface tend to increase rancidity.

Preserving and Dispensing Ointments—Animal or fatty substances may be preserved from rancidity by digesting them with balsamic resins, benzoin, poplar buds, styrax, etc. To preserve them during hot weather, they require in addition a cool temperature and freedom from exposure to the air. When a fresh lot of ointment is made to replenish a stock jar, the jar should be thoroughly cleaned, and the old ointment remaining thrown away, unless it is certain that the latter is entirely free from rancidity, as otherwise it would soon cause the new ointment to become rancid. Amber glass, stoneware or porcelain jars are the best receptacles for ointments. Fig. 728 shows a porcelain jar, which is just as useful for preserving ointments as it is for holding a penetrating substance like green soap. Fig. 729 illustrates an amber glass stock ointment jar made by the Whitall Tatum Company. The letters for the label are

blown in the glass, and then ground off, so that the label is indestructible. The only difficulty is that the label requires a strong light to enable it to be seen clearly. For dispensing ointments the opal glass pot is very useful. The best shapes are shown in Figs. 730 and 731. The bottom is rounded, so that the patient can easily reach all the ointment with the finger, and the top is metallic, with a screw cap. There is room for the label on the glass. Fig. 732 shows an ointment pot which is fitted with a metallic screw cap; the round label has a transparent celluloid disk above it and a heavy waxed disk below it, the whole making a greaseproof top to the pot. Of the very cheap boxes, those turned from wood are totally *unfit* for dispensing ointments. The ointment quickly penetrates through the grain of the wooden bottom, and the greasy abomination is exceedingly unwelcome to most housekeepers. Tin boxes are frequently used for small quantities of ointment sold to the layman and screw top wide-mouthed glass jars are also

Fig. 732



Sterling ointment pot

Fig. 733

Upressit pot (to close)

Fig. 734

Upressit pot (to open)

employed. The impervious walnut boxes, made by gluing several veneers of hard wood together, are still better. Figs. 733 and 734 illustrate the "*Upressit*" ointment pot which may be readily opened or closed by pressing the center or outer edge of the lid respectively. It is made by the United States Metal Cap and Seal Company of New York.

Collapsible Tubes—A marked improvement in the method for the dispensing of ointments is now in general use. The method in use for many years has been to introduce the ointment in a pot or jar having a slip or screw lid. An ointment in such a container is frequently exposed to dust and is almost invariably removed from the jar, as used, by means of the finger. Both of these conditions are undesirable and unsanitary. In addition, the jar method of dispensing constantly exposes the ointment, over an extended surface, to the action of the air and frequently to the action of light, and this greatly hastens evaporation in the cold cream type of ointments, making them unfit for use, and also promotes rancidity in the fatty vehicles used if these are of animal or vegetable origin.

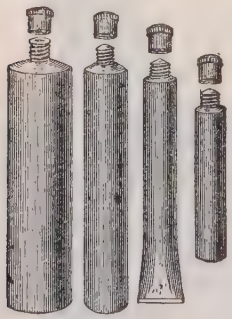
The modern plan, *i.e.*, dispensing ointments in pure tin, collapsible tubes, (see Fig. 735) avoids all of the serious defects of the jar method and at the

same time costs no more and the ointment is just as easily handled. Emphasis should be placed upon the use of pure tin tubes, as those made from composition metal are more readily attacked by certain ingredients which may enter ointments. For iodine-containing ointments a tube made of celluloid is also now available.

For eye ointments, tubes, with nozzle-like outlets, are obtainable which facilitate the application of the ointment and other special forms, fitted with nozzle-like ends, permit the dispensing of ointments for application to either the nasal passages or to the rectum.

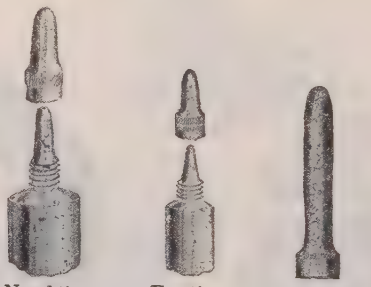
In filling the tubes with a soft ointment in prescription work, a method which has given much satisfaction because of its cleanliness, rapidity, and simplicity is as follows: Place the finished ointment in the center of a piece of manila or other strong paper of sufficient size (for an ounce of ointment use a sheet about 8 by 10 inches), fold it over so that the edges meet, with the ointment inside, place a pencil on the top fold on a counter, and, holding the under sheet, slowly roll the pencil toward the ointment. This causes it to form into a cylinder, and, when this is of a less diameter than the tube, roll

Fig. 735



Collapsible tubes

Fig. 736



Special tips for collapsible tubes (One-half actual size)

this cylinder over on the remainder of the paper so as to form a paper tube with the ointment inside. Now slip this into the collapsible tube and start to fold over the protruding end of the paper tube. When the ointment has thus been forced completely into the metal tube, bring the edges together by flattening the open end and, with the tube resting upon a firm surface hold the flattened edges together firmly with the index finger of the left hand and slowly withdraw the paper with the other hand. This leaves the ointment inside and the tube is ready to close permanently. It has also been suggested that the paper be cut off and left inside the tube, but its withdrawal seems preferable. The cap end of the tube should be open during this process of filling and closing.

In closing a tube, care must be taken to see that it is not filled too full; it should be folded over at least twice.

The capacity of each size of tube can be readily ascertained by a trial with petrolatum and this information may then become a permanent record for the prescription department.

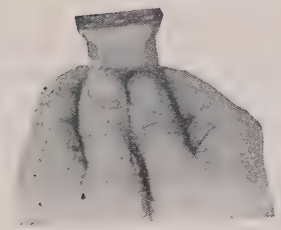
Special pliers for closing tubes are obtainable at small cost; a check cancelling machine of the type which causes numerous small cuts in the check when stamped over the written numerals has been recommended for closing and is very satisfactory, but the back of a heavy table knife is quite as effective

as the more expensive devices. In using a knife or stiff spatula, hold the filled tube in the left hand on a counter with the open end to the right, run the knife lightly along the tube to slightly flatten it, when near the end increase the pressure and, when within a quarter of an inch from the opening, hold the knife firmly and raise the tube, laying it over upon itself. Repeat this a second time and the tube is closed.

For satisfaction to the customer, in the use of tubes for ointments a hard metal clip should be clamped over the fold to prevent the contents being forced from the folded end when pressure is applied to the tube (see Fig. 737). These clips are very inexpensive and may be readily attached with the aid of a small bench vise, although many forms of machines are also available for the purpose.

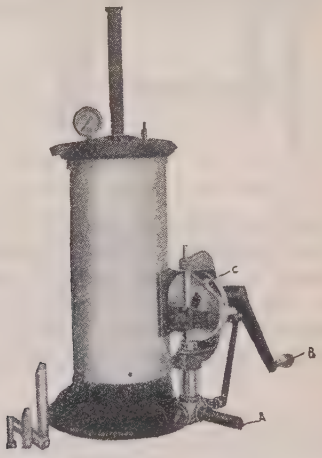
One difficulty always experienced is in the labeling of the tubes. If the label is to be attached, the tube may be dipped in compound tincture of ben-

Fig. 737



Tube closed with clip

Fig. 738



Tube filling machine

zoin or in a regular lacquer and afterwards allowed to dry. This will facilitate labeling and it is always desirable, if labels are applied, to use them in strip form so as to completely encircle the tube and prevent their coming off. Solution of sodium silicate has also been used on the tube and will cause the labels to stick. At best, however, labels are not very satisfactory, as the tube is likely to be completely rolled upon itself as the last of the ointment is used and the label soiled or destroyed, so that some pharmacists are using a paste-board box to hold the tube and carry the label, while the tube itself is stamped in the tin with the prescription number, using a numbering machine. This will permit the identification of the prescription and its renewal, even if the box is lost.

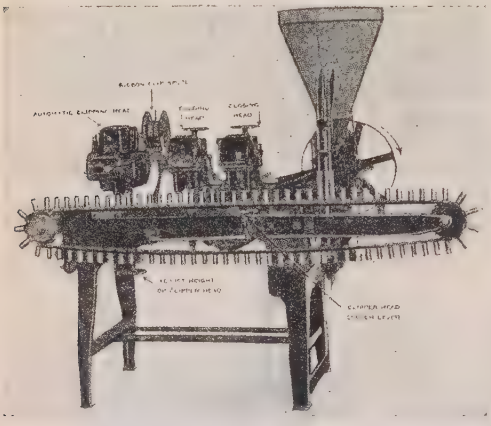
Figs. 738 and 739 illustrate machines made by the Arthur Colton Company of Detroit for filling and closing collapsible tubes. Such substances as ointments, tooth paste, etc., are rapidly and automatically handled by the larger machine and the smaller one is semi-automatic. Similar machines are made by the F. J. Stokes Company of Philadelphia.

Fig. 740 shows Alper's ointment filler. It consists of a tin kettle surrounded

by a water bath, in such a way that the liquid ointment can easily be drawn through the stopcock. Small boxes, bottles, or collapsible tubes can quickly and easily be filled with petrolatum, ointment, or similar preparations, without the inconvenience of handling them in spoons or ladles.

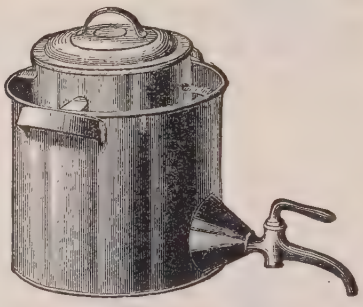
Finishing Ointment—Some skill is required to fill a box with ointment neatly and deftly by using a spatula without soiling the exterior of the box.

FIG. 739



Tube filling and closing machine

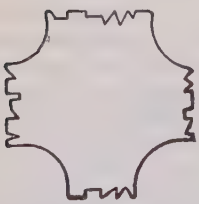
FIG. 740



Alper's ointment filler

The surface should be slightly lower than the edge of the jar to prevent the lid from tarnishing. This is accomplished by holding a spatula at a slight downward angle, with its tip at the center of the jar and its edge resting on the jar. By slowly rotating the jar an even depression is formed. It may then be held near a hot surface, like a stove plate, or may be played upon for a moment by a Bunsen flame, to give it a gloss. Occasionally it will be found

FIG. 741



Ointment finisher

FIG. 742

Finishing ointment

that some nervous patients desire to be assured that an ointment or cerate has not been tampered with by a servant, and it may be desirable for other reasons to finish the surface of an ointment with a distinctive design. This may be done by cutting a piece of tin into a shape similar to that shown in Fig. 741. By placing one of the teeth on the edge of the pot (see Fig. 742), and slowly rotating it, with alternate pauses, a very neat finish may be given to the surface. The finisher (see Fig. 741) shows four sides, and is of course capable of making four patterns.

CHAPTER CVIII

PLASTERS AND PAPERS

Emplastra—*Plasters*

Plasters are substances intended for external application, made of such materials and of such consistency as to adhere to the skin.

The base of the older form of plaster was a compound of litharge and oil. This was known as diachylon plaster and in a modified form is still employed. This type of mass requires the application of heat in spreading and in applying the plaster to the skin. Emplastrum Plumbi Oleatis or lead oleate plaster is of this type. Such a plaster mass has now been largely supplanted by a plaster made with a base of gum caoutchouc.

India rubber plaster mass, according to the nature of the plaster and its purpose is a compound of gums, such as galbanum and olibanum, with waxes, fats and excipients such as Burgundy pitch, together with proper medication, incorporated to complete the mass. The making of the India rubber plaster mass requires the use of extensive apparatus for the grinding and preparation of the rubber and gums, and the mixing of the mass and the final spreading upon cloth.

The lead and resin type of plaster mass must be heated in order that it may adhere to the skin. On the contrary, plasters made with an India rubber base are adhesive at the temperature of the body, hence ready for application without further treatment. The plaster mass, while adhesive, can be removed without the disturbance of the skin tissues.

EMPLASTRUM ADHÆSIVUM. U. S. Adhesive Plaster

[**Emp. Adhæs.**—Emplastrum Elasticum U. S. P. IX, Rubber Adhesive Plaster]

A mixture of rubber, resins, and waxes, with a filler of an absorbent powder, such as zinc oxide, orris root, or starch, mechanically mixed and spread upon cotton cloth (see page 518).

A strip of the Plaster 5 cm. by 6.5 cm. applied to a hard wood surface for thirty minutes at a constant temperature of 37° C. should resist a tension of not less than 40 pounds when applied by a tensile strength or other suitable device, the pull being exerted parallel with the warp and with the longer dimension of the Plaster.

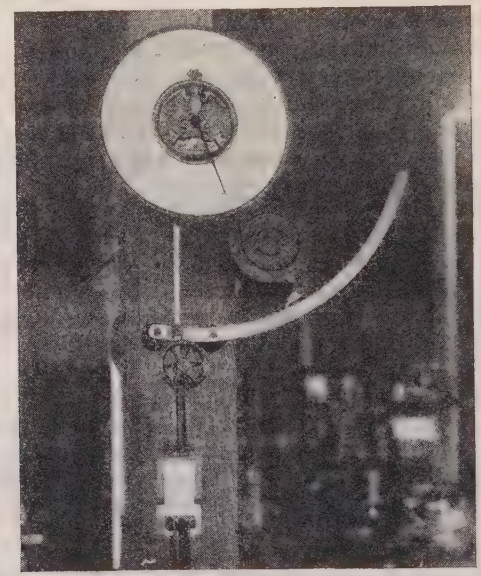
An instrument suitable for determining the tension-resistant quality of adhesive plaster is shown in Fig. 743. A strip of plaster 5 cm. by 6.5 cm. is kept at a temperature of 37° centigrade for thirty minutes, and then applied to blocks of wood, as shown in the illustration, and traction applied. The plaster should resist a tension of not less than forty pounds. It is made by Henry L. Scott and Company.

The use of the general term "adhesive plaster", without qualification, is apt to lead to confusion, there being several official and non-official plasters to which this name is applied. In modern practice, however, unless a more specific type is named, the term "adhesive plaster" is intended to apply to the adhesive plaster made with a rubber base.

Adhesive plaster made with a rubber mass is supplied in two types, one of which is known as *surgeons' adhesive plaster*. This is a plain mass of a yellow color. The second type is of a white color containing oxide of zinc and is the

kind usually required. It is known as *zinc oxide adhesive plaster*. Adhesive plaster made with a rubber base for mechanical use is spread on plain muslin, likewise on the so-called moleskin cloth, and also on felt. The plaster is supplied in rolls, one and five yards long, and of a width up to seven inches, also in rolls five yards long and twelve inches wide. It is likewise prepared in narrow widths, on spools, and in cylinder form, of varying lengths and widths.

FIG. 743



Tensile strength machine

EMPLASTRUM BELLADONNÆ. U.S. Belladonna Plaster

Belladonna Plaster contains extract of belladonna, corresponding to not less than 0.25 per cent and not more than 0.30 per cent of the alkaloids of belladonna leaves.

(For assay see page 518.)

Uses—An anodyne application in rheumatic and neuralgic pains.

EMPLASTRUM CANTHARIDIS. U.S. Cantharides Plaster

(For formula and standards see page 519.)

Uses—Employed in appropriate size to produce a blister.

EMPLASTRUM CAPSICI. U.S. Capsicum Plaster

(See page 519.)

Uses—A rubifacient.

EMPLASTRUM PLUMBI OLEATIS. U.S. Lead Oleate Plaster

(For formula, history, etc., see page 519.)

Uses—A protective also used as a base for other plasters.

EMPLASTRUM SINAPIS. U.S. Mustard Plaster

For description, standards and tests, see page 520.

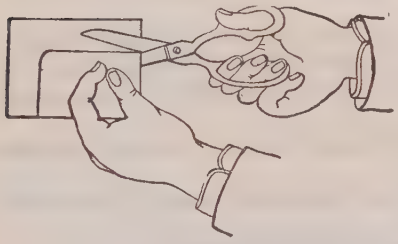
Before Mustard Plaster is applied, moisten it thoroughly with tepid water.

Uses—A rubifacient. A common substitute for the manufactured mustard plasters is the *mustard poultice* of the home, usually prepared by mixing equal parts of ground mustard and flour, moistening with tepid water to form a paste and applying to the skin in a muslin bag.

For N. F. plasters, see page 520.

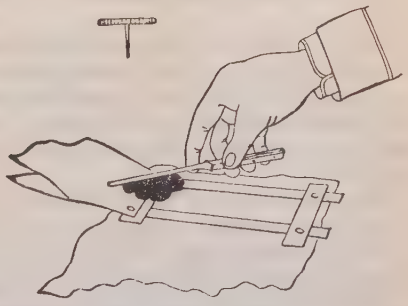
Dispensing Plasters—Since the introduction of machine spread plasters, the preparation of a plaster by a pharmacist upon the prescription of a physician has become almost a lost art. Lead base plasters are prepared for use by spreading them upon leather, muslin, paper, or adhesive plaster. A margin about a quarter or half an inch broad should usually be left uncovered, in

Fig. 744



Cutting plaster paper

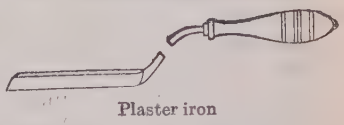
Fig. 745



Spreading a plaster

order to facilitate the removal of the plaster and to prevent the clothing from coming into contact with its edges. An accurate outline may be obtained by pasting, or fastening with thumb tacks, upon the leather, a piece of paper so cut as to leave in the center a vacant space of the required dimensions. The margin is to be removed after the plaster has been spread. To cut the pattern the paper is folded four times and cut as shown in (Fig. 744). The spreading of the plaster is most conveniently accomplished by the use of a spatula or plaster iron. This may be heated by means of a Bunsen burner. A sufficient portion of the plaster should be melted, then transferred to a piece of stiff paper, or shallow tin tray, open on one side, and when nearly cool, spread on the leather, quickly and evenly. Fig. 745 shows one method of spreading a small plaster with a spatula. Strips of paper are fastened upon the backing with thumb tacks (such as are used by draftsmen), as shown in the upper part of Fig. 745, a piece of waste paper is fastened at the top to prevent soiling the margin, the melted plaster is poured upon it and spread by the spatula, which has been previously warmed. A portion of the melted plaster precedes the blade in its passage, and thus a thin layer is spread upon the fabric. For large plasters the plaster iron (Fig. 746) may be employed.

Fig. 746



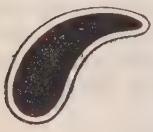
Plaster iron

Blister plasters do not usually require the application of heat to spread them. As a rule they may be spread upon the fabric by the aid of a stiff spatula.

The dispensing of plasters made with an India rubber mass consists, in the main, of the cutting of the plaster to the required shapes.

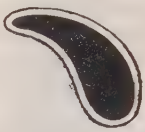
Rubber base plasters can be cut with a sharp knife, if the blade is dipped in water before cutting. Long sharp shears are preferable to small scissors, and the plasters will cut more readily if the shears are wet. It is a good practice to outline the size and shape on the plaster cloth with a pencil,

Fig. 747



Left ear plaster.

Fig. 748

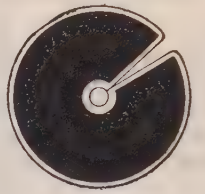


Right ear plaster

Fig. 749

Breast plaster pattern

Fig. 750



Breast plaster

then cut to the line. Square corners on a plaster should be trimmed or rounded off, as the corners are apt to rub loose.

Plasters for the chest, shoulder, back, and side, can be cut from the ordinary porous plaster made from a piece of plaster about 5×7 inches. Ear plasters can be cut from the small pieces, and breast plasters from a seven inch roll.

The illustrations, Figs. 750 to 754, show shapes which are applicable either to lead base or India rubber base plasters.

The following sizes were suggested by Dr. Rudolph Kobert (Director des Pharmacologischen Institutes zu Dorpat).

Half sheet paper size: Rectangular about $7\frac{1}{2}\times11\frac{7}{8}$ inches.

Fig. 751

Shoulder plaster

Fig. 752

Back plaster

Fig. 753

Side plaster

Fig. 754

Chest plaster

Quarter sheet paper size: About $5\frac{7}{8}\times7\frac{1}{2}$ inches. This is also known as size for trunk. An ordinary perforated (porous) plaster is very near this size.

Playing card size: $2\frac{1}{2}\times3\frac{1}{2}$ inches.

Size for surface of man's hand: $3\frac{1}{2}\times3\frac{1}{2}$ inches.

Size for neck: $2\times\frac{3}{8}$ inches.

Size for arms: $1\frac{1}{2}\times2$ inches.

Size for calves: $2\frac{1}{4}\times4$ inches.

Size for temples: $\frac{3}{4}\times1\frac{1}{4}$ inches.

Plasters, with India rubber as the base, retain their adhesiveness for a long time when preserved with proper precautions. These precautions are:

Plasters in rolls keep best standing on an end in the can or other container as they come from the maker. After use they should be replaced at once. This will obviate errors and enhance their chances of keeping more perfectly.

Cut plasters should always be kept in the original boxes with the cover closed. The plaster should always be kept covered with the face cloth. The

plaster should be kept at ordinary temperature, excluded from the air as much as possible, in a dry place, never in the cellar or in any place where they are apt to gather moisture.

India rubber plasters are quickly and disastrously affected by heat and by sunlight.

Many forms of medicated plasters are supplied by the manufacturers cut to a size of five by seven and one-half inches, with a face cloth and a back cloth made porous.

The porosity is considered a mechanical advantage in that it prevents the plaster from slipping from the point of application, each opening serving as a stop.

Porous plasters are far more comfortable than the non-porous. With the laity the porous plaster seems to have wholly superseded the non-porous.

In dispensing plasters made with an India rubber base, the user should be instructed as to the methods of applying, which are, in brief, that the part to which the plaster is to be applied should be dry and clean. This, of course, can be accomplished by the ordinary method with soap and water, or with alcohol or other cleansing agents. Cleansing the skin is important, as it removes the skin coating and allows close contact with the plaster and quick absorption of the medicinal agent. Having applied the plaster, it should be rubbed until it conforms perfectly to the skin. The user should be instructed that if the cloth on the adhesive side of the plaster adheres too closely it can easily be removed by wetting it, in which case the plaster should be wiped dry before applying.

The removal of the rubber base plaster can be done easily and simply. The ordinary method is to lift one corner and pull the plaster off with a quick jerk. This is at times painful. A better method would be to wet a sponge or little piece of cotton with denatured or any other alcohol, raise one corner of the plaster, squeeze the sponge or cotton and allow the alcohol to trickle between the skin and the plaster. Under this process, the plaster will at once release its hold and practically drop off without further effort.

Chartæ—*Papers*

Papers are preparations intended principally for external application, made either by saturating paper with medicinal substances or by applying the latter to the surface of the paper by the addition of some adhesive liquid. One paper is official in the N. F. (see Charta Potassii Nitratis, page 523), but the most largely used paper is the *mustard paper*, commonly called a mustard plaster. These are prepared by the large manufacturers and must be wet with lukewarm water before applying.

CHAPTER CIX

SURGICAL DRESSINGS

Surgical dressings is a term applied to a wide range of materials used as coverings, protectives, or supports for diseased parts.

They are employed to rest and to hold in position parts liable to misplacement, to guard against accidental injury, to apply heat or medicaments to a diseased or injured part, to prevent wound infection, and to absorb and prevent decomposition of wound discharges.

Dressings may be classified as adhesive plasters, absorbents, paddings, compresses, poultices, protectives, bandages and splints.

Adhesive plasters are discussed elsewhere. (See page 1751.)

Absorbent Cotton—Cotton fiber is the base of most of the important and greatly varying forms of surgical dressings.

The natural fiber, mechanically cleaned of dirt, carded into layers, but not otherwise treated, known as "raw cotton" or "cotton wool", has a limited use for paddings and coverings of unbroken surfaces. This form is supplied under the name of *non-absorbent cotton.*

Absorbent cotton in its varied forms is the base of many surgical dressings, and is also used in the arts and for domestic purposes.

Absorbent cotton is prepared from the cotton fiber of the market, by a series of processes which remove all impurities and foreign substances and rendering the fibers absorbent. Briefly summarized, these processes include mechanical cleaning for the removal of leaves, stems, dirt, etc., and chemical treatment for the removal of the waxes, resins, fats, and coloring matter.

The chemical processes include boiling in alkaline solutions, treatment with chemical solutions, usually some form of chlorine, and the removal of the chemicals by successive baths in water. A practically pure and white cellulose fiber is the result of these processes. Cotton thus treated is then dried, passed through carding machines which lay the fibers, so far as possible, in parallel lines interlocked to form a thin film. The filmy layers, imposed one upon another, form the laps or folds of cotton which, when rolled with tissue paper, are the sheets of absorbent cotton as they appear on the market.

The cotton, after being treated as noted, is cut into folds of varying sizes and lengths and packed into cartons. In certain instances the packages are sterilized in vapors of formaldehyde and steam, and sealed.

Absorbent cotton is official in the U. S. P. under the title *Gossypii Purificatum* or *Purified Cotton* (see page 795).

Absorbent cotton forms the base of varied forms of pads, compresses, etc., for surgical and dental use. It is also formed into disks and squares for use in filtering milk, jellies, and other liquids.

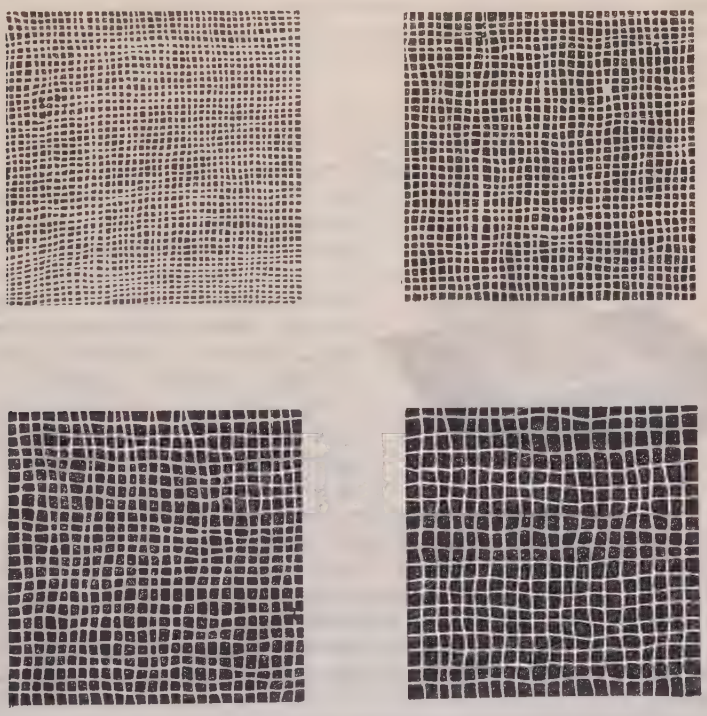
Each fiber of absorbent cotton is a hollow tube of highly absorbent cellulose which gives it peculiar powers as an absorbent and filtering material. The better grades of absorbent cotton are made from fibers approximately one inch in length, free from immature or unripe fibers which cannot be made absorbent.

Lower grades are manufactured from the combings and other wastes from cotton mills and, under such designations as "hospital grade", are used for coarser and mechanical purposes.

Absorbent cotton is also prepared by impregnating with antiseptics, forming the so-called medicated or antiseptic cottons. The principal varieties of antiseptic cotton are the following: *Borated cotton*, containing 10 per cent of boric acid; *iodoform cotton*, containing 5 per cent of iodoform; *iodized cotton*, impregnated with iodine; and *styptic cotton*, impregnated with a solution of ferric chloride. Cotton impregnated with other antiseptics, such as corrosive sublimate, phenol or carbolic acid, salicylic acid, etc., has a very limited use.

Surgical Gauze—Surgical gauze is a fabric of woven cotton fiber made absorbent, and differs materially from other cotton fabrics, such as muslin,

Fig. 755



Mesh of principal grades of gauze (actual size)

sheeting, cheesecloth, etc. In the process of making surgical gauze, the cotton fiber is mechanically cleaned and then spun or twisted into a thread, and the thread, in turn, woven into an open-mesh cloth.

The thread is loosely spun and the weave is open mesh in order that the resulting fabric may be soft, pliable and rendered absorbent.

Surgical gauze cloth is graded according to the number of threads or meshes per square inch, and the number of yards of fabric per pound. The mesh of the principal grades of gauze are shown in Fig. 755. For ascertaining the mesh or threads per inch, a small hand apparatus, known as a "pick" or "thread counter", is used (see Fig. 756).

The woven surgical gauze is rendered absorbent by processes quite similar to those employed in the preparation of absorbent cotton.

The gauze, after being made absorbent, is carried in a continuous length through a tentering machine, which stretches it to its full width, usually one yard, and then passes over a series of steam pipes and through rollers. When it leaves this apparatus, it is smooth and flat as though it had been ironed.

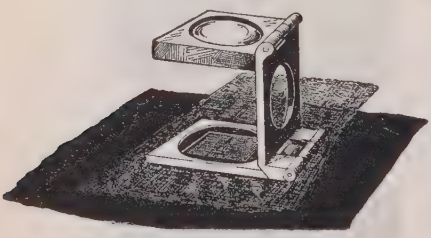
The gauze is cut into lengths, folded, rolled, and packed into various sized packages; it is also made into bandages and pads.

The final operation consists of sterilizing the packages before sealing.

Antiseptic or medicated surgical gauze came into vogue in the Listerian era of surgery, and it is still used to a considerable extent in various parts of the world. In the United States, however, plain medicated gauze is more largely employed. The antiseptic gauzes in common use are: *Borated gauze*, containing 10 per cent of boric acid; *corrosive sublimate gauze*, containing 1 to 1000 or 1 to 2000 corrosive sublimate; *carbolated gauze*, containing 5 per cent of phenol or carbolic acid; *iodoform gauze*, containing 5 per cent or 10 per cent of iodoform; *picric acid gauze* containing 2 per cent of picric acid. This last form is used as an application to burns.

Antiseptic gauze is prepared in both dry and moist form. The dry gauze is packed in sealed cardboard containers. The moist gauze is packed in glass jars, hermetically sealed. It is usually supplied in one and five yard lengths, and in narrow widths or strips for packing wounds. The gauze strips are made with a selvedge edge.

Fig. 756



Thread counter

Unless properly packed and cared for, antiseptic gauze is subject to change. Heat volatilizes carbolic acid and iodoform; iodoform is acted upon by light, especially sunlight.

Various forms of pads, compresses, and dressings are made from surgical gauze alone, or in conjunction with absorbent cotton.

Lint (*linteum*)—Lint was formerly a home-made product, consisting of a soft, fluffy fiber produced by scraping old linen cloth with the edge of a knife until a loose, tangled mass resulted. Modern lint is a specially woven cotton material in which loosely twisted threads form the warp of the material, while the cross threads are finer and more tightly twisted. The lint cloth is passed through a scraping machine which shreds the more loosely spun threads, producing a soft, fluffy surface of short fibers of cotton attached to a thread base.

Lint has great absorbent capacity and is used for absorbing discharges, and for the application of solutions, ointments, etc. Lint is supplied in the market in one-pound rolls and in smaller sized packets. In British and Continental practice, lint is supplied impregnated with antiseptics, chiefly boric acid.

Cellulose Wadding—This is sometimes called *wood wool*, and is wood pulp in the form of very thin sheets. It is very absorbent and, when several layers are put together or folded, it forms a substantial dressing. It has been used as a substitute for cotton. The disadvantages of cellulose wadding are its lack of elasticity, and the fact that when wet it becomes sodden.

Various pads and dressings are made from cellulose sheets, usually in conjunction with gauze as a binder.

Moss, *peat*, and *sawdust* have been used as materials for dressing wounds in emergencies, especially in the time of war when other dressings were not

available. These substances are harsh and are sterilized only with difficulty, and when used for wound dressing, must be enclosed in gauze or other fabric.

Jute is a fiber obtained from the inner bark of an herb of the linden family, also from the Indian mallow. It is a coarse, harsh fiber which, when treated and bleached, becomes somewhat absorbent and has a limited use for surgical dressings. Impregnated with a solution of tar it also has a limited field. Jute is usually packed in one-pound cartons.

Oakum or *marine lint* is manufactured from tarred rope, untwisted into a loose, fibrous mass. The tar has a slight antiseptic value. It is packed in cartons varying from one pound upward.

Bandages (*ligamentum*)—These terms usually imply strips or ribbons of muslin gauze, or other material employed in surgery for the retention of dressings, and for the compression, protection, or support of diseased or injured parts. They may be classed as inelastic, semi-elastic, and elastic. Still another class includes the bandages filled with hardening material, such as *plaster-of-Paris bandages*, which are virtually splints.

Ribbon, or *roller bandages*, are made of muslin, surgical gauze cloth, crinoline, etc., of widths from one-half inch upward, six or ten yards in length, and are usually rolled into firm even cylinders. *Muslin* (*calico*) roller bandages are made of bleached or unbleached muslin; the unbleached being the more commonly employed because of their softness.

Gauze bandages (*carbasus*) are made of the finer, firmer grades of surgical gauze, usually with edges ravelled; each bandage is wrapped and sealed.

A form of bandage known in England, as *water dressing bandages*, is made of a special grade of bleached cloth, heavier and more closely woven than gauze, but not as firm as muslin. They are absorbent and firm and are used largely for the application of solutions.

Crinoline bandages are gauze bandages stiffened with dextrin. They are usually wet before applying, and upon drying form a firm support. They also form the base upon which the plaster-of-Paris is applied.

Starch bandages are gauze bandages impregnated with starch paste. Their use is similar to that of the crinoline bandage.

Triangular bandages are usually made by cutting a square of cloth diagonally from corner to corner, forming two right triangles of equal size and shape. These bandages were brought into prominence by Esmarch and carry his name. They are particularly adapted for emergency use and can, with safety, be applied by inexperienced hands. Bandages, slings, and compresses, can readily be constructed from triangular bandages. The *triangular bandage* is particularly adapted for military, police, and railway service. This bandage usually comes printed with illustrations showing methods of application and is made a component part of First Aid packages.

Elastic bandages are bandages made to secure elastic compression or constriction of limbs, etc. Those made of India rubber are made of the pure gum vulcanized, or of threads of rubber woven with silk or other threads into a webbing.

Crêpe bandages are elastic, but contain no rubber. They are constructed of wool, or cotton and wool combined. The peculiar weave employed gives elasticity.

Flannel bandages are semi-elastic. They permit a certain amount of swelling in the part to which they are applied without producing undue pressure. They also retain the body heat. They should be made of pure wool which has been shrunken.

Plaster-of-Paris bandages are composed of gauze ribbons (crinoline is

sometimes employed), through the meshes of which the powdered plaster is distributed. The bandage when wet becomes plastic and upon drying or "setting" a cast or splint is formed. The plaster-of-Paris used to form the bandage should be a grade suitable for surgical uses, of a moderate setting time, *i.e.*, neither too fast nor too slow. The addition of common salt to the water with which the bandage is wetted will accelerate the speed of the setting of the plaster. One heaping teaspoonful of salt to a gallon of water speeds the setting time about one-third. Gelatin and glue will retard or destroy the setting properties.

Difference of manipulation used by operators is, at times, the cause of complaint in respect to these bandages. The following is the procedure employed by successful operators.

A vessel deep enough to hold one bandage standing on end should be nearly filled with water and placed on a table. Water of ordinary temperature is satisfactory.

The bandage should be completely submerged, and squeezed several times with the fingers to work out the air and allow the water to enter. It should be allowed to remain in the water not more than one minute, then removed, the excess water squeezed out, and applied as rapidly as possible. If, during application, there are parts where the plaster seems too dry water may be added from time to time by sprinkling on with the fingers. If there are parts of the gauze not properly covered with plaster (and this is likely to occur with the first few turns owing to having been washed out by the water), more should be sprinkled on from an excess supply, provided for the purpose. By smoothing and stroking with the hand as the application progresses, a solid, strong cast of good appearance can be produced.

Plaster-of-Paris bandages are supplied by the manufacturers in lengths of five yards and of varying widths. Each bandage is wrapped in paper with an excess of plaster packed in a sealed container. Plaster-of-Paris bandages must be kept in sealed, air-tight and moisture-proof containers, and stored where they will remain perfectly dry. The entrance of moisture into the container will cause a reaction in the plaster and its efficiency will be impaired.

Stockinette bandages are made of stockinette material knitted or woven in tubular form, without seams. They are usually supplied three inches wide, flat measure, five yards in length. They are used to cover the skin prior to the application of a plaster-of-Paris bandage.

Protectives—These are employed as wound coverings, either to shield the parts from external infection, or to prevent the escape of fluids contained in the dressing, and are also used as a covering for poultices, and for the retention of heat. In common use as protectives are oiled silk, oiled muslin, gutta percha tissue, rubber, wax or paraffined paper, and mackintosh or jaconet.

Oiled silk (*sericum oleatum*) is a thin, fine silk, coated with a flexible linseed oil varnish. Two varieties are made, one is semi-transparent, the other variety is opaque, made so by the application of talc or starch with the final coating. It is a very soft, pliable fabric, and is supplied in packages of one and five yard lengths, and also in smaller squares.

Oiled muslin or *oiled cambric* (*sindon oleata*) is similar to oiled silk, except that the basic fabric is of glazed cotton. It is thicker and heavier, and consequently less pliable than oiled silk.

Oiled silk and oiled muslin are liable to deteriorate with age, owing to the decomposition of the coating when subject to moist, humid atmosphere. They should be kept dry with access of air to the interior of the containers.

Waxed or paraffined paper is prepared by passing a parchment-like sheet of

paper through melted wax or paraffin. It is used largely as an economical substitute for more expensive protectives.

Gutta percha tissue consists of a thin, tissue-like sheet of gutta percha. While it is soft and pliable, it is lacking in strength and is quite liable to deteriorate with age. It is destroyed by hot solutions.

Rubber dam is a fine, thin tissue of pure India rubber, soft, pliable and elastic. It can be cleansed with soap and hot water, steam, or boiling water, and is employed for purposes similar to oiled silk or oiled muslin. It is liable to deterioration with age.

Mackintosh or *jaconet* is a thin, firm cotton cloth, coated upon one side with a layer of India rubber. It is a soft, pliable fabric and is often used as a covering for moist dressings, poultices, etc.

Rubber sheeting is a rubber-coated cloth, waterproof and flexible. It is supplied in various lengths and widths for use as a covering for bedding. One form used as a protection blanket is provided with eyelets for lacing under the bed. A so-called "nursery sheeting" is supplied, coated only on one side.

Care of Surgical Dressings

Surgical dressings of every nature must be properly cared for in order that their integrity may be preserved. The most suitable storage places are dustproof cases of glass or wood. The storage place should be dry and not near steam or furnace heat.

The absorbency and the whiteness of absorbent cotton and gauze are affected by prolonged contact with heat.

Many of the antiseptics contained in surgical dressings are volatilized by heat.

Some forms of surgical dressings are affected by the rays of the sun which act upon many of the antiseptics contained in these products.

Surgical dressings must be kept clean, free from dust, and handled carefully and with clean hands. Packages containing surgical dressings should be delivered to the consumer in sealed packages. The packages should not be opened and the contents exposed except at the time of use. Exposure of surgical dressings to dust, and especially to unnecessary handling is liable to be a means of conveying infection. The practice of selling small portions of dressings from large containers is especially objectionable.

ANTISEPTIC DRESSINGS IN THE BRITISH PHARMACEUTICAL CODEX (1924)

Carbasus Acidi Borici, B. P. C., Boric Acid Gauze, Boric Gauze.
Boric acid, distilled water (boiling), aniline red, unmedicated gauze, of each, a sufficient quantity.
Prepared by immersing the gauze in a saturated solution of boric acid in the boiling distilled water, tinted with aniline red, pressing the gauze, and drying. Contains from 10 to 15 per cent of boric acid.

Carbasus Acidi Carbolici, B. P. C., Carbolic Acid Gauze, Carbolic Gauze, Phenolated Gauze.
Phenol, 2 ounces, resin, 8 ounces, hard paraffin, 8 ounces, unmedicated gauze 18 ounces.
Prepared by melting together the phenol, resin, and paraffin, saturating the gauze with the mixture, and pressing between warm metal plates. Contains from 5 to 6 per cent of phenol.

Carbasus Acidi Picrici, B. P. C., Picric Acid Gauze, Picric Gauze.
Picric Acid, 146 grains, distilled water (warm), 35 fl. ounces, unmedicated gauze, 16 ounces.
Prepared by dissolving the picric acid in the warm distilled water, saturating the gauze with the solution, and drying. Contains from 1.5 to 2 per cent of picric acid.

Carbasus Aluminii Acetatis, B. P. C., Aluminium Acetate Gauze.
Solution of Aluminium Acetate, 8 fl. ounces, distilled water, 8 fl. ounces, absorbent gauze, 16 ounces.
Prepared by saturating the absorbent gauze with the mixture. Strength approximately 3 per cent.

Carbasus Hydrargyri Perchloridi, B. P. C., Mercuric Chloride Gauze, Sublimate Gauze.
Solution of mercuric chloride (1 in 1000), 16 fl. ounces, unmedicated gauze, 16 ounces.
Prepared by soaking the gauze in the solution of mercuric chloride so that the solution is equally distributed, and drying. Contains from 0.1 to 0.15 per cent of mercuric chloride.

Carbasus Hydrargyri et Zinci Cyanidi, B. P. C., Mercury and Zinc Cyanide Gauze, Double Cyanide Gauze.

Double cyanide of mercury and zinc, ½ ounce, solution of mercuric chloride (1 in 4000), 35 fl. ounces, aniline violet, a sufficient quantity, unmedicated gauze, 16 ounces.

Prepared by diffusing the cyanide of mercury and zinc in the solution of perchloride of mercury, colored lightly with aniline violet. Place the gauze in the mixture, pressing and agitating, so that the insoluble powder is equally diffused over the gauze.

Contains, when dry, from 2 to 3 per cent of mercury and zinc cyanide.

Carbasus Iodoformi, B. P. C., Iodoform Gauze.

Iodoform, ½ ounce, ether, 8 fl. ounces, unmedicated gauze, 9½ ounces.

Prepared by dissolving the iodoform in the ether, and pouring the solution on the gauze under pressure; when the whole of the liquid is absorbed and equally diffused, allowing the ether to evaporate. Contains from 4 to 5 per cent of iodoform.

Carbasus Iodoformi cum Glycerino, B. P. C., Iodoform Gauze with Glycerin, Moist Iodoform Gauze.

Iodoform, 2 ounces, glycerin, 2 fl. ounces, ether, 16 fl. ounces, unmedicated gauze, 16 ounces.

Dissolve the iodoform in the ether, add the glycerin, and pour the mixture on the gauze under pressure. Allow the ether to evaporate in a current of air.

Carbasus Salis Alembroth, B. P. C., Sal Alembroth Gauze, Blue Gauze.

Alembroth salt, 70 grains, distilled water, 16 fl. ounces, aniline blue, a sufficient quantity, unmedicated gauze, 16 ounces.

Prepared by dissolving the alembroth salt in the water, and tinting with the dye, placing the gauze in the solution, pressing until the gauze has absorbed all the solution. Contains from 0.75 to 1 per cent of alembroth salt.

Carbasus Styptica, B. P. C., Styptic Gauze, Tarred Gauze.

Tar, 380 grains, resin, 230 grains, benzene, 14 fl. ounces, absorbent gauze, 16 ounces.

Dissolve the tar and resin in the benzene, allow to stand for twenty-four hours, and saturate the gauze with it. Dry the gauze in a steam-heated chamber where there is a good current of air. Strength approximately 5 per cent.

Carbasus Zinci Sulphitis, B. P. C., Zinc Sulphite Gauze.

Zinc sulphate, 1 oz. 17½ gr., sodium sulphite, 385 grains, distilled water, 32 fl. ounces, gentian violet, a sufficient quantity, absorbent gauze, 16 ounces.

Dissolve the salts separately in warm distilled water, mix and add sufficient water to produce 100 (16 fluidounces). Slightly color the solution with gentian violet, immerse the absorbent gauze in the colored liquid, and press it so that the whole of the mixture is evenly absorbed. Now submit the gauze to strong pressure to remove the sodium sulphate formed, immerse in distilled water, 100 (16 fluidounces), and again press to remove sodium sulphate, then dry.

Strength approximately 5 per cent.

Gossypium Acidi Borici, B. P. C., Boric Acid Wool, Boracic Acid Wool; Boric Wool.

Boric acid, 16 ounces, absorbent cotton, in thin sheets, 16 ounces, distilled water, boiling, a sufficient quantity.

Prepared by making a hot saturated aqueous solution of the boric acid tinted with aniline red, immersing the cotton in the liquid, removing the sheets to wire trays, and allowing to drain and cool. The medicated cotton is afterwards pressed sufficiently and dried. Contains from 15 to 25 per cent of boric acid.

Gossypium Acidi Salicylici, B. P. C., Salicylic Acid Wool, Salicylic Wool.

Salicylic acid, 292 grains, alcohol, 16½ fl. ounces, absorbent cotton, 16 ounces.

Dissolve the salicylic acid in the alcohol, and pour the solution over the cotton under pressure. Then dry in thin layers. Contains 4 per cent of salicylic acid.

Gossypium Acidi Salicylici Forte, B. P. C., Strong Salicylic Acid Wool.

Salicylic acid, 1 oz. 340 grains, alcohol, 16½ fl. ounces, absorbent cotton, 16 ounces.

Same process as the foregoing. Contains 10 per cent of salicylic acid.

Gossypium Capsici, B. P. C., Capsicum Wool.

Liquid extract of Capsicum, 2 fl. ounces, absorbent cotton, in thin sheets, 18 ounces, alcohol, 14 fl. ounces.

Mix the extract with the alcohol, and pour the solution over the cotton, under pressure.

Gossypium Carbolisatum, B. P. C., Carbolised Wool.

Phenol, in crystals, 368 grains, ether, 16¾ fl. ounces, absorbent cotton, 16 ounces.

Dissolve the phenol in the ether, and pour the solution over the cotton under pressure. Approximately of 5 per cent strength when freshly made.

Gossypium Ferri Perchloridi, B. P. C., Ferric Chloride Wool, Perchloride of Iron Wool; Gossypium Stypticum; Styptic Wool.

Ferric chloride, 2 oz. 360 grains, distilled water, 19 fl. ounces, absorbent cotton, 16 ounces.

Dissolve the ferric chloride in the water, saturate the cotton evenly with the solution, dry by exposure to the air.

Gossypium Hamamelidis, B. P. C., Hamamelis Wool.

Tincture of hamamelis, 50 fl. ounces, glycerin, 3 fl. ounces, absorbent cotton, 15 ounces.

Mix the glycerin with the tincture, saturate the cotton evenly with the mixture, dry by exposure to the air.

Gossypium Hydrargyri et Zinci Cyanidi, B. P. C., Mercury and Zinc Cyanide Wool, Double Cyanide Wool.

Mercury and zinc cyanide, 216 grains, solution of mercuric chloride (1 in 4000), 32½ fl. ounces, absorbent cotton, 16 ounces, aniline violet, a sufficient quantity.

Diffuse the mercury and zinc cyanide in the solution of mercuric chloride, and color lightly with the aniline violet. Place the absorbent cotton in the mixture. When the whole of the mixture is absorbed dry the "wool."

Gossypium Hydrargyri Iodidi, B. P. C., Mercuric Iodide Wool; Biniodide of Mercury Wool; Red Iodide of Mercury Wool.

Mercuric Iodide, 7 grains, potassium iodide, 7 grains, distilled water, 16 fl. ounces, absorbent cotton, 16 ounces.

Dissolve the salts in the water, diffuse the solution evenly through the cotton under pressure, and dry. Strength 1 in 1000, sometimes colored pale red by adding a little eosin to the medicated solution.

Gossypium Hydrargyri Perchloridi, B. P. C., Mercuric Chloride Wool, Perchloride of Mercury Wool, Sublimate Wool.

Mercuric Chloride, 35 grains, glycerin, 35 minims, distilled water, 32 fl. ounces, absorbent cotton, 16 ounces.

Dissolve the mercuric chloride in the glycerin and water, immerse the cotton in the solution, and press out the liquid until the medicated cotton weighs 32 ounces, and dry.

Gossypium Iodisatum, B. P. C., Iodised Wool, Iodine Wool.

Iodine, 1 ounce, potassium iodide, 1 ounce, glycerin, 2 fl. ounces, ether, 20 fl. ounces, absorbent cotton, 16 ounces.

Dissolve the iodine and potassium iodide in the ether, add the glycerin, saturate the cotton evenly under pressure. Then dry.

Gossypium Iodoformi, B. P. C., Iodoform Wool.

Iodoform, 1 oz. 340 grains, ether, 16 fl. ounces, absorbent cotton, 16 ounces.

Dissolve the iodoform in the ether, and pour the solution over the cotton under pressure. Allow the ether to evaporate. Approximately of 10 per cent strength.

Gossypium Menthol, Menthol Wool.

Menthol, 1 oz. 340 grains, liquid paraffin, 1 fl. ounce, ether, 50 fl. ounces, absorbent cotton, 16 ounces.

Dissolve the menthol in the ether, add the liquid paraffin, shake thoroughly, and saturate the cotton evenly with the mixture. Dry by exposure to the air.

Gossypium Menthol Compositum, B. P. C., Compound Menthol Wool.

Menthol, 306 grains, solution of formaldehyde, 288 minims, oil of lavender, 288 minims, oil of eucalyptus, 288 minims, alcohol, 20 fl. ounces, absorbent cotton, compressed, a sufficient quantity.

Dissolve the menthol in the alcohol, add the oils and solution of formaldehyde. Soak sheets of the compressed absorbent cotton in the mixture, and dry.

Gossypium Salis Alembroth, B. P. C., Sal Alembroth Wool, Blue Wool.

Alembroth salt, 286 grains, distilled water, 32½ fl. ounces, aniline blue a sufficient quantity, absorbent cotton, 16 ounces.

Prepared by dissolving the salt and aniline blue in the water, immersing the cotton in this solution, removing, pressing sufficiently and drying. Contains from 0.75 to 1 per cent of alembroth salt.

CHAPTER CX

FIRST AID DRESSINGS

FORMERLY, in the case of an accident on the street or elsewhere, the victim was carried to a drug store, and the pharmacist was called upon to apply "first aid" treatment.

Modern first aid requires its application by more or less trained workers in the factory, work shop, store, household, or wherever the accident may occur.

Under this system, the pharmacy becomes a depot from which the necessary supplies for the administration of first aid may be secured.

The prime office of first aid is to relieve the injured person from immediate suffering and prevent further injury, this aid to be applied at the place where the injury occurred. After first aid is applied, the next step is to remove the person to a place where medical and surgical attention may be rendered.

It may be borne in mind, that permanent treatment, care of injuries, administration of medicines, diagnoses, and treatment of disease or injuries, have no part in first aid.

In modern times, large numbers of lay people, through the associated efforts of the Red Cross Society and first aid organizations, have been trained to give first aid service successfully.

It is the province of the pharmacist to direct his patrons in the selection of first aid appliances, and, so far as possible, as to the proper method of applying the same.

In a large number of the states, equipment of factories, work shops, etc., with "First Aid Outfits" is required by law. An example of this is found in the Industrial Code of the Department of Labor of the State of New York, which requires that in every factory employing more than ten persons, in which power machinery is used, there shall be provided a First Aid Cabinet accessible at all times. The content of the First Aid Cabinet under these regulations is as follows:

Instruments

1 pair scissors,
Thumb forceps,
Tourniquet,
Graduated medicine glass.

Drugs

2 oz. aromatic spirit of ammonia,
2 oz. 4 per cent boric acid solution,
2 oz. alcoholic iodine solution, half strength (for external use),
2 (3 oz.) collapsible tubes of bicarbonate of soda mixed with petrolatum (3 per cent) (for burns),
2 oz. castor oil (for eye injuries)

Dressings

1 doz. assorted sizes, sterile gauze bandages,
1 spool ZO adhesive plaster, 1 inch by 5 yards,
3 (½ oz.) packages of absorbent cotton,
3 (1 yard) packages of sterile gauze,
Splints of assorted sizes for fractures,
Wooden applicators wound with cotton,
Wooden tongue depressors.

The Liability Insurance Acts of many states, likewise require the installation of a *First Aid Kit* or *Outfit* containing the following articles:

Instruments

1 pair scissors,
3 pairs splinter forceps,
Tourniquet,
Graduated medicine glass (unless medicine is furnished in ampuls).

Drugs

2 oz. (or a minimum of 10 ampuls) aromatic spirits of ammonia,
Boric acid, liquid, powder or tablet form to make 4 per cent solution,
2 oz. (or a minimum of 10 ampuls) iodine solution, half strength (for external use),
2 collapsible tubes (3 oz. each, or at least 6 individual tubes of burn dressing),
2 oz. castor oil (for eye injuries).

Dressings

1 doz. assorted sizes, sterile gauze bandages, or
1 doz. assorted compresses in sealed packets,
1 spool adhesive plaster, 1 inch by 5 yards,
3 packages (½ oz. each) of absorbent cotton,
Splints of assorted sizes for fractures, or wire splints,
Wooden applicators wound with cotton.

Manufacturers of dressings supply cases of this character in compact form for factory use.

First aid is rapidly being extended beyond its original inception to all walks of life. This is particularly true in respect to the greatly increased use of automobiles, and the liability to accidents in the home, on the farm, and in other places. Outfits are now supplied for these special uses, even to small pocket outfits.

Pharmacists are often called upon to supply not only the first aid material for use in the home, but for simple domestic remedies for emergency use in case of sudden illness.

First aid is likewise being extended to measures for the prevention of the spread of contagious and infectious disease. For all of these phases of first aid, the trained pharmacist should be well fitted.

It is recommended that every pharmacist become familiar through the use of first aid manuals, and otherwise, with emergency measures that may, so far as possible, tend to educate his patrons in first aid, and induce them to install in their households or shops, equipment of this character.

CHAPTER CXI

LIGATURES AND SUTURES

This important class of surgical materials is largely prepared by special manufacturers, the pharmacist, however, must handle and dispense the prepared material, hence the necessity for an intimate acquaintance with the various kinds of these articles. An explanation of the more common terms is here given in a condensed form.

The terms "ligature" and "suture" are often used as of equivalent meaning. The difference between the two is quite distinct.

Ligature, when used as a noun, means the thread or cord with which an artery or vein is tied to prevent or arrest hemorrhage. It is also applied to a cord, thread, or wire used to remove tumors, etc. When used as a verb, it means to tie.

Suture, when used as a verb, means to stitch or to sew. In surgery it means the stitching together of the edges or lips of a wound to assist nature until normal union is effected. Suture material is used in sewing together tissues, blood vessels, nerves, bones, etc., until normal union is performed by nature. The same material, however, is used both for sutures and ligatures.

Material used for ligatures and sutures may be divided into two general classes, *viz.*, the "absorbable" and the "non-absorbable".

Absorbable Sutures—This type of sutures or ligatures are those which, during the healing process, are absorbed by the tissues in which they are imbedded. The absorbable materials most commonly used are catgut and animal tendon. Animal tendons consist of layers of longitudinal fibers which are split to form a suture of suitable size. Animal tendons are readily absorbed.

The tendon of the kangaroo (wallaby) is the best known and the most used of all animal tendons. For use as sutures or ligatures the tail tendons are split into rather irregular sizes. Kangaroo tendons cannot be accurately gauged as to size and length. They are roughly divided into fine, medium, and coarse, as to size, with an average length of twelve inches. Kangaroo tendon suffers deterioration by steam sterilization, boiling in water, and by heat processes generally.

Surgical catgut is descended from the musical string. The term "catgut" is generally explained upon the basis that the word itself was originally derived from "kitgut" or "kitstring", meaning a fiddle, and this term has become confused with "kit", meaning a little cat. Modern catgut is really sheep gut. Catgut as made from sheep intestine, is a ribbon-like material twisted into a cord, presenting the most acceptable type of absorbable suture.

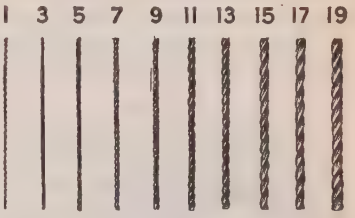
Absorbable suture material can be treated so as to resist absorption, *e.g.*, *hardened, chromic*, or *tanned catgut.*

Non-Absorbable Sutures—Certain suture materials are in use which are practically non-absorbable and, as such, remain in the tissues for an indefinite length of time. Examples of such substances are silk, silkworm gut, linen, horsehair, and the various metallic wires, such as silver, copper, aluminum, bronze, etc. It may be noted that in the course of time, sometimes years, these so-called "non-absorbable" sutures disintegrate and disappear, but they are not absorbed during the process of wound healing. This, however, does not happen in the case of hardened catgut, which disappears within varying periods.

Silk Sutures—The silk fiber consists of a continuous thread spun by that species of caterpillar known as the silkworm. The so-called mulberry silkworm, cultivated in many countries, produces the bulk of the silk of the market. The silk fiber is obtained by unreeling the cocoon, and this produces what is known as raw silk. The short tangled fibers from the exterior of the cocoon are the source of floss silk from which, in turn, spun silk is made.

The chief chemical constituents of silk consist of sericin, fibroin, resins, fats, and mineral matter. Fibroin is a proteid analogous to that contained in wool. Sericin, an altered form of fibroin, is the so-called silk glue which forms the outer coating of the fiber. Silk is notable for its tensile strength, which is stated to be equal to that of an iron wire of equivalent diameter. It is very elastic.

Fig. 757



Twisted Silk (Sizes 1 to 20)

Silk will withstand a temperature of 110° C. without decomposition. It is dissolved by strong, hot alkalies, and by concentrated sulphuric or hydrochloric acid. Silk readily absorbs coloring matter and dyes.

The threads, as spun by the silkworm, are twisted and braided together to form what are known technically as *"twisted silk"* and *"braided silk"*, respectively. Raw silk is cream or orange color. As found in the market, however, it is white, due to scouring and bleaching.

Many surgeons prefer silk sutures that have been dyed black, this color being more readily perceptible in the wound tissues. Silk of this type is known as *"iron dyed"*. The exact sizes are shown in Fig. 757.

Silkworm Gut—Silkworm gut is made direct from the silkworm before it forms its cocoon.

Silkworm gut is a cream white, smooth, lustrous material, but it is quite stiff, and is usually soaked in warm or hot water before attempting to tie it. The diameter of silkworm gut is irregular and limited. In surgery, silkworm gut is used principally for suturing the skin.

A recent innovation is a so-called *"artificial silkworm gut"* which is said to be made by taking a strand of twisted silk and coating it with a solution of silk. This form of suture is very pliable, but is not as strong as the natural product. It can be produced in long strands and many sizes. It is used primarily as a skin suture.

Linen Sutures—These are literally linen thread, and ordinarily, are used in their original grayish-white form. Some operators, however, prefer the black linen cord.

A form known as "Pagenstecher's Linen" is a linen thread impregnated with celluloid. This is to overcome capillarity and thus prevent infection from being carried into the wound by the strand. The coating increases the tensile strength and overcomes any tendency to irritate. This form is but little used.

Linen thread, coated with paraffin or with beeswax, has some use.

Horsehair Sutures—These sutures are taken from the tail of the horse and are prepared for surgical use as follows: They are first subjected to a thorough cleansing, with boiling water and soap, to remove the gross dirt. This is followed by repeated washing and sterilizing in hot water and steam. Owing to the liability of the presence of tetanus and other organisms in horsehair, a thorough sterilization is required.

Horsehair is a fine, elastic substance with very little tensile strength. It is

used chiefly for the suturing of the skin, particularly about the face, neck, and lips, and leaves but little scar or cicatrix.

No particular gradation of sizes for horsehair sutures can be made. They are usually supplied in approximately uniform lengths, packed in tubes or envelopes, and sterilized within the container.

Wire Sutures—Silver wire sutures are made of drawn wire of silver alloyed with copper. As it cannot be knotted, it is fastened by twisting the ends. In surgery, the main use for silver wire is for suturing the bones. Wire sutures have been made of other metals, such as aluminum, bronze, etc. At present, however, they are but little used. Metallic sutures in the course of time disintegrate and disappear in the tissues.

Catgut—Catgut is the product of the intestines of the sheep. The intestines are tubes from sixty to seventy feet long. For surgical purposes only about one-third of the tube can be utilized.

The intestinal tube has been compared to a garden hose consisting of layers of tissue with elastic properties in several directions. It is made up of four distinct coats or layers, a central mucous layer, a so-called submucous layer, and two muscular layers, one with lengthwise fibers and the other in which the fibers run crosswise (see Fig. 758). In the process of manufacture, all the layers except the submucous are removed.

FIG. 758

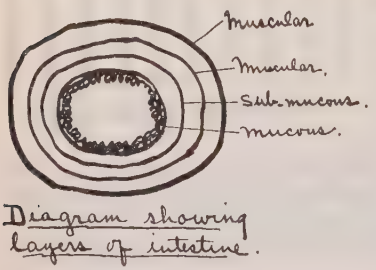


Diagram showing layers of intestine.

The process of preparing the intestines includes the removal of the fecal contents, the splitting of the tube into halves, the separation of the tissue layers, which is done under systems of cleansing, washing and disinfection. The separate ribbons are then twisted into a cord, dried and polished, gauged, and wound into coils for the subsequent sterilization processes.

Catgut, from a chemical point of view, is a complex albuminoid substance, an organized collagen. In terms of physiological chemistry, "a colloidal substance known is collagen, or the parent substance of glue and gelatin".

Approximately, catgut contains over seventy per cent of collagen convertible into gelatin, ten per cent of proteins not convertible into gelatin, two per cent of carbohydrates, waxes, fats, etc., and about three per cent of inorganic constituents, ash, etc.

The complex composition of catgut indicates the action liable to follow in the course of its manipulation and preparation for surgical use. Acids, alkalies, and most chemical substances act upon the collagen in a greater or less degree. Tannin, formaldehyde, alum, mercuric chloride, and other like substances react upon collagen. Watery fluids, especially under the influence of heat are highly destructive to catgut tissue. Many antiseptic agents react upon catgut, but not always destructively. Heat can be applied to catgut in the process of sterilization, provided the catgut is perfectly free from moisture.

It is apparent that a complex substance, such as catgut, when imbedded in a wound, after performing its office of holding the wound tissue together, must undergo a series of changes before being absorbed in the healing process.

Hardened Catgut—Catgut and other absorbable suture material can be so treated that the processes of absorption will be retarded. The process in quite general use consists of treating the gut with a solution of chromic acid or a salt of chromic acid. The strength of the chromicizing bath and the period of exposure govern the degrees of hardness or resistance to absorption that may be desired.

The chromicizing process originally devised by Lister, and still used with modifications by manufacturers, is as follows: Soak the catgut during twenty-four hours in 20 times its weight of "preparing liquid", made as follows: Dissolve chromium trioxide in 240 parts of water, by weight, add sufficient sulphurous acid to produce the green color of chromium sulphate ($Cr_2(SO_4)_3$). Then add sufficient water to make 480 parts by weight. Next add a solution consisting of 2 parts of mercuric chloride in 320 parts of water, by weight. Dry the catgut on the stretch. (*British Medical Journal*, 1908, Vol. I, 125.)

The terms "ten", "twenty", and "thirty", day have been applied as indicative of the time in which the strand would resist absorption. These terms cannot be construed literally. The time of absorption varies with the individual patient and the tissue in which the strand may be imbedded. Quite generally catgut is supplied in two grades of hardness, using the terms "*medium-hard chromic*" and "*extra-hard chromic*". These are purely relative terms, used to indicate the degree or rate of resistance that the catgut offers against absorption when imbedded in the tissues.

As indicating the relative value of these terms it may be stated that under ordinary conditions in the striated muscle, the material known as "medium-hard" chromic catgut, size No. 2, will retain its integrity for from ten to twenty days, whereas the "extra-hard" chromic catgut will retain its integrity for from thirty to forty days, or perhaps longer.

Methods of Preparing Catgut

The methods which have been devised for the preparation of catgut for surgery number several hundred. They have been subject to constant modification and change, hence have not become standard. Methods in use for preparing various forms of Antiseptic Catgut will be found in the *A. J. P.*, Vol. 95, p. 737.

Modern Methods—Manufacturing laboratories have adopted methods for the preparation and sterilization of ligatures which are designed to fulfil present day surgical requirements. Different treatment is necessary for the different varieties of ligature material; no general process can cover them all. Certain prominent features are present in all processes, the chief characteristic in most cases being the thermol treatment. In some instances, the processes are carried out upon the twisted strand of catgut, in other cases the processes begin with the cleansing and disinfection before the tissue is twisted to form the cord. Practically, such a method involves a continuous series of processes, carried out along the following lines.

1. The cleansing and disinfection of the intestines directly after their removal from the sheep.
2. Disinfection of the individual ribbon.
3. Twisting the ribbon under sanitary conditions (see Fig. 759).
4. Dehydration and extraction of fats and waxes, etc.
5. Heat sterilization applied in kind, quantity and manner to assure the effective destruction of all organisms that may be present. This is ordinarily performed by boiling in cumol or an equivalent hydrocarbon at a temperature reaching or exceeding 152° C.
6. Storing in tubes or envelopes and sealing.
7. Sterilizing after the tubes or envelopes are sealed.
8. Bacteriological examination of each lot for verification and control of sterility.

The aim of such methods is to destroy and eliminate organisms present in the gut tissue so as to avoid contamination in the process of manufacture and protection in subsequent handling. In certain instances, antiseptics are added during the process or in the storing fluid.

The modern method combines a thorough continued disinfection or sterilization, not dependent upon any one feature, or upon the power of any antiseptic, or any one degree of heat, but upon the combination of the whole.

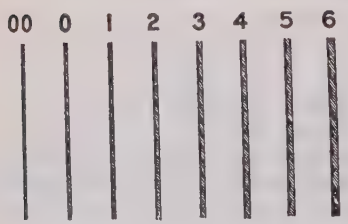
Catgut Sizes—Formerly catgut sizes were designated by the letters used in the musical string trade, A, B, C, etc. This system was changed to the use of

Fig. 759

Preparing catgut

numbers. The Brown and Sharpe wire gauge is sometimes used in the measurement of the strands. Latterly a rational scale of measurement has come into use for catgut. This scale is based upon the thousandths of an inch, each size being three-thousandths of an inch increase over the next smaller one. While some slight variation in size cannot be avoided, this system gives a more

Fig. 760



Catgut Size Scale (exact size)

Catgut Size Scale

No.	Thousandths Inch	No.	Thousandths Inch
00	12	4	27
0	15	5	30
1	18	6	33
2	21	7	36
3	24		

regular sized strand. The exact sizes for catgut are exhibited in the table here shown, Fig. 760.

Sizes of Silk Ligatures—The standard for silk ligatures is based upon the yardage per ounce. The following table shows the approximate yardage per ounce of the twenty sizes used in surgery.

Surgeons' Twisted Silk

No.	Yards to Ounce	No.	Yards to Ounce
1	2265	11	299
2	1865	12	232
3	1532	13	170
4	1198	14	136
5	932	15	115
6	765	16	95
7	565	17	80
8	465	18	65
9	444	19	50
10	365	20	40

Surgeons' Braided Silk

No.	Yards to Ounce	No.	Yards to Ounce
1	670	11	90
2	414	12	80
3	356	13	63
4	320	14	50
5	223	15	45
6	177	16	41
7	170	17	36
8	148	18	31
9	120	19	28
10	103	20	24

Surgeons' white as well as the so-called "iron-dyed" or black silk are of the same sizes.

Surgeons frequently use the designations "*fine*", "*medium*" and "*coarse*", which, respectively, would be equivalent to numbers 5, 9, and 12, in twisted silk, and 4, 7 and 10, in braided silk. Approximately, numbers 5, 9, and 12, in twisted silk, and 4, 7, and 10, in braided silk, are equivalent to numbers 1, 2 and 3, in catgut.

Silk is stronger than catgut of the same size, and is not weakened by the ordinary processes of sterilization, or by a variety of influences which tend to weaken catgut and other sutures.

Tensile Strength of Catgut

The tensile strength of ligature material is usually sufficient for the purpose to which it is applied, and, with the exception of catgut, is seldom brought into question. The peculiar nature of catgut tissue, the methods employed in sterilization and manipulation affect its tensile strength. Any attempt to judge the tensile strength of a strand of catgut by pulling or jerking the strand will be deceptive. A sudden jerk will break a heavy cord or even a piece of wire. In absence of proper apparatus, a strand may be held firmly between the hands and given an even, steady pull until the breaking point is reached.

Manufacturers use an apparatus made primarily for testing the strength of yarns similar to the machine illustrated in Fig. 743. In absence of such an apparatus, a hand spring scale (see Fig. 761) gives approximate results. Caution should be observed in testing a strand that it is free from kinks, nicks, splinters, or weakened points, as the cord is most liable to break at such spots. A catgut cord not uniform from end to end may break at a certain place, and yet be strong at all other points. The following table gives the average approximate breaking point of catgut on a straight pull, as shown by a yarn testing apparatus.

Approximate Breaking Point of Surgical Catgut

Size	Pounds	Size	Pounds
00	4	4	21
0	6	5	24
1	8	6	27
2	12	7	30
3	18		

The Selection of Ligature and Suture

It is the province of the surgeon to select the kind and size of material which he may desire to use in a given condition. The pharmacist, however, should be sufficiently informed to discuss the subject intelligently, if called upon to assist the surgeon in his selection.

The office of a ligature or suture in a wound is to hold the parts together until the healing process takes place. When the mission of the strand is ended, the cord, if non-absorbable, may be removed or allowed to remain as a neutral foreign body. In the case of catgut, as the wound heals, it is disintegrated and taken into the tissues.

The following suggestions follow the lines of established practice in respect to catgut.

The small sized suture is more quickly absorbed under the same conditions than a larger suture. The danger in using a small sized suture, under ordinary circumstances, lies in the fact that it might soften too soon, *i.e.*, lose its function as a suture before the wound had completely healed, and as a result the wound may spread open or "gape".

Chromic or hardened catgut enables the surgeon to use small sizes of sutures without running the risk of their absorbing prematurely.

The following table shows the sizes and kinds of suture material which many surgeons have found to give the most satisfactory results in the different tissues:

Striated Muscle	No. 1 or 2 medium hard
Fascia	No. 0 or 1 medium hard
Skin (through and through)	No. 0 or 1 medium hard or plain, silkworm gut or horsehair
Skin (subcutaneously)	No. 00 extra hard or No. 0 medium hard
Peritoneum (alone)	No. 00 or 0 medium hard
Peritoneum (through and through)	No. 1 or 2 extra hard
Cervix	No. 2 extra hard
Vagina	No. 2 extra hard
Kidney	No. 2 extra hard
Stomach, Intestines, and Glandular Tissue	No. 0 or 1 extra hard re-enforced by silk

Special Sutures—To meet the varying physiological conditions, sutures and ligatures for use in special parts are prepared. For suturing the skin, silk, silkworm gut, or horsehair is usually preferred by surgeons. To meet conditions present in certain forms of operations in the peritoneum an extra hard (forty day) chromic catgut is prepared.

A special form of catgut known as "*obstetrical catgut suture*" is prepared to hold from ten to twelve days.

Tubes of *obstetrical silk* and *obstetrical silkworm gut*, threaded on curved needles, are prepared for those surgeons who do not favor the use of catgut for immediate perineal repair.

For circumcision work, a small size catgut on a curved needle, called a *circumcision suture*, is prepared.

Special sutures are also prepared for use in the cervix, known as *cervix sutures*; for blood vessel surgery, known as *arterial sutures*; for suturing the skin, known as *skin sutures*; for intestinal work, known as *gastro-enterostomy sutures*. Various types of material with needles attached are commonly called *emergency sutures*.

The pharmacist, through a study of the adaptability of the various forms of ligatures and sutures to particular needs, can gain the confidence of his medical patrons by being able to assist them in making their selection of ligature and suture material.

Forms of Enclosure—Ligatures and sutures are supplied in various forms. Catgut, raw, untreated and unsterilized, in strands of ten feet, coiled, silk in skeins or on spools; silkworm gut and horsehair in coils. Prepared ligatures and sutures are supplied enclosed in tubes (see Fig. 762) or in envelopes (see Fig. 763); the tube form being the more largely used. The envelope form of package is prepared as follows:

The ligatures are first wrapped in a piece of manila paper and then in a second piece. The sterilization is done after sealing in two papers or envelopes, and the ligature is not handled thereafter until used by the surgeon. These double-wrapped sutures are then placed in the outer protective envelope.

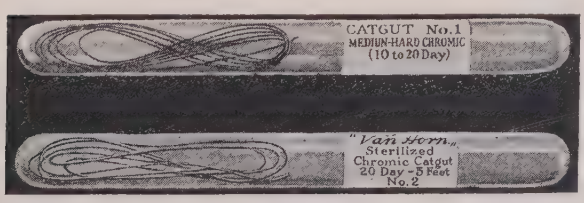
Ligatures in the Operating Room—In handling enveloped ligatures in the operating room, the procedure is usually as follows:

Non-sterilized hands open the papers, touching only one end of the inner paper. The same non-sterilized hand holds the same end of the inner paper while a sterile hand cuts, with sterile scissors, the untouched end of the inner

Fig. 761

Hand spring scale

Fig. 762



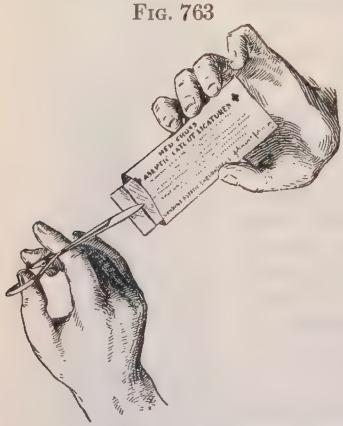
Catgut in tubes

and sterile paper. Following this, a sterile hand with sterile forceps removes the ligature from the cut end of the inner sterile paper.

If the operating room is free from ether vapors, the cut end of the inner paper may be passed through the flame of an alcohol lamp before the ligature is withdrawn. The sterilization of the container is made perfect by burning the end of the paper, and by this means also the necessity of careful handling of the papers, as previously described, is done away with.

In the tube form, the ligature is sterilized and covered with a storing fluid, such as alcohol, chloroform, cumol, etc. The tube is then flame sealed. A file mark carried around the tube permits easy breaking open at that point.

FIG. 763



Catgut in envelopes

A demand has been created for two quite distinct kinds of suture material known as *"boilable"* and *"non-boilable"*. This distinction is important. The terms refer to the manner of disinfecting the outside of the tube. The material inside the tube is intended to be sterile in either case.

The disinfection of the exterior of the tube bears no relation to the sterilization of the contents of the tube.

With the "boilable" tube the outside of the tube may be sterilized by boiling in water, or placing the tube in the steam sterilizer with instruments and dressing.

Tubes labeled "non-boilable" cannot be boiled or subjected to steam sterilization.

The difference lies largely in the storing fluid in the tube. In the "boilable" tubes, this fluid is of such a nature that the tube and its contents are not injured by the heat. In the "non-boilable" tubes, the fluid usually carries a percentage of moisture to keep the ligature soft; hence, boiling or steam sterilization would ruin it.

"Boilable" sutures are the more hard and wiry; "non-boilable" are the more pliable.

The usual method of procedure in boiling the tubes is as follows:

The tubes to be used for the operation are wrapped in a piece of gauze holding all of the tubes necessary for the operation. The gauze enclosed package is then placed in the instrument sterilizer for the usual thirty minutes. The gauze prevents the instruments from striking against the tubes and possibly breaking them. When taken from the sterilizer, the tubes are allowed to cool, after which they are broken in sterile gauze, and the suture removed.

To sterilize the outside of the glass tube containing catgut of the "non-boilable" variety, requires a wholly different process from that which is "boilable". The usual method is to wash the tube with soap and water and immerse it in a disinfecting fluid. The tubes must be weighted down by means of a perforated disk heavy enough to hold them under the solution.

The following solutions have been found to work out satisfactorily for disinfection of the exterior of the tube:

Formulas for Disinfecting Exterior of Ligature Tubes

Harrington's Solution—Mercuric chloride, 185 grains; hydrochloric acid, 2 fluidounces; water, 10 fluidounces; alcohol, 20 fluidounces. Used full strength it will disinfect in ten minutes' exposure.

Mercuric Oxycyanide Solution—One part of mercury oxycyanide to 1000 parts of water. Full strength will disinfect in ten minutes.

Mercuric Iodide Solution—One Gm. of red mercuric iodide dissolved in 5 cc. of a 20 per cent solution of potassium iodide and adding distilled water to make 500 cc. Full strength will disinfect in ten minutes.

Potassium Dichromate Solution—Ten Gm. of potassium dichromate, dissolved in a 10 per cent solution, by volume, of sulphuric acid. A dilution (1 in 10) disinfects in twenty minutes.

Hydrochloric Acid Solution—Hydrochloric acid, diluted 15 parts in 100 parts, disinfects in ten minutes.

Formaldehyde Solution—Thirty parts of solution of formaldehyde to seventy parts of water, by volume, will disinfect in fifteen minutes.

Acriflavine Solution—One part of acriflavine in 1000 parts of water will disinfect in ten minutes.

Softening Catgut

Catgut especially in the form known as "boilable" is stiff and wiry and thus difficult to handle and tie. The strand may be rendered pliable by a short immersion in water or in physiological salt solution. The strand is liable to injury by too long immersion. A second method is by the use of a sterile towel dipped in cold sterile water, or a solution of mercury bichloride, and wrung out by hand. The strands of catgut are laid between the folds of the towel. A third method is immersion in 60 per cent alcohol. By experiments, a minimum and maximum time of immersion can be established. Below the minimum time, the strand is not sufficiently softened; above the maximum time, the tissue is softened too much. The following table may be used as a guide for the immersion of catgut strands by the methods described.

Catgut Immersion

Minimum Time in Minutes

	Size		
	0	1	2
Immersion in water	½	3	4
Between folds of moist towel	3	10	15
Immersion in 60 per cent alcohol	8	15	25

Maximum Time in Minutes

Immersion in water	3	6	8
Between folds of moist towel	10	40	60
Immersion in 60 per cent alcohol	30	50	80

The water should be that which has been sterilized, and should be used at room temperature.

The Bacteriological Testing of Ligatures

It is well within the province of the hospital pharmacist, the laboratory technician, or the pharmacist who has a laboratory, to carry out the bacteriological testing of ligatures.

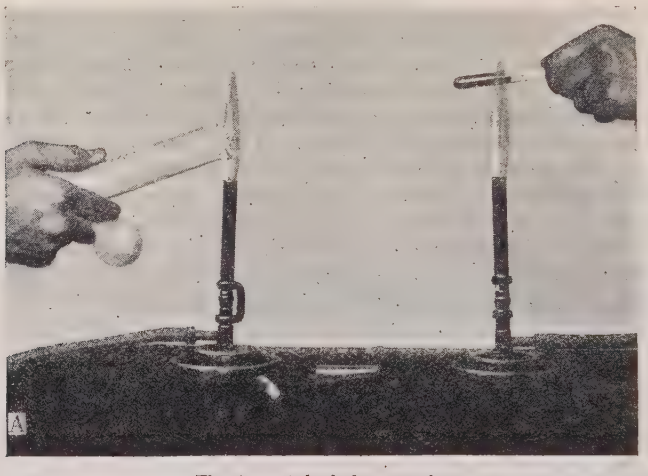
The processes here given are applicable to ligatures and sutures as supplied in the ordinary market forms—sealed envelopes and sealed glass tubes.

The processes involve the placing of the material to be tested in a sterile culture medium, incubating under proper temperature for a suitable period; absence of growth indicates sterility. The entire operation must be conducted under rigid conditions to prevent accidental contamination.

The culture broth is made in the usual manner of beef extract, peptone and salt, and has a slightly alkaline reaction. Each test tube is to contain 75 cc. of broth, previously sterilized, and then incubated at 37.5° C. for five days to make certain of its sterility.

Two operators wearing mouth and nose protectors should work at the transfers. One attends to opening the packages, the other holds the test tube, removes the cotton plug, passes the mouth of the test tube through the flame, heats the forceps in the flame, withdraws the ligature from its container held by his companion, transfers it quickly to the test tube and replaces at once the

Fig. 764



Flaming a tube before opening

cotton stopper. The whole operation must be performed rapidly to prevent accidental contamination.

When testing ligatures in envelopes, the outer printed envelope is removed. The end of the sealed paper within is now torn off, and the inner paper pulled out until its end projects beyond the outer one (see Fig. 763).

The operator now tears or cuts off the end of this inner paper as far as possible from the contained ligature. The cut or torn edge is then set on fire in the flame and immediately extinguished by waving in the air. While this is being done, the other operator, with the test tube in one hand held at an angle and the forceps in the other, has removed the cotton plug, flame-sterilized the forceps and mouth of the tube, and now carefully but quickly withdraws the ligature, drops it at once into the test tube and replaces the cotton plug. This operation is preferably conducted with the hands and arms working inside of a protecting closet.

In opening a glass tube, the tube is first held in the Bunsen flame so that the mark at which it is to be broken and the glass for a short distance on each side of it are enveloped in flame (see Fig. 764). The sterilizing action of the flame is instantaneous. Keeping the fingers as far away as possible from the breaking point, the tube is carefully broken.

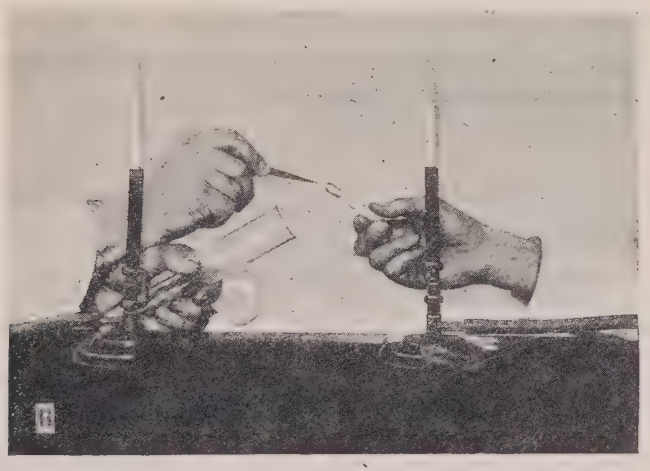
The operator who breaks the tube holds the half containing the ligature so that his companion can seize the strand with flame-sterilized forceps and withdraw it (see Fig. 765). It is then shaken rapidly to remove excess of liquid and dropped at once into the culture tube as previously described.

The culture tubes containing the suture material are now incubated at 37.5° C. for a period of seven days and, if negative, reincubated for another three days.

When making anaërobic tests, the same culture broth is used with the addition, before sterilization, of 2 per cent of dextrose.

Immediately after sterilizing, and while the broth is still hot, add a one-half inch layer of previously sterilized mineral oil (oil sterilized at 163° C. dry heat for one hour) and then incubate them for five days at 37.5° C. to prove sterility.

FIG. 765



Removing ligature for testing sterility

The technic for transferring the material to be tested is the same as for aërobic transfers.

In testing suture material that is stored in a fluid containing an antiseptic such as iodine, bichloride of mercury, biniodide of mercury, etc., use a large volume of broth (400 cc.) in an Erlenmeyer flask. This is done to overcome, by dilution, the inhibitory action of the antiseptic. The manual technic remains the same as described above.

Dispensing Ligatures and Sutures

The dispensing of ligatures and sutures goes beyond simply handing out the strand required by the surgeon. It is a service where technical knowledge is highly essential.

A pharmacist's knowledge must not only apply to prepared ligatures he has in stock, but to all kinds on the market, so that if he cannot supply what the surgeon needs, he can intelligently secure it.

Three or four sizes of catgut and silk ligatures are in far greater demand than other sizes. Silkworm gut, kangaroo tendon, silver wire, and other forms of ligature material are not in much demand in everyday practice.

Manufacturers supply a varied assortment of tubes, bottles, jars, boxes, and paper wrappers containing material ready for use. Ordinarily, two general styles of packing for ligatures—tubes and envelopes—are dispensed. The tubes are usually prepared in three sizes. Large tubes, holding about ten feet of material, intended for cases in which a large amount of a given size is to be used; standard tubes, holding about five feet of material, prepared for general operative work; small (or half-meter) tubes, holding only sufficient material to meet an emergency, or where an extra ligature is required to finish an operation.

Cautions—Sterile suture material, like sterile dressings should always be stored in a clean, cool, and dry place.

In storing catgut or silk ligatures in envelopes, dampness and moisture must be guarded against.

The individual tubes or envelopes should always be kept in their containers and never allowed to lie about indiscriminately either in a drawer or on a tray or a shelf.

The dispensing of such highly specialized products as ligatures and sutures calls for the most painstaking intelligence and care.

CHAPTER CXII

STERILIZATION AND STERILE SOLUTIONS

The extensive use of sterile solutions, preparations and dressings in medical practice and the large application of the principles of sterilization to manufacturing processes, for the purpose of preserving products from decomposition, have made it necessary that the pharmacist be familiar with these processes and in many instances apply them. The United States Pharmacopœia and the National Formulary have both included a brief consideration of sterilization and contain preparations which must be sterilized. Those who assume the responsibility for the preparation of sterile products must, at the very outset, be impressed with the importance of a thorough preliminary training in the technic of bacteriological practice. Many operations require the most exacting care and training for their successful accomplishment. What is presented here is largely suggestive, and space cannot be taken for that intricate detail which is necessary. The pharmacist who would add this service to his other professional duties is therefore urged to secure laboratory training in general bacteriological methods before undertaking work along this line.

The pharmacist will also often handle sterile products, prepared in special laboratories, and it is important that he should know and always remember that they remain sterile only so long as they are properly protected from contamination. No wrappings should be removed, or seals broken, or containers opened until ready for use. The responsibility in dealing with this class of preparations is very heavy, as often life itself may depend upon the product being properly sterilized and then kept in that condition until used.

Portions of the U. S. P. and N. F. articles on sterilization are incorporated in the following:

The term Sterilization, as used in medical or pharmaceutical practice, means a process whereby the destruction or removal of all microscopic living organisms and their spores is accomplished. Some bacteria, under certain conditions, undergo a transformation into a resting stage, when they are called spores. In the spore state they are able to resist influences which would kill the bacteria. Most disease-producing bacteria do not form spores and are therefore comparatively easily killed. The anthrax and tetanus bacilli are exceptions to this, as their spores are quite resistant. An object which is free from living microörganisms is spoken of as being "sterile", but this condition can be maintained only so long as the necessary precautions are taken to prevent contact with the atmosphere or other media or apparatus which may carry microörganisms.

The uses of sterilization, as applied by pharmacists, are:

1. For the preparation of solutions for hypodermic injection.
2. For the preparation of aseptic medicines for internal or external administration.
3. For the preparation of solutions, dressings, etc., for surgical use.
4. For the preservation of preparations or substances through the destruction of organisms which would otherwise cause deterioration or decomposition.

There are various methods whereby sterilization may be accomplished, and it is necessary that the operator shall select in each case the one which is most suitable.

From the viewpoint of the pharmacist it is important to know:

First—That most microörganisms multiply rapidly at temperatures between 20° and 40° C. (68° and 104° F.) if there is some nutritive material present.

Second—If contaminated substances are maintained at a temperature of freezing (0° C. or 32° F.) or below, the development of organisms is retarded, but they are not necessarily destroyed.

Third—All classes of microörganisms, whether they are bacteria, molds, yeasts, diatoms or protozoa, also their spores, may be destroyed by practically the same procedure. Any method which will kill all bacterial spores will also destroy every form of life.

Fourth—Bacteria may develop in almost any substance if sufficient moisture and atmospheric oxygen are present and the temperature is favorable. Some bacteria are anaërobic, that is, they do not require oxygen, and will not survive in its presence.

Yeasts develop in saccharine substances, while molds develop within and upon a large variety of organic substances. Protozoa and diatoms may occur in water which is highly contaminated with organic matter. Bacteria and molds do not thrive in sunlight, while diatoms and algæ generally develop best in sunlight.

Fifth—Bottles, flasks, test tubes, etc., stoppered with purified cotton (which has been wrapped in gauze to prevent contamination from filaments of cotton, and afterwards passed quickly through a flame to burn off any loose filaments on the gauze), then sterilized and kept dry, may be maintained in a sterile condition for an indefinite period. Before opening, however, the orifice should be sterilized by passing it through a Bunsen flame. The exterior of the cotton plug is burned off at the same time, thus destroying bacteria which may have lodged there.

Sixth—It is desirable that the pharmacist should operate, while preparing sterilized solutions, ointments, etc., under conditions which will avoid the possibility of the contamination of the material, apparatus, etc., by the falling of dust during the operation.

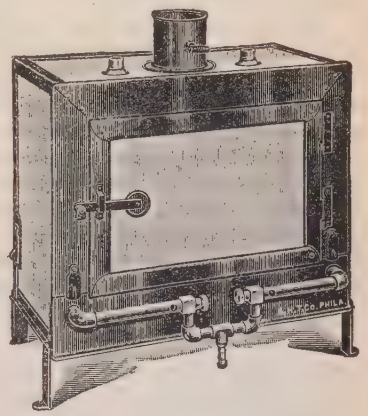
Seventh—Bottles containing sterilized liquids to be dispensed should be closed with rubber stoppers which have previously been sterilized by boiling for ten minutes in a 5 per cent phenol solution, then thoroughly rinsed in boiling water and stored in alcohol until used. These should be handled only with large forceps, the tips of which have been sterilized by heating in a Bunsen flame.

Eighth—Sterilized freshly distilled water should be used in preparing all aqueous solutions. It should be prepared as follows: Place the necessary quantity of freshly distilled water in a flask of Jena or other so-called "non-soluble" glass, which has been previously cleansed and sterilized as described for glassware, under *Dry Heat*, page 1781. Close the mouth of the flask with a pledget of sterilized purified cotton (which has been wrapped in gauze to prevent contamination from filaments of cotton and afterwards passed quickly through a flame to burn off any loose filaments on the gauze), boil the contents for one hour, or sterilize it in an autoclave at 15 pounds' pressure for twenty minutes. Then allow it to cool without removing the cotton plug. Finally protect the mouth of the flask and the cotton stopper from infection with dust by wrapping it in sterilized paper. For use in hypodermic injections only freshly distilled water should be taken, and it should be used within forty-eight hours after sterilization (see *Aqua Destillata Sterilisata*, page 1795).

The methods by which sterilization may be accomplished are as follows:

Direct Flame (Flaming)—It is sometimes possible to make use of the direct application of the flame of the Bunsen or Meker burner (see Figs. 69, 71 and 72) for sterilization, when the object will not be injured. Such objects as platinum needles, dry pipettes, the metallic orifice of a Berkefeld-type filter, the lip of a bottle or test tube, the points of tweezers or forceps used for handling sterilized rubber stoppers, the walls of a metallic closet, etc., may be sterilized by holding them within the Bunsen or Meker flame for about ten seconds or playing the flame over them a few times.

Fig. 766

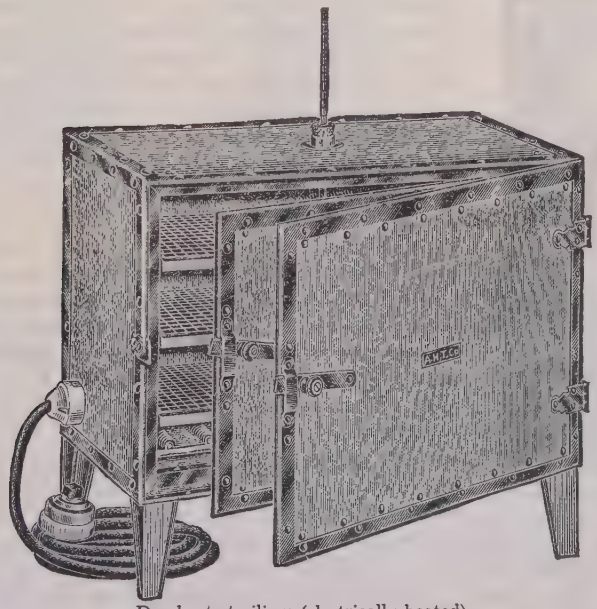


Dry heat sterilizer (gas heated)

Dry Heat—This method requires that the object be heated in an oven or other suitable apparatus (see Figs. 766 and 767) at a temperature of from 160° to 170° C. (320° to 338° F.) or at even higher temperatures, continued for at least two hours. It is desirable that the object be wrapped in paper so that it may be afterwards handled and stored in a sterile condition. Slight browning or charring of the paper is not objectionable, and is one of the indications that the proper temperature has been reached.

This process may be used for the sterilization of empty flasks, ampuls, bottles, funnels, test tubes, Petri dishes, ointment jars, and other glassware,

Fig. 767



Dry heat sterilizer (electrically heated)

but should not be used for any substance which may be injured by the high temperature required.

Bottles and other glassware which are to be sterilized should be thoroughly

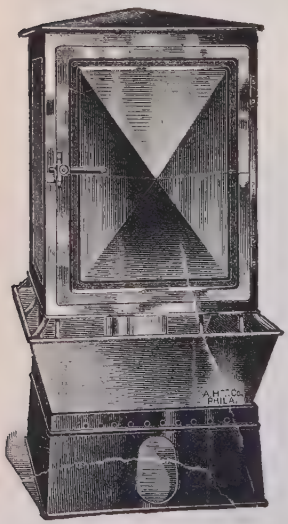
cleansed to remove all organic matter, afterwards rinsed with very weak hydrochloric acid (about 0.3 per cent) to neutralize the alkalinity of the glass, then with distilled water until the washings are neutral and, after drying, stoppered with purified cotton, and finally wrapped in paper and heated for one hour at about 180° C. (356° F.).

This method may also be used for the sterilization of petrolatum, fixed oils, lard, and many powders as talc, kaolin, boric acid, zinc oxide, and others which are not injured by this temperature, the precaution being taken, however, to spread them out in a thin stratum, about 6 mm. (¼ inch) in thickness, so that the heat may penetrate.

In sterilizing petrolatum and fixed oils, apply the heat directly to a sand bath carrying the vessel containing the substance, raise the temperature of the oil to 200° C. (392° F.), and then immediately withdraw the heat and protect the sterilized product from contamination. Glycerin should not be heated higher than 150° C. (302° F.) and this temperature should be maintained for one-half hour. Volatile substances, such as Camphor Liniment, for example, should be placed in strong bottles, such as solution of magnesium citrate bottles, with the stoppers fastened in, or they should be placed in ampuls and sealed, and the containers and contents heated in an oil bath or a concentrated, aqueous calcium chloride solution to a temperature of about 121° C. (249.8° F.) for one hour.

Moist Heat at 100° C. (212° F.)—The use of live steam for sterilization, usually in an Arnold sterilizer (see Fig. 768) or in a covered kettle or boiler, is more generally applicable than dry heat. On account of the greater penetrating power of steam than that of dry heat a lower temperature is equally efficient for sterilization. By this process the substance to be sterilized is sometimes heated but once in live steam, the treatment continuing for from thirty minutes to one hour, but "interrupted" or "fractional" sterilization is preferable, due to the fact that many substances are injured by prolonged heating, and especially because organisms may exist in the spore stage and in that condition will not be destroyed by the first heating. For the application of "interrupted" sterilization, the substance is heated in live steam, after the temperature has been raised to 100° C. (212° F.) for fifteen minutes each day on three successive days, the substance being kept during the resting period between the heatings at a temperature of about 20° C. (68° F.). The "moist heat" sterilization at 100° C. (212° F.) may be used for many pharmaceutical solutions, such as some eye waters, gargles, and similar solutions, some medicinal syrups, mucilages, etc. This method may also be used for the sterilization of collapsible metal tubes.

Fig. 768



Arnold steam sterilizer

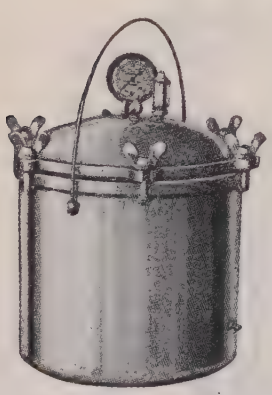
Materials or utensils to be sterilized should not be packed in the sterilizer too tightly, whether dry heat or steam is used. They should be placed in the sterilizer in such a manner as to insure free circulation of the heat and with due regard to the possibility of the heat reaching every portion of the material to be sterilized. When sterilizing empty, plugged test tubes, flasks, etc., they should be placed so that the stoppers are downward to insure more rapid and complete evacuation of the contained air.

Much of the pharmaceutical glassware on the market is relatively quite soluble in water. When solutions are sterilized in glass vessels of this character, a copious precipitate appears on cooling, together with a clouding of the glass, and in the sediment may be seen glistening spicules or thin flakes. It is therefore advisable to use vessels made of one of the varieties of glass known as "non-soluble".

For the preparation of sterile solutions for subcutaneous, intramuscular or intravenous administration all glassware used in preparing the distilled water, the making of the solutions, and the filling, and the ampuls themselves, must comply with the test for alkalinity in the glass as given in detail under *Selecting Ampuls*, page 1791. If such glass is employed this method may be used in sterilizing solutions for culture media, caffeine, caffeine salicylate, caffeine benzoate, sodium arsenate, sodium cacodylate and the mineral acid salts of strychnine, morphine and cocaine.

Steam Under Pressure—For laboratory purposes this form of sterilization has many advantages. Its application by the use of a steam cylinder, known

FIG. 769

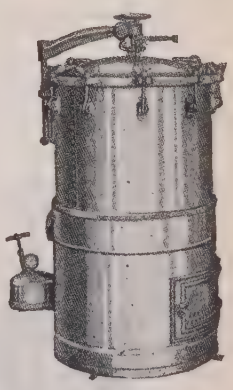


"National" aluminum high pressure sterilizer

FIG. 770

"Pressure cooker" which may be used as an autoclave

FIG. 771



"National" autoclave (may be heated with gas, steam, or by gasoline burner)

as an autoclave (see Figs. 769 to 773), produces results from one heating of twenty minutes, under a pressure of one atmosphere [a temperature of about 121° C. (249.8° F.)], which are more reliable than the method requiring heating at 100° C. (212° F.) each day for three successive days. The higher temperature, however, must again be considered and the method cannot be used for substances which are injured by this degree of heat. The process is well adapted to the sterilization of solutions of stable salts, etc.

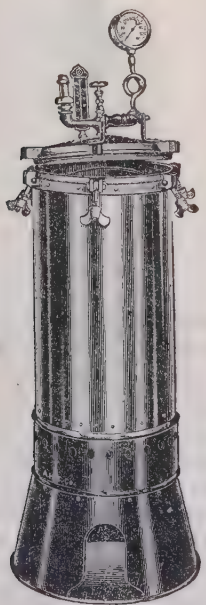
Some autoclaves are operated by live steam generated from an outside source, while in others the steam is generated by heating water placed in the bottom. The latter type is most common and is most generally employed in smaller laboratories. After placing water in the autoclave the material to be sterilized is placed in position on shelves or trays above the water. The door or top is closed and securely fastened, the air valve is opened, and heat is applied. As steam is generated, the air is forced out of the air valve and when all air has been expelled, the air valve is closed and the steam pressure allowed to increase until the desired pressure or temperature is reached.

Below is given a table of pressures and the corresponding temperatures for "saturated steam".

Pounds pressure	Degrees F.	Degrees C.	Pounds pressure	Degrees F.	Degrees C.
0	212	100	12	244	117
2	218	103	14	248	120
4	224	107	16	252	122
6	230	110	18	255	124
8	235	112	20	259	126
10	239	115	22	262	128

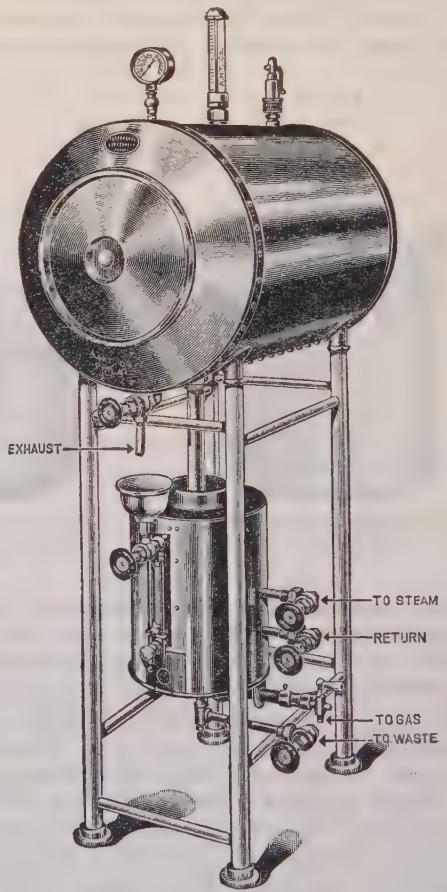
The safety valve should be set for the desired steam pressure or the source of heat should be regulated so as to maintain the desired pressure. After the pressure has been continued for the desired length of time the heat is withdrawn and the autoclave allowed to cool. When the pressure is reduced to 0 pounds, the air valve is opened slowly and air admitted. The autoclave may then be opened and the material removed. Should the air valve be opened quickly to hasten the reduction of steam pressure, there is danger of liquid materials boiling over in the autoclave and cotton plugs in test tubes, flasks, etc., are likely to be blown out. The "National" sterilizers are manufactured by the Northwestern Steel and Iron Works.

FIG. 772



Vertical autoclave

FIG. 773



Horizontal autoclave

Stoppers—Cork stoppers should not be used for containers to be sterilized. Cotton stoppers may be employed, and when used may be wrapped in a layer

of gauze and covered with stout paper or tinfoil as described under *Aqua Destillata Sterilisata*. Rubber stoppers should be wrapped and should be sterilized separately or attached to the outside of the necks of the containers. These stoppers should be long enough so that they may be inserted and removed without touching the lip of the container with the fingers. The sterilized wrapper of the stopper may be used as a cap. Glass-stoppered containers are sterilized preferably by dry heat, capped, and the stopper separated from tight contact with the neck of the container by a strip of paper.

Articles Made of Rubber—Rubber tubing and rubber stoppers should not be sterilized by hot air, but by steam under pressure, with the precautions indicated above, or by boiling for thirty minutes in a 2 per cent aqueous solution of cresol or phenol.

Medicinal Substances Not Easily Decomposed by Heat—If in aqueous solution, these substances should be sterilized by steam under pressure. In order that the exposure to heat may be the shortest which will effect thorough sterilization, the container should not be of thick glass and should be of as small a capacity as can conveniently be used. The preliminary heating before the temperature of 121° C. (249.8° F.) is reached may be shortened by admitting the steam to the autoclave under pressure from a separate generating plant, delivering a pressure constantly above eighteen pounds. The stoppers should be of cotton, as above described, and a wrapped rubber stopper should be attached to each container unless the contents are for immediate use.

If the substances are dry or oily, they should be sterilized by dry heat, preferably in glass-stoppered containers, as described under *Glass and Metal Utensils*. Cap the utensil or container with parchment paper before sterilization for protection against contamination and do not remove the paper until the substance is to be used.

Surgical Dressings—Cotton, bandages, gauzes, ligatures, etc., may be rendered sterile by treatment with steam in a pressure apparatus (autoclave) at 121° C. (249.8° F.) for twenty minutes or by exposure to dry heat in an ordinary air-bath or sterilizer at a temperature of from 160° to 170° C. (320° to 338° F.) for two hours. It should be remembered that all surgical materials are not amenable to such thorough treatment without more or less deterioration taking place. Bandages must be folded or packed in such a manner as to permit the penetration of steam or dry heat during the process and should be so arranged that after the sterilization is completed all subsequent contamination with bacteria will be prevented. This is usually accomplished by immediately enclosing them in glass containers or wrapping them in a number of thicknesses of previously sterilized parchment paper.

Low Temperature (Pasteurization)—This process is carried out in practically the same way as described on page 1782 [interrupted sterilization with moist heat at 100° C. (212° F.)], except that the temperature is maintained at from 60° to 70° C. (140° to 158° F.).

Material to be sterilized at pasteurization temperature is heated on six successive days for from one-half to one hour each day at the temperature indicated above, and during the resting stage between the heatings, kept at about 20° C. (68° F.).

This method is employed when the material to be sterilized is readily decomposed by heat, and it is recommended for the sterilization of solutions of organic salts, alkaloids, alkaloidal salts, and such other substances as are subject to decomposition by exposure to a higher temperature.

Filtration—This method, when suitable apparatus is used, affords one of the most practical and efficient processes for preparing sterilized solutions

A Berkefeld or Chamberland type of filter candle, which is made of stone or porcelain, is so arranged that the orifice projects from the bottom of a glass or metallic cylinder, a metallic bell being attached above and around the outlet. To hasten the operation, the jar may be arranged so that it can be closed and air pressure applied over the liquid to be filtered. Pressure may be applied by a rubber bulb or hand pump through a tube fitted with a stopcock. When the pressure has been applied the stopcock may be closed and the filtration allowed to proceed.

To use this apparatus it is supported on a tripod or retort stand, the metallic orifice and inside of the bell cover sterilized by the direct application of the Bunsen flame; the lip and cotton stopper of the sterilized vessel also flamed, the cotton plug removed and the bottle slipped over the outlet from the filter. The liquid to be sterilized is then poured into the jar, the pressure applied, and when all of the liquid has filtered into the bottle, the latter is closed with a sterilized stopper.

The more customary procedure, however, is to connect the outlet of the filter, by means of a tightly-fitting stopper, with a sterile, hard glass flask, having a side tube. A vacuum is then applied to the side tube to hasten the filtration. When the filtration is completed the air is admitted slowly through a wash bottle or through a good air filter to prevent contamination by the inrush of dust-ladened air.

If a large tube having a stopcock at the top is inverted over the filter candle in such a manner that the liquid may be drawn in at the bottom when the apparatus is filled, and the stopcock opened, the liquid will completely immerse the filter candle (see A Fig. 780). When the stopcock is closed and the filtration is allowed to proceed, the filter candle will remain completely immersed until practically all the solution is filtered. Otherwise, if the filter jar is not full, the efficiency of the filter candle is materially reduced.

When filtering solutions of mercury salts, etc., which are injured by contact with metal, the vacuum system is especially to be recommended and the metal parts of the filter should be dipped in melted paraffin so that they may be covered with a thin coating of paraffin. A Berkefeld filter without metal parts may also be used. The Berkefeld filtering apparatus should be taken apart after each operation and the candle filter thoroughly cleaned. This may be accomplished by forcing water through the filter from the inside outward and scrubbing gently with a stiff brush, after which it should be connected as for filtration and a quantity of distilled water allowed to pass through. After careful washing, the filter candle should be sterilized in an autoclave, or by heating at 100° C., in live steam or boiling water, during one hour. The candle should be frequently tested by placing the entire candle under water and forcing air through it by means of a rubber bulb or a pump. By this means a break or crack is easily detected. Types of filter candles and methods of using are shown in Figs. 774, 775, 780 and 787.

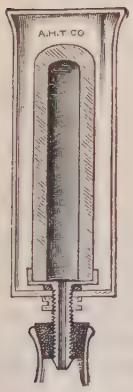
This device may be used, if the proper precautions are taken, for aqueous solutions such as gargles, eye washes, solutions of alkaloids, etc.

Extemporaneous Sterilization—It may become desirable, when time is not available or when substances are easily injured by heat, to prepare solutions or preparations which are approximately sterile. If this method is to be used it is essential that distilled water, the several sizes of bottles, funnels, filter paper, rubber stoppers, ointment vehicles, ointment jars, collapsible metal tubes, etc., be kept on hand in a sterile condition.

The operator may conduct the necessary manipulation within a large sheet iron oven, the door of which is open and the interior of which has been ster-

ilized with a Bunsen flame, or under a glass box which has been cleansed with alcohol and chloroform, or under a cloth canopy stretched on a wooden frame, the cloth immediately before use being moistened with five per cent phenol solution. All weighings and operations should be carried out under the protected area. Weighings should be made on glass scale pans which have been first cleansed with alcohol and afterwards with chloroform, or on metallic pans which have been sterilized in a Bunsen flame. If a spatula is to be used it should be treated with alcohol and chloroform or passed through the Bunsen flame several times.

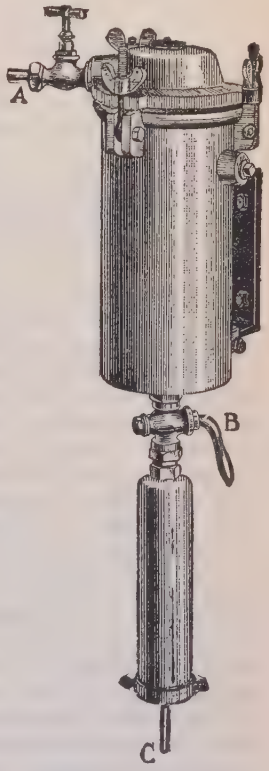
Fig. 774



Candle filter

If an aqueous solution is to be prepared, the material is weighed and transferred to a sterilized bottle, the mouth of which has been sterilized in the flame before removing the cotton plug, the sterilized water is then added and the bottle stoppered with a sterilized stopper. Chemical salts and other substances which are likely to be used for making sterile preparations by this method should be procured especially for this work, and should be carefully protected from dust and other contamination. If a solution requires filtration, this can be done in the protected area, using a sterilized funnel and sterilized cotton or filter paper, which has been thoroughly washed with alcohol. Ointments, powders, etc., may be mixed within the protected space, using sterilized materials, apparatus, and containers. It must be remembered that this operation results in only approximate sterility, and that freedom from dust in the room, personal cleanliness of the operator, and the most scrupulous care throughout are required for satisfactory results.

Fig. 775



Filtering under pressure

This process is the one used in the preparation of Salvarsan or "606".

Emulsions in Glycerin or Oil—Approximately sterile solutions or emulsions in glycerin or oil may be prepared in the following manner: Heat glycerin or oil in flasks of thin glass containing not over 50 cc. each, for two hours at from 120° to 130° C. (248° to 266° F.) in a dry air sterilizer, then introduce the sterile or approximately sterile medicinal substances after the liquid has cooled. The desired medicament may be incorporated by triturating it with a sterilized pestle in a mortar containing the previously sterilized medium (glycerin or oil) and the solution or emulsion should then be quickly transferred to a sterilized glass container.

Sterilization by Means of Chemical Agents—For the purpose of assisting in sterilization or of protecting substances from subsequent contamination, chemical agents are sometimes employed.

Dependence solely upon chemical germicides demands larger proportions of these than are usually allowable; hence they should be used as adjuncts only, and generally in quantities insufficient to insure sterility in themselves.

When chemical agents are employed, the usual precautions should be

observed as to cleansing and sterilizing bottles, graduates, stoppers, etc., and in so far as possible without injury, the substance itself should be sterilized or pasteurized by heat. The chemical agents should be only used to assist in the processes and to hinder subsequent contamination.

This method is frequently used for:

1. The disinfection of the hands and the table before the preparation of a sterile solution.

2. For the disinfection of scale pans and spatula, etc., alcohol, ether, or chloroform chiefly being used for this purpose; but sterilization by heat is better.

3. To sterilize large glass vessels that cannot easily be subjected to heat—such as carboys, large bell jars, etc.

4. To maintain in a sterile condition various agents such as antitoxins, bacterial vaccines, etc.

For the preservation of antitoxins and bacterial vaccines, phenol or cresol is used, the former in the proportion of 0.5 per cent, the latter from 0.25 per cent to 0.4 per cent. Cresol is from two and a half to three times as strongly germicidal as phenol and no more poisonous. While other chemical germicides may be used, these have been preferred because they are uniform and relatively non-toxic.

It is impossible to set definite limits which will fit all cases for the amounts of the chemical agents which may be employed, because the composition of the substance and its degree of contamination are important factors in sterilization.

Solutions of salts, practically free from organic matter, are easily sterilized, while solutions which contain appreciable, though small, amounts of organic substances may be difficult to sterilize.

Mineral acids, while objectionable as disinfectants in pharmaceutical preparations, inhibit the development of germs in very weak solutions, and acid solutions sterilize more easily than do neutral or slightly alkaline solutions.

Iodine is one of the most effective of disinfectants, and preparations containing free iodine in material proportions become sterile of themselves. The same is true of solutions containing chlorine or hypochlorites, or bromine. The chlorides, bromides, and iodides in general have only very feeble disinfecting power, but the soluble fluorides are active.

Chlorine and the hypochlorites, also bromine, have long been used as disinfectants, but because of their irritant properties their use was restricted. Now, however, various non-irritant chlorine compounds are being largely used in surgery, in the treatment of wounds, and in water sterilization (see pages 547 and 570).

The salts of mercury and of silver are active germicides and are among the most important disinfectants for physiological use, but they have specific actions which limit, or may prohibit, their addition to pharmaceuticals for antiseptic or disinfectant purposes. Salts of copper are powerful fungicides, but are feeble antiseptics. Other neutral salts are feebly antiseptic and not generally of value for this purpose.

Peroxides, when under conditions in which they liberate nascent oxygen, may sterilize, but are useful only in proportion to their own decomposition. Similar powers are attributed to persulphates and permanganates, which act by liberating nascent oxygen, and which require an intimate contact with the substance to be sterilized to be effective.

Of the organic bodies, alcohol stands first in pharmacy as a preservative. Alcohol, when present to the extent of from 20 to 40 per cent by volume, is an

efficient antiseptic. Solutions containing from 40 to 80 per cent are actively disinfectant, the latter strength being most efficient. Above 80 per cent its efficiency tends to diminish, and stronger alcohol may preserve without killing the microörganisms.

Formaldehyde is one of the most efficient of disinfectants (see page 1866), and is antiseptic in very small proportions, but may be objectionable for pharmaceutical preparations.

Chloroform and bromoform are both active germicides in aqueous solutions while iodoform is employed medicinally for this one purpose. Thymol iodide is another instance of like character.

Phenol is perhaps the most common of disinfectants, and with cresol is the substance most frequently used in hypodermatic and epidermatic medicaments. These have the advantage of combining activity with stability. Other phenolic compounds, as resorcinol, thymol, betanaphthol, phenyl salicylate (salol), etc., are useful agents and are frequently used in medication for their antiseptic qualities.

Chlorbutanol (see page 861) is also used for the preservation of some solutions intended for hypodermic injection and has the added advantage of its local anesthetic action.

A number of the volatile oils, as anise, clove, cinnamon, pine, gaultheria, etc., possess appreciable value as antiseptics, and, while used mainly as flavors, are also employed for their antiseptic actions. Benzoic and salicylic acids are often preferred for internal administration. They are efficient as antiseptics, but are feeble as disinfectants. In foods benzoic acid is limited, by food commissioners, to one part per thousand, which is not sufficient for sterilization, but which inhibits the development of most germs.

If the responsibility is thrown upon the pharmacist, the first consideration should be the character of the substance to be sterilized, the presence of antiseptic ingredients, whether active or feeble, being considered, and the action of heat upon them. Heat sterilization should always receive first consideration.

If pasteurization only is allowable, the use of 0.5 per cent to 1 per cent of phenol will aid materially in insuring sterility, since all germicides are much more efficient at high than at low temperatures. Cresol, in 0.1 to 0.4 per cent solution, is also frequently used. These proportions may not be sufficient in themselves to produce sterility, but they are aids in securing and maintaining this condition, and are usually preferred in preparations for hypodermatic and epidermatic medication.

For sterilizing medicinal substances for internal administration hydrogen dioxide, sulphurous, salicylic or benzoic acid should be first considered. One part per thousand is the common limit for these, excepting hydrogen dioxide. The latter is often efficient in very small proportions (one in ten thousand), but is slow in action and of little value in mixtures or for preserving preparations used intermittently. It has the advantage of not seriously disturbing digestion.

The use of chemical disinfectants or antiseptics and the problems of sterilization call for judgment and some knowledge of the principles involved. No definite procedure can be recommended which will fit all cases. Success in sterilization must depend, as in other things, upon an intelligent application of principles rather than upon a literal following of arbitrary rules.

The use of the ultraviolet ray for the sterilization of water is also employed in large laboratories and hospitals. The water is passed through a special apparatus where it is exposed to the ultraviolet ray, which causes the destruc-

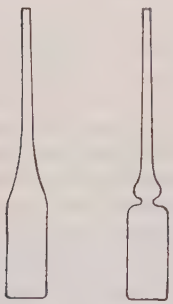
tion of all bacteria. An apparatus carrying one 110-volt lamp is capable of sterilizing 150 gallons of water per hour.

Pasteurizing Milk—When milk is heated at low temperatures (between 50° and 80° C. or 122° and 176° F.) for from twenty to thirty minutes, most of the bacteria are destroyed without altering the nutritive quality of the milk. In many communities pasteurized milk may be obtained from milk dealers, but it may be readily prepared in the home by placing the milk in suitable bottles, usually the regular, round milk bottles used for infant feeding, holding from six to twelve fluidounces, stoppering them with absorbent cotton, placing them in a frame holding six or more bottles and this in a kettle of water. The water and milk are then heated to the desired temperature, usually between 65° and 70° C. (149° to 158° F.), then allowed to stand, without further heating, for from twenty to thirty minutes, and afterwards quickly cooled. The milk should be kept in the bottles in which it was pasteurized, preferably on ice, until used.

STERILE SOLUTIONS

The use of sterilized medicinal solutions or suspensions, usually intended for hypodermic injection, either subcutaneously, intramuscularly, or intravenously, has become very popular in recent years and the number of medici-

Fig. 776



Varieties of ampuls

Fig. 777

Ampul vial

Fig. 778

Bulk container for sterile liquids

nal preparations prepared in this manner is constantly increasing. The popularity of this form of medication is due largely to its convenience to the busy practitioner, the ease with which sterile products may be preserved and handled, and the advantages obtained with minimum dosage and rapidity of action without impairing the patient's digestive mechanism and without the digestive secretions impairing the action of the medicament.

These solutions are prepared for dispensing in hermetically sealed containers of several types as follows:

Ampuls—This is a term applied to small, flask-shaped glass containers (see Fig. 776), which after filling, are sealed by melting the glass at the tip until it fuses. The name is derived from the Latin *Ampulla* meaning flask.

Ampul Vials—These are small vials (see Fig. 777) usually made from glass tubing and sealed with a rubber stopper which may be punctured with the needle of a hypodermic syringe when it is desired to withdraw the solution.

Bulk Containers are vials or bottles (see Fig. 778) made of the same high quality of glass as ampuls or ampul vials and are closed with a puncturable

rubber diaphram which is preferably held in place by a metal cap either screwed or crimped on. With the latter container, the physician may withdraw a number of doses, for testing the patient's tolerance to the drug and for graduating the dose according to their susceptibility, without the loss of material.

Selecting the Empty Ampuls—The first consideration is the containers. While these may be made by the pharmacist, when sufficiently skilled, from glass tubing, the better plan is to buy them from regular glass blowers. The kind of glass from which they are made is, however, of great importance. Common flint or bottle glass, or even the usual glass for chemical apparatus, is too soluble and alkaline for many substances. They should be made of a colorless, so-called "hard" or "non-soluble" glass. The ordinary amber glass is not well suited as it is exceptionally soluble, but a tinted glass has been produced which is non-soluble and also excludes the more powerful light rays. If protection from light is required, this may be secured by enclosing the filled ampuls in suitable boxes.

The glass used for ampuls should pass the following test for solubility and reaction prescribed by the N.F. V. Dissolve 0.005 Gm. of phenolphthalein in 0.5 cc. of neutral alcohol and mix this solution with 100 cc. of distilled water. Fill the ampuls to be tested with this solution, seal them, and then immerse them in live steam or boiling water for six hours. After cooling, the content of the ampuls must show no pink color and no loose scales or flakes of glass.

Fig. 779

Filling ampuls

Ampuls may be cleansed and sterilized as follows: A piece of rubber tubing is fitted to a large-bore hypodermic needle and is securely tied on. The other end of the tubing is fitted to the spigot of a hydrant and water is run into the ampuls by introducing the needle into them and allowing the water to run freely until the ampul is thoroughly cleansed. The ampul is emptied by the use of an atomizer bulb which is connected to another hypodermic needle by means of which the water is sucked or blown out of the ampul.

The washing of ampuls with a dilute acid solution (0.3 per cent hydrochloric acid) and then thoroughly washing with distilled water until all traces of the acid are removed, has a tendency to neutralize the alkalinity of the glass and prevent precipitations which might otherwise occur in the ampul.

The ampuls are then placed in wire baskets and sterilized by heating in an oven for one hour at a temperature of 180° C. (356° F.) after which they are carefully protected from contamination until filled and sealed.

Filling Ampuls—Many ingenious devices have been offered for filling ampuls. One general plan calls for the inversion of fifty or more empty sterile ampuls in a sterilized jar, the pouring on top of them of just sufficient of the sterile solution to fill the ampuls, then the creation of a vacuum in the jar and ampuls by means of a suction pump, followed by the slow admission of air through a cotton filter. The air pressure forces the solution into the ampuls, which may then be quickly sealed.

Another plan is illustrated in Fig. 779. Here the solution is sterilized by filtration through a candle filter located at the top of the apparatus, and is received in the sterilized glass reservoir below. By turning the stopcock the amount for each ampul may be measured in the graduated cylinder on the side and by another turn of the stopcock the liquid is delivered into the ampul

below, which is subsequently sealed. This apparatus is expensive, difficult to sterilize, and very slow in operation. Machines are being automatically operated on a large scale whereby sterile ampuls are filled, individually, as each passes a certain point on the outer edge of a revolving disk. At this point a syringe, similar to a hypodermic syringe, delivers the measured volume of sterile solution inside the ampul. As the disk revolves another empty ampul moves into position for filling, while the filled ampul is sealed, then removed, and its place taken by a fresh, empty ampul. The pharmacist, however, is not likely to equip himself with elaborate apparatus for doing this work, especially when a burette having a glass stopcock and with a large bore hypodermic needle attached to the lower orifice by means of a piece of rubber tubing will be found very satisfactory for filling ampuls. Having sterilized the empty ampuls, the burette, and the solution or suspension, and set up the apparatus in a protected area where it is not likely to be contaminated by falling or floating dust the ampuls may be readily filled. The needle should be plunged inside the ampul to a point below the neck, so that the air may escape and the neck remain dry for sealing. For viscous solutions a hypodermic syringe, preferably of veterinary size with a barrel, may be employed in the same manner. When filled, the ampul is sealed by holding it in a Bunsen burner at an angle, so that the contents do not run into the neck of the flask, and slowly rotating it continuously, so that as the glass melts it tends to turn inward, sealing the neck with a bead of glass. If available, a blast lamp is to be preferred for the sealing, as non-soluble glass melts slowly in the Bunsen flame. In whatever manner it has been filled, it is best to sterilize the sealed ampul again to insure a perfect product.

Many of the devices offered for filling ampuls have been found upon application to be impractical, due either to the fact that they are expensive, slow in operation, difficult to clean, difficult to sterilize, or that with their use it is difficult if not impossible to prevent contamination. The apparatus described below has been designed by Gilbert L. Harvey, after using a number of these devices and has been found to be practicable.

The use of this apparatus is as follows: After cleansing the hard glass, receiving bottle, it is rinsed with dilute hydrochloric acid (0.3 per cent) and then thoroughly with distilled water. The neck is fitted with a rubber stopper having two perforations of suitable size. Through one opening is forced a glass tube reaching to the bottom of the bottle and through the other is forced a bent glass tube reaching just through the stopper (see Fig. 780). To the top of the long tube is fitted a piece of rubber tubing two or three inches long which has been heated in an autoclave and then thoroughly washed with dilute ammonia water to remove the "bloom", and afterwards with dilute acid and distilled water. The end of the long glass tube is carefully wrapped in gauze and to the end of the bent glass tube is attached an air filter D. The receiving bottle is then sterilized in an autoclave.

The air filter, just referred to, may be constructed by packing a glass tube of from 6 to 8 inches in length and 1 inch in diameter, with gauze and inserting perforated rubber stoppers in both ends. Small glass tubes are forced through the openings in both stoppers.

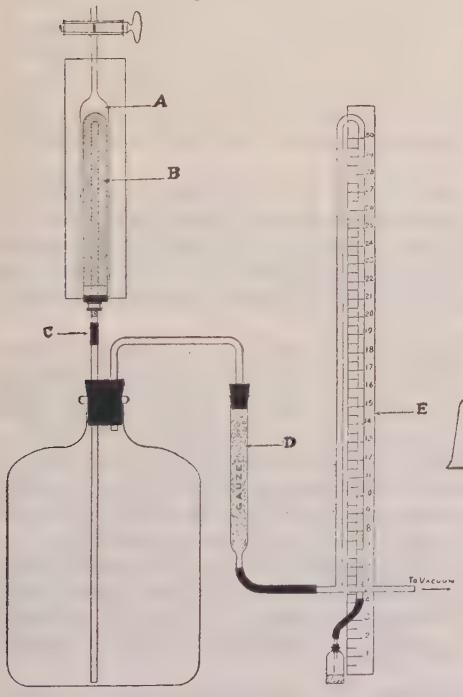
When ready for use, the gauze wrapping on the long tube is first "flamed" to destroy bacteria which may have lodged there, and then removed and the rubber tubing connected to the orifice of a previously sterilized, Berkefeld-type filter, care being used to prevent contamination.

The solution is then filtered into this receiver. If the vacuum method of filtration is used, a vacuum pump is connected to the end of the air filter.

When filtration is completed, the vacuum is broken by permitting the air to slowly enter the receiver through the air filter. The receiver is now carefully disconnected from the filter and connected to the previously sterilized filling attachment, the parts being quickly "flamed" and care being used to prevent contamination in so doing.

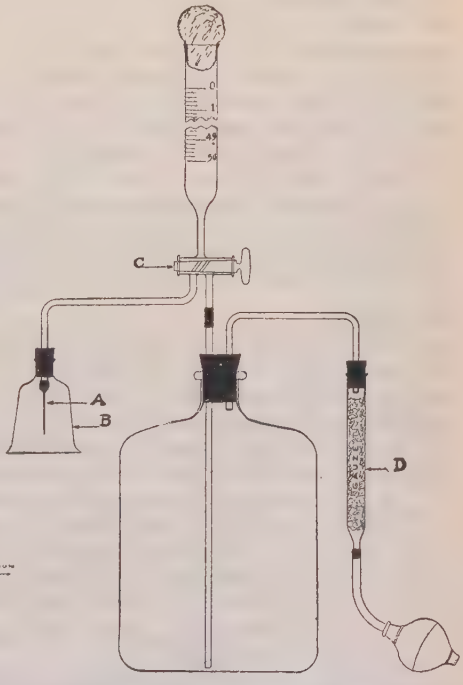
The filling attachment consists of a graduated burette with a two-way stopcock. The tube used for the inlet is left straight and the tube used for the outlet is bent at right angles, first outward, and then downward. A glass bell is fastened to the outlet tube by means of a rubber stopper to prevent dust or microörganisms from falling into the containers while filling. For

FIG. 780



Apparatus for sterilizing solutions by passing them through a Berkefeld-type filter. A–Tube over filter candle. B–Filter candle. C–Rubber tube connection. D–Air filter. E–Vacuum gauge.

FIG. 781



Apparatus for filtering sterile solutions. A–Filling needle. B–Glass protecting bell. C–Two-way stopcock. D–Air filter.

filling ampuls a large hypodermic needle or capillary glass tube is attached to the glass tube under the bell by means of a short piece of rubber tubing treated as previously described (see page 1792).

A rubber atomizer bulb is attached to the air filter and the apparatus is now ready to use. By turning the stopcock to the proper position the liquid is made to rise in the burette by pressure on the atomizer bulb. By giving the stopcock a half turn the solution will then flow out of the burette into the sterile containers. To the top of the burette is attached an air filter to prevent contamination as air flows in to replace the liquid flowing out.

Before using, the filling attachment is carefully wrapped in gauze and sterilized in an autoclave.

This apparatus can be easily assembled, readily cleaned, and sterilized.

The solution can be received in a large sterile container and the receiver is connected with the filling device by means of but one connection. The possibility of contamination is therefore reduced to a minimum. The expense of the apparatus is low and the speed with which ampuls may be filled is, of course, dependent upon the skill of the operator.

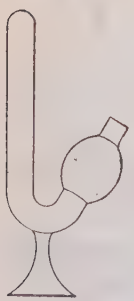
Sterilizing Ampuls—The method to be followed in sterilizing the empty glass ampuls has already been given. Delicate glass apparatus, used in filling ampuls, must be sterilized with great care, especially avoiding sudden changes of temperature. It must be heated and cooled slowly, whether sterilized in an autoclave or with dry heat. It is not possible to outline specific directions for sterilizing the solutions to be filled into ampuls, as they must be given individual consideration. Some substances are not injured by even the heat of the dry air sterilizer, while others are destroyed by 100° C. (212° F.) and therefore must be pasteurized. Often the alkalinity of the glass used for making ampuls is a contributing factor in decomposition. Substances, reported sensitive to heat, may often be successfully sterilized at the higher temperatures if contained in non-soluble glass when, under the influence of alkalies from soluble glass, they would have been quickly destroyed.

When ampuls have been filled and sealed for the final sterilization, if the autoclave temperature and pressure are permissible, that is always preferred and may be easily secured for the pharmacist by heating the sealed ampuls for fifteen minutes in a concentrated solution of calcium chloride to 121° C. (249.8° F.), thus providing the usual autoclave conditions within the ampuls.

The filled, sealed, and sterilized ampuls, may be tested for imperfect sealing and small fractures by warming in a dilute methylene blue solution. The air in the imperfect ampul is forced out on warming and as they cool, the blue solution is sucked into the ampul and the imperfect ampuls readily detected.

In cases of low temperature sterilization, or of solutions which are especially difficult to sterilize, or for extemporaneous dispensing, an antiseptic agent, such as cresol (0.1 to 0.4 per cent), or phenol (0.3 to 1.0 per cent), or other suitable germicide may be added to insure sterility.

Fig. 782



Fermentation tube

When a germ-proof filter is employed the heat-sterilization process may be omitted provided the filter has been tested, and proved to be free from leakage or defects, and to be actually germ-proof, and the operation conducted under aseptic conditions.

Sterility Testing—After the final sterilization of the ampuls, especially those solutions which are sterilized by pasteurization or filtration, they should be tested for sterility by "planting" a portion of the solution from several ampuls in a culture medium. This should consist of broth to which salt and peptones have been added. Prepare a culture medium as described on page 1576, under Lactose, Litmus, Agar-agar, omitting the agar, and adjusting to a slight alkaline reaction.

This solution is filled into fermentation tubes, see Fig. 782, and sterilized by the discontinuous method. One or two cc. of the solution to be tested should be added to each tube and they should be incubated at body temperature (37½° C.) for seven days. Control tubes containing the broth, but none of the solution being tested, should also be incubated at the same time.

At the end of seven days, the solution in the tubes containing the "plants" should be perfectly clear, should show no signs of gas in the closed end of

the tube, and in every way should be identical with the liquid in the control tubes.

The U. S. P. X requires the following solutions to be sterilized.

AQUA DESTILLATA STERILISATA. U. S. Sterilized Distilled Water

[Aq. Dest. Steril.]

Water, freshly distilled, a sufficient quantity.

Place freshly distilled water, neutral to litmus paper, in sterilized containers of insoluble glass, having a capacity of not over 1000 cc. each. Stopper the containers with plugs of purified absorbent cotton, wrapped in gauze. Fasten stout, non-absorbent paper or tinfoil over the top of the plug and the lip of the flask, and sterilize in an autoclave, under steam pressure giving a temperature of 115° C., for thirty minutes.

If an autoclave is not available, close the mouth of the flask containing the freshly distilled water with a plug of purified absorbent cotton wrapped in gauze, boil the contents actively for one hour and allow the water to cool without removing the cotton plug. Until ready for use, protect the mouth of the flask and the plug from infection through dust by wrapping the top of the flask tightly with paper.

Sterilized Distilled Water should be used within twenty-four hours after its distillation if it is to be employed for intravenous injection. For other uses, it is preferable that the Water be resterilized after each opening and that it be used within a month after its preparation.

It is necessary to carry out the details of this process with great exactness, if the product is to be satisfactory. Freshly distilled water is directed because water is likely to contain many microörganisms even a few hours after distillation and these, even if afterwards destroyed in the sterilization process, render the water unfit for use as they consist of foreign protein and practically make a "bacterin" of the water, which if injected intravenously, may cause notable systemic disturbance.

A "hard" or so-called "non-soluble" glass flask is directed, as the ordinary glass flask is slightly soluble in boiling water and would partially dissolve. Under these conditions the sterilized water, when cold, would contain numerous crystals of silicates and the water could not be used as a solvent for hypodermic or intravenous injections.

N. F. Preparations—Ampullæ; Liquor Procainæ Hydrochloridi.

LIQUOR SODII CHLORIDI PHYSIOLOGICUS. U. S. Physiological Solution of Sodium Chloride

[Liq. Sod. Chlor. Physio.—Physiological Salt Solution, Normal Salt Solution]

	Metric	Alternative
Sodium Chloride	8.5 Gm.	124 gr.
Distilled Water, a sufficient quantity,		
To make	1000 cc.	2 pints

Dissolve the sodium chloride in sufficient freshly distilled water, neutral to litmus paper, to measure 1000 cc., and filter, returning the filtrate until free from foreign particles. Transfer the solution to a sterile flask of insoluble glass, having a capacity of about 1000 cc., and stopper with a plug of purified absorbent cotton, wrapped in gauze. Fasten stout, non-absorbent paper or tin foil over the top of the plug and the lip of the container, and sterilize in an autoclave under steam pressure maintaining a temperature of 115° C., for thirty minutes.

This solution should be used within twenty-four hours if it is to be employed for intravenous injection. For other uses it is preferable that the solution be resterilized after each opening, and that it be used within a month after its preparation.

This preparation must be made with great caution, observing the directions exactly, since it is frequently used for intravenous or subcutaneous injection and also in surgical operations, and its sterility is important. The water is required to be freshly distilled, since distilled water, even after standing for a few days, is likely to be contaminated with microörganisms and, although these are destroyed by the process of sterilization, the toxins remain and cause disturbances when injected. A hard glass flask should also be used or the solution will contain soluble silicates which may separate in needle-like crystals on cooling.

The N. F. V has listed the following sterile solutions under the heading *Ampulla* (ampuls):

AMPULLÆ CAFFEINÆ SODIO-BENZOATIS. N. F. Ampuls of Caffeine Sodio-Benzoate

[Ampul. Caff. Sod.-Benz.]

A sterile aqueous solution of caffeine sodio-benzoate containing 0.25 Gm. in each cc.

	Metric	Alternative
Caffeine Sodio-Benzoate	**55 Gm.**	1 oz. av. 411 gr.
Sterilized Distilled Water, a sufficient quantity To make	**220 cc.**	7 fl. oz. 210 min.
To fill about	**100 ampuls**	

Dissolve the caffeine sodio-benzoate in sufficient sterilized distilled water to make 220 cc. [7 fl. oz. 210 min.] of solution and filter. Fill into ampuls and sterilize at 60° C.

NOTE—0.1 per cent of cresol or 0.25 per cent of phenol may be added to this solution for extemporaneous preparation.

Average dose—1 ampul.

AMPULLÆ CAMPHORÆ. N.F. Ampuls of Camphor

A sterile solution of camphor in cottonseed oil containing 0.2 Gm. of camphor in each cc.

	Metric	Alternative
Camphor	**22.0 Gm.**	340 gr.
Cottonseed Oil, containing not more than 1 per cent of free fatty acid, a sufficient quantity, To make	**110 cc.**	3 fl. oz. 345 min.
To fill about	**100 ampuls**	

Sterilize about 110 cc. [3 fl. oz. 345 min.] of the cottonseed oil by heating to 120° C., for one hour in a suitable flask, and cool to or below 60° C. Dissolve the camphor in sufficient of this sterilized oil to make 110 cc. [3 fl. oz. 345 min.] of solution, and filter. Fill into double-end ampuls and sterilize by heat at 100° C.

Average dose—1 ampul.

AMPULLÆ EMETINÆ HYDROCHLORIDI. N. F. Ampuls of Emetine Hydrochloride

[Ampul. Emet. Hydrochl.]

A sterile solution of emetine hydrochloride in physiological salt solution containing 0.03 Gm. in each cc.

	Metric	Alternative
Emetine Hydrochloride	**3.3 Gm.**	51 gr.
Physiological Solution of Sodium Chloride, a sufficient quantity, To make	**110 cc.**	3 fl. oz. 345 min.
To fill about	**100 ampuls**	

Dissolve the emetine hydrochloride in sufficient physiological salt solution to make 110 cc. [3 fl. oz. 345 min.] of solution. Titrate 5 cc. of the solution with tenth-normal potassium hydroxide, using phenolphthalein as indicator, and adjust by the addition of normal hydrochloric acid or of sodium bicarbonate so that each cubic centimeter of solution will show 0.01 per cent of free hydrochloric acid. Filter, fill into ampuls, and sterilize by heat at 100° C.

Average dose—1 ampul.

AMPULLÆ IODI. N. F. Ampuls of Iodine

[Ampul. Iodi—IODINE SWABS]

	Metric	Alternative
Iodine	**35 Gm.**	1 oz. av. 74 gr.
Potassium Iodide	**25 Gm.**	365 gr.
Distilled Water	**300 cc.**	9 fl. oz. 288 min.
Alcohol, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Dissolve the potassium iodide in the distilled water, add the iodine and about 650 cc. [22 fl. oz.] of alcohol. Agitate the mixture until the iodine is completely dissolved, then add sufficient alcohol to make the product measure 1000 cc. [2 pints].

Fill the liquid into ampuls of any desired size.

When dispensed with a pledget of absorbent cotton or gauze, for convenient application of the iodine solution to the skin, these are known as Iodine Swabs.

AMPULLÆ QUININÆ ET UREÆ HYDROCHLORIDI. N. F. Ampuls of Quinine and Urea Hydrochloride

[Ampul. Quin. et Urea Hydrochl.]

A sterile aqueous solution of quinine and urea hydrochloride containing 0.5 Gm. in each cc.

	Metric	Alternative
Quinine and Urea Hydrochloride	**55 Gm.**	1 oz. av. 411 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**110 cc.**	3 fl. oz. 345 min.
To fill about	**100 ampuls**	

Dissolve the quinine and urea hydrochloride in sufficient sterilized distilled water to make 110 cc. [3 fl. oz. 345 min.] of solution and filter. Fill into ampuls and sterilize by heat at 60° C.

Average dose—1 ampul.

AMPULLÆ QUININÆ DIHYDROCHLORIDI. N. F. Ampuls of Quinine Dihydrochloride

[Ampul. Quin. Dihydrochl.]

A sterile aqueous solution of quinine dihydrochloride containing 0.5 Gm. in each cc.

	Metric	Alternative
Quinine Dihydrochloride	**55 Gm.**	1 oz. av. 411 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**110 cc.**	3 fl. oz. 345 min.
To fill about	**100 ampuls**	

Dissolve the quinine dihydrochloride in sufficient sterilized distilled water to make 110 cc. [3 fl. oz. 345 min.] of solution. Titrate 1 cc. of this solution with tenth-normal potassium hydroxide solution, using phenolphthalein as indicator, and adjust the remaining solution by the addition of hydrochloric acid or of sodium bicarbonate so that each cubic centimeter will require 12.6 cc. of tenth-normal potassium hydroxide solution to produce a pink color with phenolphthalein. Then filter, fill into ampuls, and sterilize by heat at 100° C.

Average dose—1 ampul.

AMPULLÆ SODII CACODYLATIS. N. F. Ampuls of Sodium Cacodylate [Ampul. Sod. Cacodyl.]

A sterile aqueous solution of sodium cacodylate containing 0.3 Gm. in each cc.

	Metric	Alternative
Sodium Cacodylate	**33 Gm.**	1 oz. av. 72 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**110 cc.**	3 fl. oz. 345 min.
To fill about	**100 ampuls**	

Dissolve the sodium cacodylate in sufficient sterilized distilled water to make 110 cc. [3 fl. oz. 345 min.] of solution. To 5 cc. of this solution add 0.5 cc. of phenolphthalein T.S. and note the reaction. Then add to the solution if needed, sufficient hydrochloric acid or sodium carbonate to produce a slight pink, but not a deep color in the above test. Filter the solution, fill into ampuls and sterilize by heat at 100° C.

NOTE—For extemporaneous preparation 0.1 per cent of cresol or 0.25 per cent of phenol may be added to this solution.

Average dose—1 ampul.

Unofficial Sterile Solutions

In addition to the sterile solutions listed officially in the U. S. P. X and the N. F. V there are a large number of commercial preparations which, though they are unofficial have an extensive sale, and formulas for some of these are supplied with Type Processes for their preparation.

Type Process A—*General directions for preparing sterile solutions of substances which may be sterilized in an autoclave.*

Dissolve the salt or salts in sterilized distilled water (see page 1795), or in physiological solution of sodium chloride (see page 1795) in a flask of hard glass, making up to the exact volume specified. Filter the solution through a hard, Whatman filter (No. 50 preferred), in a Buchner funnel, using a vacuum pump (see pages 206 and 207) to hasten filtration, and filtering into a flask or bottle of hard glass. Return the filtrate if necessary until free from all foreign particles. Fill the solution into sterile containers of hard glass, *under aseptic conditions*, and immediately seal. Finally sterilize the filled and sealed containers by heating them in an autoclave at 15 pounds' pressure (121° C.) for twenty minutes. (See sterilization by steam under pressure, page 1783.)

Type Process B—*General directions for preparing sterile solutions of substances which may be sterilized at 100° C. in an Arnold sterilizer.*

Proceed exactly as directed under "A", (see above) except in the sterilization, where the filled and sealed containers are to be sterilized in an Arnold sterilizer, for one hour after the temperature has reached 100° C. (See sterilization by moist heat at 100° C. (212° F.) page 1782.)

Type Process C—*General directions for preparing sterile solutions of substances to be rendered sterile without the use of heat but by filtration through a Berkefeld-type filter.*

Dissolve the salt or salts in sterilized distilled water (see page 1795), or in physiological solution of sodium chloride (see page 1795), as directed, in a flask of hard glass, making up the exact volume specified. Filter the solution through a Berkefeld-type filter (see page 1787), which has been sterilized by boiling for one hour, or in an autoclave, and collect the solution in a sterile bottle or flask of hard glass. It is desirable to use a vacuum pump to facilitate filtration (see pages 206 and 207). Fill the solution into sterile containers, *under aseptic conditions*, and immediately seal. (See sterilization by filtration, page 1785.)

STERILE SOLUTION OF ATROPINE SULPHATE

A sterile solution of atropine sulphate in physiological salt solution containing 0.00065 Gm. ($\frac{1}{100}$ grain) in each cc.

	Metric	Alternative
Atropine Sulphate	**0.065 Gm.**	1 gr.
Physiological Solution of Sodium Chloride, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution, and adjust to a slight acid reaction, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process C, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF CALCIUM CACODYLATE

A sterile aqueous solution of calcium cacodylate containing 0.05 Gm. ($\frac{3}{4}$ grain) in each cc.

	Metric	Alternative
Calcium Cacodylate	**5 Gm.**	77 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process A, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF CALCIUM CHLORIDE

A sterile aqueous solution of calcium chloride containing 0.05 Gm. (¾ grain) in each cc.

	Metric	Alternative
Calcium Chloride	**25 Gm.**	365 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**500 cc.**	1 pint

Prepare a solution, filter, sterilize, and fill into 5 cc., sterile containers as directed under Type Process A, page 1798.

Average dose—5 cc.

STERILE SOLUTION OF DEXTROSE (GLUCOSE)

(50 per cent Solution)

A sterile aqueous solution of dextrose containing 0.5 Gm. (7¾ grains) in each cc.

	Metric	Alternative
Dextrose, anhydrous	**500 Gm.**	16 oz. av. 300 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a solution, heating carefully, filter, sterilize, and fill into 50 cc., sterile containers as directed under Type Process C, page 1798.

Average dose—50 cc.

STERILE SOLUTION OF HEXAMETHYLENAMINE

A sterile aqueous solution of hexamethylenamine containing 0.3 Gm. (4⅝ grains) in each cc.

	Metric	Alternative
Hexamethylenamine	**150 Gm.**	5 oz. av.
Sterilized Distilled Water, a sufficient quantity,		
To make	**500 cc.**	1 pint

Prepare a solution, filter, sterilize, and fill into 5 cc., sterile containers as directed under Type Process A, page 1798.

Average dose—5 cc.

STERILE SOLUTION OF INDIGO CARMINE

(1 per cent Solution)

A sterile aqueous solution of indigo carmine containing 0.01 Gm. (⅙ grain) in each cc.

	Metric	Alternative
Indigo Carmine	**5 Gm.**	73 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**500 cc.**	1 pint

Prepare a solution, filter, sterilize, and fill into 1 cc. and 5 cc., sterile containers as directed under Type Process B, page 1798.

STERILE SOLUTION OF IRON ARSENITE (SOLUBLE)

A sterile aqueous solution of iron arsenite and ammonium citrate containing 0.065 Gm. (1 grain) in each cc.

	Metric	Alternative
Iron Arsenite and Ammoninm Citrate	**6.5 Gm.**	100 gr.
Quinine and Urea Hydrochloride	**1.0 Gm.**	15½ gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution by dissolving the iron arsenite and ammonium citrate and the quinine and urea hydrochloride separately and then pouring the solution of quinine and urea hydrochloride into the solution of iron arsenite and ammonium citrate while stirring rapidly. Neutralize carefully with ammonia water using litmus paper, leaving the solution slightly acid, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process B, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF IRON CACODYLATE

A sterile aqueous solution of iron cacodylate containing 0.032 Gm. (½ grain) in each cc.

	Metric	Alternative
Iron Cacodylate	**3.2 Gm.**	50 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution by adding the salt to boiling water and immediately cooling, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process A, page 1798.

Average dose—1 cc.

To prepare a sterile solution for intravenous injection, each cc. containing 0.013 Gm. ($\frac{1}{5}$ grain) of iron cacodylate, use 6.5 Gm. for 500 cc. of solution, filter, sterilize and fill into 5 cc., sterile containers by Type Process A, as directed on page 1798.

Average dose—5 cc.

NOTE—Some lots of iron cacodylate, while differing imperceptibly from others, so far as can be determined chemically, cause extreme irritation at the site of injection and also violent reactions. Each lot of salt should therefore be tested for irritation by injecting 0.2 cc. of a solution prepared as directed above into the arm of the operator. If more than a slight burning sensation is experienced, the salt should be rejected.

STERILE SOLUTION OF IRON CITRATE

A sterile aqueous solution of iron and ammonium citrate containing 0.065 Gm. (1 grain) in each cc.

	Metric	Alternative
Iron and Ammonium Citrate	**6.5 Gm.**	100 gr.
Quinine and Urea Hydrochloride	**1 Gm.**	15½ gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution by dissolving the iron and ammonium citrate and the quinine and urea hydrochloride separately and then pouring the solution of quinine and urea hydrochloride into the solution of iron and ammonium citrate while stirring rapidly. Neutralize carefully with ammonia water, using litmus paper, leaving a slightly acid reaction. Filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process B, page 1798.

Average dose—1 cc.

NOTE—To prepare a sterile solution, each cc. containing 0.050 Gm. (¾ grain) of iron and ammonium citrate, use 5 Gm. of iron and ammonium citrate and 1 Gm. of quinine and urea hydrochloride for 100 cc. of solution. Filter, sterilize, and fill into 1 cc., sterile containers as directed above.

Average dose—1 cc.

STERILE SOLUTION OF MAGNESIUM SULPHATE

A sterile aqueous solution of magnesium sulphate containing 0.5 Gm. (7¾ grain) in each cc.

	Metric	Alternative
Magnesium Sulphate	**100 Gm.**	3 oz. av. 231 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**200 cc.**	6 fl. oz. 366 min.

Prepare a solution, filter, sterilize, and fill into 2 cc., sterile containers as directed under Type Process A, page 1798.

Average dose—2 cc.

STERILE SOLUTION OF MERCURY CACODYLATE

A sterile aqueous solution of mercury cacodylate containing 0.032 Gm. (½ grain) in each cc.

	Metric	Alternative
Mercury Cacodylate	**3.2 Gm.**	50 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process C, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF MERCURY CYANIDE

A sterile solution of mercury cyanide in physiological salt solution containing 0.0013 Gm. ($\frac{1}{50}$ grain) in each cc.

	Metric	Alternative
Mercury Cyanide	**0.13 Gm.**	2 gr.
Physiological Solution of Sodium Chloride, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process B, page 1798.

Average dose—1 cc.

NOTE—To prepare a sterile solution, each cc. containing 0.005 Gm. ($\frac{1}{200}$ grain), use 0.5 Gm. of mercury cyanide for 100 cc. of solution. Filter, sterilize, and fill into 1 cc., sterile containers as directed above.

Average dose—1 cc.

STERILE SOLUTION OF MERCURY OXYCYANIDE

A sterile aqueous solution of mercury oxycyanide containing 0.0016 Gm. ($\frac{1}{625}$ grain) in each cc.

	Metric	Alternative
Mercury Oxycyanide	**0.8 Gm.**	11⅔ gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**500 cc.**	1 pint

Prepare a solution, filter, sterilize, and fill into 5 cc., sterile containers as directed under Type Process C, page 1798.

Average dose—5 cc.

STERILE SOLUTION OF MERCURY SALICYLATE

A sterile suspension of mercury salicylate containing 0.130 Gm. (2 grains) in each cc.

	Metric	Alternative
Mercury Salicylate	13 Gm.	200 gr.
Guaiacol	2 cc.	32 min.
Oil of Theobroma, a sufficient quantity,		
To make	100 cc.	3 fl. oz. 183 min.

Prepare a uniformly smooth mixture by triturating the ingredients in a warm glass mortar, sterilize for one hour in an Arnold sterilizer, and fill into 1 cc., sterile containers, under aseptic conditions, while warm, using a large sterile glass syringe, and shaking the mixture thoroughly just before filling each container.

Average dose—1 cc.

STERILE SOLUTION OF MERCURY SUCCINIMIDE

A sterile aqueous solution of mercury succinimide containing 0.010 Gm. (⅙ grain) in each cc.

	Metric	Alternative
Mercury Succinimide	1 Gm.	15½ gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	100 cc.	3 fl. oz. 183 min.

Prepare a solution, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process C, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF PROCAINE HYDROCHLORIDE

A sterile aqueous solution of procaine hydrochloride containing 0.02 Gm. (⅓ grain) in each cc.

	Metric	Alternative
Procaine Hydrochloride	2 Gm.	31 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	100 cc.	3 fl. oz. 183 min.

Prepare a solution, filter, sterilize, and fill into 1 cc. sterile containers as directed under Type Process A, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF RED MERCURIC IODIDE (BINIODIDE)

A sterile aqueous solution of mercury iodide containing 0.01 Gm. (⅙ grain) in each cc.

	Metric	Alternative
Mercuric Iodide, Red	1 Gm.	15½ gr.
Sodium Iodide	1 Gm.	15½ gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	100 cc.	3 fl. oz. 183 min.

Prepare a solution, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process C, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF SILVER NITRATE

A sterile aqueous solution of silver nitrate containing 0.01 Gm. (⅙ grain) in each cc.

	Metric	Alternative
Silver Nitrate	1 Gm.	15½ gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	100 cc.	3 fl. oz. 183 min.

Prepare a solution, neutralize, if necessary, with tenth-normal sodium hydroxide, and fill into 1 cc., dark-colored sterile containers, as directed under Type Process B, page 1798, except that the solution need not be sterilized. After finishing, the container should be kept in a carton as the solution is darkened by exposure to light.

STERILE SOLUTION OF SODIUM ARSENATE

A sterile aqueous solution of sodium arsenate containing 0.00026 Gm. ($\frac{1}{250}$ grain) in each cc.

	Metric	Alternative
Sodium Arsenate	0.065 Gm.	1 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	250 cc.	8 fl. oz. 218 min.

Prepare a solution, filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process B, page 1798.

Average dose—1 cc.

STERILE SOLUTION OF SODIUM BICARBONATE

A sterile aqueous solution of sodium bicarbonate containing 0.050 Gm. (¾ grain) in each cc.

	Metric	Alternative
Sodium Bicarbonate	**50 Gm.**	1 oz. av. 293 min.
Sterilized Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a solution, filter, sterilize, and fill into 20 cc., sterile containers as directed under Type Process A, page 1798.

Average dose—20 cc.

STERILE SOLUTION OF SODIUM CHLORIDE (CONCENTRATED)

A sterile aqueous solution of sodium chloride containing 0.085 Gm. ($1\frac{3}{10}$ grains) in each cc.

	Metric	Alternative
Sodium Chloride	**85 Gm.**	2 oz. av. 366 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a solution, filter, sterilize, and fill into 50 cc., sterile containers as directed under Type Process A, page 1798.

NOTE—50 cc. with 450 cc. of sterilized distilled water makes physiological solution of sodium chloride (normal salt solution).

STERILE SOLUTION OF SODIUM CITRATE
(For blood transfusion)

A sterile solution of sodium citrate in physiological solution of sodium chloride containing 0.01 Gm. (⅙ grain) in each cc.

	Metric	Alternative
Sodium Citrate	**10 Gm.**	146 gr.
Physiological Solution of Sodium Chloride, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a solution, filter, sterilize, and fill into 50 cc., sterile containers as directed under Type Process B, page 1798.

STERILE SOLUTION OF SODIUM IODIDE

A sterile aqueous solution of sodium iodide containing 0.1 Gm. (1½ grains) in each cc.

	Metric	Alternative
Sodium Iodide	**100 Gm.**	3 oz. av. 148 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a solution, add a small crystal of sodium thiosulphate, and adjust to a slightly alkaline reaction with normal sodium hydroxide. Filter, sterilize, and fill into 20 cc., sterile containers as directed under Type Process B, page 1798.

Average dose—20 cc.

STERILE SOLUTION OF SODIUM SALICYLATE

A sterile aqueous solution of sodium salicylate containing 0.2 Gm. (3 grains) in each cc.

	Metric	Alternative
Salicylic Acid, finest reagent grade	**43.13 Gm.**	1 oz. av. 192 gr.
Sodium Bicarbonate, finest reagent grade	**26.25 Gm.**	383 gr.
Sodium Citrate	**5 Gm.**	73 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**250 cc.**	8 fl. oz.

Dissolve the acid, sodium bicarbonate, and sodium citrate in 150 cc. of distilled water, in a flask of hard glass, with the aid of heat. Neutralize the solution carefully, using either sodium hydroxide solution or citric acid solution as may be required, and add sterilized distilled water to make exactly 250 cc. If preferred, and if obtainable, dissolve 50 Gm. of sodium salicylate, *free from phenol derivatives*, in sterilized distilled water to make 250 cc.

Filter, sterilize, and fill into 5 cc., sterile containers as directed under Type Process B, page 1798.

Average dose—5 cc.

STERILE SOLUTION OF SODIUM SALICYLATE AND SODIUM IODIDE WITH COLCHICINE

A sterile aqueous solution containing sodium salicylate 0.050 Gm. (¾ grain), sodium iodide 0.050 Gm. (¾ grain), and colchicine 0.000032 Gm. ($\frac{1}{2000}$ grain), in each cc.

	Metric	Alternative
Sodium Salicylate, free from phenol derivatives	**50 Gm.**	1 oz. av. 293 gr.
Sodium Iodide	**50 Gm.**	1 oz. av. 293 gr.
Colchicine	**0.032 Gm.**	½ gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**1000 cc**	2 pints

Prepare a solution, adding a small crystal of sodium thiosulphate, and adjust to a slightly alkaline reaction, with normal sodium hydroxide. Filter, sterilize, and fill into 20 cc., sterile containers as directed under Type Process B, page 1798.

If sodium salicylate, free from phenol derivatives is unobtainable, it may be replaced in this formula by using salicylic acid (finest reagent grade) 43.13 Gm. (1 oz. av. 192 gr.), sodium bicarbonate (finest reagent grade) 26.25 Gm. (405 grains), and sodium citrate 5 Gm. (77 grains).

Average dose—20 cc.

STERILE SOLUTION OF SODIUM THIOSULPHATE

A sterile aqueous solution of sodium thiosulphate containing 0.1 Gm. (1½ grains) in each cc.

	Metric	Alternative
Sodium Thiosulphate	**100 Gm.**	3 oz. av. 148 gr.
Sterilized Distilled Water, a sufficient quantity,		
To make	**1000 cc.**	2 pints

Prepare a solution, filter, sterilize, and fill into 10 cc., sterile containers as directed under Type Process C, page 1798.

Average dose—10 cc.

NOTE—To prepare a sterile solution, each cc. containing 0.5 Gm. (7¾ grains) of sodium thiosulphate, use 100 Gm. for 200 cc. of solution. Filter, sterilize, and fill into 2 cc., sterile containers as directed above.

STERILE SOLUTION OF STRYCHNINE SULPHATE

A sterile solution of strychnine sulphate in physiological salt solution containing 0.001 Gm. ($\frac{1}{65}$ grain) in each cc.

	Metric	Alternative
Strychnine Sulphate	**0.1 Gm.**	1½ gr.
Physiological Solution of Sodium Chloride, a sufficient quantity,		
To make	**100 cc.**	3 fl. oz. 183 min.

Prepare a solution, and adjust to a slightly acid reaction. Filter, sterilize, and fill into 1 cc., sterile containers as directed under Type Process A, page 1798.

Average dose—1 cc.

TYPICAL PRESCRIPTIONS

The following prescriptions are reproduced with several purposes in view: First, they place before the pharmacy student a rather comprehensive collection of modern prescriptions of many types, with which there should be familiarity. Secondly, they offer a basis for practice in prescription filling (see Part XVI) although it is strongly recommended that they be supplemented by prescriptions taken from the current files of drug stores in the vicinity of the college.

Thirdly, the prescriptions here given may suggest forms for prescribing approved therapeutic agents and may incidentally come to the attention of physicians. It is entirely within the province of the pharmacist, who has been able to develop the correct professional relationship with the physicians of his community, that he should at times suggest prescription forms. This opportunity may present itself during a friendly conversation or in a letter to physicians, or perhaps in a joint meeting of physicians and pharmacists. A publication of the American Medical Association, "The Pharmacopœia and the Physician", by Hatcher and Wilbert, and "Practical Materia Medica and Prescription Writing", by Oscar W. Bethea, which give typical prescriptions for various needs, are of special value in this connection.

Most of the prescriptions which follow were taken from the recent files of pharmacies in Philadelphia, Washington, and Detroit. They do not necessarily represent especially difficult prescriptions but rather the usual types received daily in a pharmacy. In a few instances, suggestions for filling have been added but in most cases the dispenser is given liberty to use his own knowledge of the physical or chemical characteristics of the several ingredients and their influence within the mixture, and then to proceed as his judgment suggests, a condition which pertains at the prescription counter of the pharmacy. These prescriptions are numbered in sequence, starting with a number of five figures. This large number has been used to give better training in dispensing, in the writing of labels and checking of figures.

32001

℞ For Mary Pierce

Hydrarg. Chlor. Corr.	gr.i
Fldext. Staphisag.	f℥i
Alcohol.	f℥i
Aq. Ros. q.s. ad	f℥iii

Misce.

Sig.—Poison—Apply as a wash.

White.

32002

℞ For Frank Rhodes

Sod. Salicyl.	℥iii
Aq. Ammon.	min.x
Liq. Ferr. et Ammon. Acet. q.s.	f℥iii

M.

Sig.—f℥i in water t.i.d.

Harris.

32003

℞ For M. R. Morgan

Pot. Chlorat.	℥ss
Acid. Hydrochl.	gtt.x
Tr. Ferr. Chlor.	gtt.lxxx
Tr. Aconit.	gtt.xii
Glycerin.	f℥ss
Aq. Font. q.s.	f℥ii

M.

Sig.—f℥i every three hours.

Britton.

Note—Introduce the powdered potassium chlorate into a clean, dry bottle. Add the hydrochloric acid, permit the reaction to continue for a few moments, add the tincture of ferric chloride, and the other ingredients; chlorine is developed, and some is dissolved.

32004

℞ For Baby Jones
Sol. Cupr. Sulph. (1 per cent) f℥iv
M.
Sig.—Use locally in mouth three times a day.
Reilly.

32005

℞ For Thos. J. Harris
Quin. Sulph. gr. lxxv
Acid. Hydrochl. Dil. min. lxxv
Elix. Arom. q.s. f℥iii
M. ft. sol.
Sig.—f℥i t.i.d.
Shaffer.

32006

℞ For A. C. Frazier
Caff. (Alkaloid)
Sod. Salicyl. āā ℥i
Aq. Cinnam. q.s. ad f℥iii
M. ft. sol.
Sig.—f℥i after meals.
Riggs.

32007

℞ For Mr. Barber
Fldext. Cinchon. f℥v
Tr. Cardam. Co.
Elix. Arom. āā f℥x
M.
Sig.—f℥i with water p.c.
Martin.

32008

℞ For John Owen
Fldext. Cinchon.
Tr. Gentian. Co. āā f℥ii
M.
Sig.—One teaspoonful before meals.
Slocum.

32009

℞ For W. C. Potter
Sod. Bicarb. gr. xc
Tr. Gentian. Co. f℥x
Aqua q.s. ad f℥iii
M.
Sig.—Two or three teaspoonfuls before meals.
Sloan.

32010

℞ For F. B. Wheeler
Pot. Chlorat. ℥ii
Phenol. gr. iv
Infus. Rhois Glab. q.s. ad f℥viii
M. ft. sol.
Sig.—Use as a gargle every two hours.
True.

32011

℞ For H. D. Jones
Alcohol.
Liq. Hydrog. Diox.
Liq. Antisept. āā f℥ii
M. ft. sol.
Sig.—f℥iii in one-third glass of water. Use as a gargle.
Carpenter.

32012

℞ For Miss Morgan
Ammon. Chlor. ℥vi
Tr. Opii. Camph. f℥vi
Syr. Pin. Alb. Co. q.s. f℥vi
M. ft. sol.
Sig.—f℥i every three hours.
Kelly.

32013

℞ For J. C. Schaffer
Guaiacol.
Glycerin. āā f℥i
M. ft. sol.
Sig.—Use as directed.
Rice.

32014

℞ For Miss Saunders
Sol. Arg.-Prot. Mit. (25 per cent) f℥iv
M.
Sig.—gtt.x in each nostril at night.
Goddard.

32015

℞ For M. F. Landis
Resorcin. ℥i
Acid. Salicyl. ℥ii
Ol. Ricin. f℥iv
Ol. Bergam. gtt.vi
Alcohol.: 50 per cent q.s. f℥vi
M. ft. mist.
Sig.—Apply to scalp twice daily.
Nelson.

32016

℞ For John Sterling
Ammon. Chlor. ℥iss
Ammon. Carb. ℥i
Codein. Sulph. gr.vss
Tr. Hyoscy. f℥iiss
Tr. Lobel. f℥iiiss
Fldext. Casc. Sagr. Arom. f℥iss
Syr. Prun. Virg. q.s. f℥iv
M.
Sig.—f℥i in water every three hours.
Baldwin.

32017

℞ For Frank C. Abbott
Ol. Ricin.
Tr. Canthar. āā f℥ii
Sp. Myrciæ f℥i
Alcohol. q.s. ad f℥vi
M.
Sig.—Apply locally to scalp.
Wood.

32018

℞ For Miss Kolb

Codein. Sulph.	gr. ii
Sod. Salicyl.	ʒiss
Sod. Cit.	ʒii
Syr. Ipecac.	fʒiss
Syr. Sarsap.	fʒi
Aq. Dest. q.s. ad	fʒiii

M.

Sig.—One teaspoonful in water every three hours.

Nelson.

32019

℞ For Grace Aaron

Tr. Canthar.	fʒii
Ammon. Carb.	ʒi
Sp. Myrciæ	fʒii
Aq. q.s. ad	fʒvi

M.

Sig.—Apply with brush rubbing in the scalp after washing with tar soap.

Peterson.

32020

℞ For Mary Ross

Hydrarg. Iod. Flav.	gr. ss
Pot. Iod.	ʒii
Inf. Digit. q.s.	fʒiii

M.

Sig.—ʒi in H_2O, t.i.d. p.c.

Sloan.

32021

℞ For W. J. Knowlton

Tr. Opii. Camph.	fʒi
Liq. Pot. Cit.	fʒiii
Ammon. Chlor.	gr. xii
Syr. Scill. Co.	fʒiv
Syr. Prun. Virg.	fʒiss
Aq. Dest. q.s. ad	fʒiii

M. ft. sol.

Sig.—fʒi in water every three hours.

Little.

32022

℞ For Miss Turner

Terpin. Hyd.	gr. xxiv
Tr. Hyosc.	fʒiiss
Sp. Chlorof.	fʒiii
Alcohol.	fʒiv
Syr. Prun. Virg.	fʒi
Aq. Dest. q.s. ad	fʒiv

M. ft.

Sig.—fʒi in water every two hours.

Bush.

32023

℞ For Miss Hartman

Chloral. Hydr.	ʒi
Sod. Brom.	ʒii
Aq. Menth. Pip. q.s. ad	fʒiii

M.

Sig.—fʒi in water every two or three hours.

Saunders.

32024

℞ For Wm. Hood

Pot. Cit.	ʒiii
Glyceryl. Nitrat.	gr. $\frac{1}{8}$
Syr. Limon.	fʒii
Liq. Ferr. et Ammon. Acet.	fʒiii
Liq. Pot. Cit. q.s.	fʒvi

M. ft. sol.

Sig.—fʒii every four hours. (The color changes from red to green.)

Springer.

Note—Spirit of glyceryl trinitrate would doubtless be used in this prescription, 17 min. of the 1 per cent representing $\frac{1}{6}$ gr. of glyceryl trinitrate.

32025

℞ For Clarence Gardner

Sod. Brom.	ʒvi
Aq. Menth. Pip. q.s.	fʒiii

M. ft. sol.

Sig.—fʒi in water q.d.

Green.

32026

℞ For Edna Hunter

Pot. Iod. (Sat. Sol.)	fʒiv

Sig.—Ten drops in H_2O. t.i.d. p.c.

Wilson.

32027

℞ For F. R. Wheeler

Sod. Chlorat.	gr. xx
Tr. Ferr. Chlor.	fʒi
Mucil. Acac.	fʒii
Aq. Dest. q.s.	fʒii

M. ft. sol.

Sig.—Use as a gargle.

Morris.

Note—This prescription is usually dispensed by adding the tincture to the sodium chlorate in a bottle, when some chlorine will be liberated. The other ingredients are then added. By diluting the tincture, no chlorine is liberated.

32028

℞ For Frank White

Tr. Ferr. Chlor.	fʒvi
Acid. Acet. Dil.	fʒii
Glycerin.	fʒvi
Pot. Acet.	ʒi
Elix. Arom. q.s. ad	fʒvi

M. ft. sol.

Sig.—fʒi in one-half glass of water three times a day p.c.

Miller.

32029

℞ For John Thompson

Phenol. Liq.	gtt. vi
Sod. Bor.	
Sod. Bicarb. āā	gr. viii
Glycerin.	fʒi
Aq. Dest. q.s.	fʒii

M. ft. sol.

Sig.—Use in atomizer.

Frantz.

32030

℞ For Miss Springer

Sod. Bicarb.	ʒi
Sp. Ammon. Arom.	fʒii
Aq. Menth. Pip. q.s. ad	fʒiv

M. ft. sol.

Sig.—(Shake well) fʒss in water every four hours.

Hammond.

32031

℞ For Mr. Ballinger

Glycer. Acid. Tan.	fʒv
Aquæ q.s.	fʒvi

M. ft. sol.

Sig.—Use as a throat swab twice daily.

Knight.

32032

℞ For Edward Anderson

Acetphen.	gr. xv
Caff.	gr. viii
Sod. Brom.	ʒi
Elix. Adjuvantis	fʒiii

M.

Sig.—fʒii as directed.

Wear.

32033

℞ For Miss Lynn

Tr. Zingib.	fʒiv
Chlorof.	fʒi
Elix. Arom. q.s.	fʒiii

M.

Sig.—fʒi thirty minutes after eating.

Simpson.

32034

℞ For J. D. Adams

Ammon. Chlor.	ʒi
Mist. Glycyrrh. Co. q.s. ad	fʒiii

Misce.

Sig.—Shake the bottle and take a teaspoonful three times a day.

Weiler.

32035

℞ For Mr. Bamford

Sod. Bicarb.	ʒi
Sp. Ammon. Arom.	fʒss
Sp. Æth. q.s.	fʒi

M.

Sig.—"Shake". fʒi in water every two hours until relieved.

Wilcox.

32036

℞ For Mr. Hughes

Tr. Aconit.	
Chlorof. āā	min. xlv
Tr. Benz.	min. cl

M.

Sig.—Apply to tooth as needed.

Weiser.

32037

℞ For Louis P. Baer

Tr. Capsic.	fʒiii
Sp. Camph.	fʒiii
Chlorof.	fʒi
Alcohol. Dil. q.s. ad	fʒiii

M.

Sig.—Half a teaspoonful as a dose.

Joyce.

32038

℞ For F. C. Miller

Tr. Nuc. Vom.	min. lxxv
Sod. Bicarb.	gr. cl
Aq. Dest. q.s. ad	fʒv

M.

Sig.—fʒi p.c.

Simpson.

32039

℞ For J. S. Crane

Syr. Ferr. Iod.	fʒii
Syr. Acid. Hydriod.	fʒi
Syr. Hypophos. Co.	fʒi
Elix. Arom. q.s. ad	fʒiii

M.

Sig.—fʒi in water every four hours.

Terry.

32040

℞ For Fred Ogden

Liq. Pot. Arsen.	fʒss

Sig.—Four drops in H_2O t.i.d. p.c.

Smith.

(Use a dropper bottle).

32041

℞ For Fred Brown.

Tr. Ferr. Chlor.	fʒii
Syr. Aurant.	fʒi
Syr. Hypophos. Co. q.s.	fʒiii

M.

Sig.—ʒi t.i.d. p.c.

MacFarland.

32042

℞ For C. W. Payne

Sod. Salicyl.	ʒiiss
Syr. Aurant.	fʒiss
Aquæ q.s. ad	fʒiii

Misce.

Sig.—Two teaspoonfuls every three hours.

Stuart.

32043

℞ For Sara Wilson

Acetanil.	gr. xx
Ammon. Chlor.	gr. xx
Ammon. Carb.	gr. xv
Syr. Seneg.	fʒii
Acid. Hydrochl. Dil.	min. xviii
Syr. Tolu	fʒi
Elix. Pepsin. Co. q.s.	fʒiii

M.

Sig.—fʒi every three hours with water.

Krewson.

32044

℞ For Mr. Hart

Phenol.	gr. ii
Camph.	gr. v
Menthol.	gr. i
Glycerin. q.s.	f℥ss

M. ft. mist.
Sig.—gtt. v in ear as directed.

Peacock.

32045

℞ For E. J. Harrison

Sp. Glyceryl. Nitrat.	gtt.xvi
Strophanthin.	gr. $\frac{1}{5}$
Sod. Brom.	℥iv
Elix. Pepsin. Co.	f℥ii
Aq. Cinnam. q.s.	f℥iv

M.
Sig.—f℥ii four times a day.

Brinton.

32046

℞ For Mrs. Lawson

Sod. Salicyl.	℥ss
Sod. Iod.	℥i
Tr. Digit.	f℥ss
Elix. Cinch. q.s.	f℥iv

M. ft. sol.
Sig.—f℥ii in water after meals.

Brown.

32047

℞ For Walter Mitchell

Sod. Iod.	gr. xxxvi
Sod. Salicyl.	℥ii
Elix. Pepsin. et Rennini Co. q.s.	f℥iii

M. ft. sol.
Sig.—f℥ii in water after meals.

Brown.

32048

℞ For Miss Singer

Liq. Pot. Arsen.	gtt. xii
Stront. Brom.	℥iii
Tr. Hyoscy.	f℥i
Tr. Gentian. Co.	f℥iii
Aq. Dest. q.s.	f℥iv

M. ft. sol.
Sig.—Dessertspoonful in water before meals.

Ryan.

32049

℞ For Frank Logan

Pepsin.	℥ii
Sp. Chlorof.	f℥ii
Acid. Hydrochl. Dil.	f℥ii
Aq. Cinnam. q.s.	f℥iii

M. ft. sol.
Sig.—f℥i in two tablespoonfuls of water after meals.

McCall.

32050

℞ For Mr. McFarland

Acid. Benz.	8
Acid. Bor.	12
Aq. Cinnam.	360

M.
Sig.—f℥ss in water four times daily.

Moore.

32051

℞ For John W. Nesbitt

Ammon. Chlor.	℥ii
Tr. Nuc. Vom.	f℥i
Tr. Cinch. Co. q.s. ad	f℥iii

M. ft. sol.
Sig.—f℥i in water every four hours.

Krauss.

32052

℞ For Mrs. R. F. Roberts

Ammon. Carb.	℥ss
Syr. Scill.	
Syr. Prun. Virg. āā	f℥ss
Aq. Dest. q.s. ad	f℥ii

M. ft. sol.
Sig.—Teaspoonful every two hours.

Gregory.

32053

℞ For John Brooks

Inf. Digit.	f℥viii

M.
Sig.—f℥iv in water every four hours.

Nixon.

32054

℞ For F. R. Brinton

Methenam.	℥ii
Ammon. Benz.	℥iv
Tr. Cardam. Co.	f℥iv
Aq. Menth. Pip. q.s.	f℥vi

M. ft. sol.
Sig.—f℥ii in water t.i.d. p.c.

Kercher.

32055

℞ For Mr. Little

Tr. Nuc. Vom.	
Acid. Hydrochl. Dil. āā	f℥iii
Tr. Cardam. Co.	
Elix. Pepsin. Co. āā q.s.	f℥vi

M. ft. sol.
Sig.—f℥ii in H_2O p.c.

Kline.

32056

℞ For Chas. Houston

Hydrarg. Chlor. Corr.	gr. ii
Sod. Iodid.	℥vi
Elix. Gent. Glycerin.	f℥ii
Aq. Cinnam. q.s. ad	f℥iii

M. ft. sol.
Sig.—f℥i in aq. t.i.d. p.c.

Roberts.

32057

℞ For Mr. Strong
Liq. Iodi Co. f℥i
Sig.—gtt. xx in grape juice t.i.d. p.c.
Roberts.

32058

℞ For Harry Stoner
Tr. Iodi f℥iss
Acid. Tan. ℥iss
Glycerin. f℥vi
Sol. Pot. Chlorat. Saturat. q.s. f℥vi
Misce.
Sig.—Use undiluted as a gargle.
Weeks.

32059

℞ For Harry Fisher
Pot. Cit. 2
Pot. Brom. 1
Tr. Hyosc. 2
Tr. Bellad. 1
Liq. Ferr. et Ammon. Acet. 4
Elix. Pepsin. Co. q.s. ad 60
M. ft. sol.
Sig.—f℥i t.i.d.
Walters.

32060

℞ For Walter Rogers
Liq. Ferr. et Ammon. Acet. f℥vi
Sig.—f℥ii in water t.i.d., after meals.
Snyder.

32061

℞ For Louis Harvey
Pot. Cit. ℥vi
Syr. Aurant. f℥i
Aq. Dest. q.s. f℥iii
M. ft. sol.
Sig.—f℥i in water every three hours.
Landis.

32062

℞ For Miss Gordon
Ol. Morrh. q.s. (40 per cent)
Syr. Prun. Virg. f℥ii
Methyl. Salicyl. gtt.v
Acac.
Aq. Dest. āā q.s. f℥ii
M. ft. Emul. sec. art.
Sig.—f℥i t.i.d. p.c.
Marshall.

32063

℞ For Mrs. C. F. Carter
Benzyl. Benz. 10
Methyl. Salicyl. 8
Trag. 15
Aq. Dest. q.s. 50
M. ft. Emuls. (The English method must be used.)
Sig.—f℥i t.i.d.
Copy on label.
Horn.

32064

℞ For Baby Pierce
Ol. Ricin. f℥iv
Ol. Cinnam. gtt.v
Acac. q.s.
Aq. Dest. q.s. f℥ ii
M. ft. Emuls.
Sig.—f℥i after meals.
Johnson.

32065

℞ For Mr. King
Emuls. Asafœt. f℥iv
Ol. Tereb. f℥i
Glycerin. f℥i
Aqua. q.s. ad Oi
M. ft.
Sig.—Use as an enema as directed.
Roberts.

32066

℞ For H. A. Saunders
Syr. Scill.
Syr. Seneg. āā f℥iii
Ammon. Carb. gr. x
Ol. Morrh. f℥iv
Syr. Prun. Virg. f℥i
Acac. q.s.
Syr. Pic. Pin. q.s. f℥iii
M. ft.
Sig.—f℥i in water every three hours.
Bailey.

32067

℞ For Mary Williams
Arg. Nit. q.s. (1 per cent)
Aq. Dest. f℥ss
M. ft. sol.
Sig.—One drop in each eye at night.
Smith.

32068

℞ For J. C. Bowers
Zinc. Sulph. gr. ii
Acid. Bor. Sat. Sol. f℥i
Aq. Dest. q.s. f℥ii
M. ft. collyr.
Sig.—Eye drops—Use freely.
White.

32069

℞ For F. R. Watson
Acid. Bor. ℥ss
Aq. Camph.
Aq. Dest. āā q.s. f℥iii
M. ft. collyr.
Sig.—Use freely in eyes.
Griggs.

Copy ℞ on label

32070

℞ For J. S. Thompson

Pilocarpin.	gr. $\frac{1}{12}$
Zinc. Phenolsulph.	gr. iss
Acid. Bor.	gr. xx
Aq. Camph.	f℥ii
Aq. Ros. q.s. ad	f℥ii

M. ft. collyr.

Sig.—Use in each eye with eye cup t.i.d

Lawrence.

32071

℞ For C. Schultz

Aq. Hamam.	f℥ii
Aq. Sambuc.	f℥i
Sat. Sol. Acid. Bor. q.s. ad	f℥iii

M.

Sig.—Bathe eyes freely.

Alexander.

32072

℞ For Miss Brown

Holocain. (1 per cent sol.).	f℥ii

M. ft. sol.

Sig.—Two drops in the right eye every third hour.

Kelly.

32073

℞ For Henry Downs

Sod. Chlorid.	gr. iii
Zinc. Sulph.	gr. ii
Acid. Bor.	℥ss
Aq. Dest. q.s.	f℥iii

M. ft. collyr.

Sig.—Ten drops in left eye every three hours.

Murphy.

32074

℞ For Laura Rhodes

Acid. Bor.	gr. xxx
Sod. Chlor.	gr. ii
Zinc. Phenolsulph.	gr. ii
Aq. Menth. Pip.	f℥ii
Aq. Dest. q.s.	f℥iii

M. ft. collyr.

Sig.—Use as eye wash twice a day.

Anderson.

32075

℞ For Miss Myers

Atrop. Sulph.	gr. i
Aq. Dest.	f℥ii

M. ft. sol.

Sig.—Eye Drops—Poison—One (1) drop in each eye three times a day.

Chase.

32076

℞ For Mr. Reynolds

Physostig. Salicyl.	gr. $\frac{1}{50}$
Acid. Bor.	gr. x
Aq. Dest.	f℥i

M. ft. collyr.

Sig.—One or two drops in each eye twice daily.

Olds.

32077

℞ For Miss Brown

Homatrop. Hydrobr.	gr. i
Aq. Dest.	f℥i

M. ft. sol.

Sig.—Poison—Drop in eyes as directed.

Adams.

32078

℞ For L. C. Merrick

Sod. Chlor.	1
Sat. Sol. Acid. Bor.	50
Sassaf. Med.	2
Aq. Camph.	
Aq. Dest. aa. q.s. ad	120

M. ft. collyr.

Sig.—Use as eye wash.

Dalton.

32079

℞ For M. L. Scott

Arg. Prot. Mit (10 per cent sol.)	f℥i

M.

Sig.—One drop in each eye t.i.d. (Dispense in dropper bottle.)

Brinton.

32080

℞ For Mrs. Connell

Bism. Subnit.	℥iss
Acac.	℥iss
Elix. Pepsin. et Rennin. Co.	f℥ii

M. ft. mist.

Sig.—f℥i every two hours.

Shannon.

32081

℞ For Harry James

Bism. Subcarb.	℥iii
Mucil. Acac.	f℥ii
Elix. Pepsin. Co. q.s.	f℥iv

M. ft. mist.

Sig.—f℥ii every three hours.

Wilcox.

32082

℞ For Mr. Holmes

Bism. Subnit.	℥iiss
Betanaph.	℥ss
Syr. Acac.	f℥iss
Aq. Camph. to make	f℥iii

M. ft. mist.

Sig.—One teaspoonful to be given every two hours. Shake well.

Swope.

32083

℞ For Mrs. Jefferson

Creosot.	gtt.v
Elix. Pepsin. Co.	f℥ii
Syr. Zingib. q.s. ad	f℥iii

M. ft. mist.

Sig.—Teaspoonful every two hours.

Scott.

32084

℞ For Frank Dilks

Tr. Bellad.	f℥iii
Sod. Bicarb.	℥iv
Fldext. Casc. Sagr.	f℥i
Magma Mag.	f℥i
Mist. Cret. q.s.	f℥vi

M. ft. mist.
Sig.—f℥ii in aq. t.i.d. p.c.

Williams.

32085

℞ For Frank A. Good

Quin. Sulph.	gr. lxxv
Fldext. Glycyrrh.	f℥iv
Elix. Arom. q.s.	f℥iii

M. ft. mist.
Sig.—f℥i t.i.d.

Sullivan.

32086

℞ For Miss Anna Harper

Sod. Salicyl.	8
Ammon. Chlor.	6
Tr. Hyoscy.	10
Mist. Glycyrrh. Co. q.s.	120

M. ft. mist.
Sig.—5 cc. every three hours.

Bayton.

32087

℞ For Miss Gardiner

Ammon. Chlor.	℥i
Syr. Ipecac.	
Syr. Scill. āā	f℥ss
Tr. Opii Camph.	f℥iii
Mist. Glycyrrh. Co.	f℥i
Aq. Dest. q.s. ad	f℥iii

M. ft. sol.
Sig.—f℥i every third hour c. water.

Grant.

32088

℞ For Mr. White

Tr. Benz. Co.	
Glycer. Boroglyc. āā q.s.	f℥ii

M. ft. mist.
Sig.—Use as directed.

Landis.

32089

℞ For Oscar Newton

Bism. Subnit.	℥v
Cer. Oxal.	℥ss
Tr. Nuc. Vom.	f℥i
Tr. Opii Camph.	f℥iss
Mucil. Acac.	f℥iss
Syr. Zingib.	f℥iv
Aq. Cinnam. q.s.	f℥iv

M.
Sig.—℥i followed by water every three hours.

Baldwin.

32090

℞ For J. A. King

Phenol.	min. xii
Glycerin.	f℥i
Resorcin.	℥i
Acid. Bor.	℥ii
Bism. Subnit.	℥iii
Alum.	℥ss
Aq. Dest. q.s.	f℥iv

M. ft. mist.
Sig.—Apply locally every two hours.

Strickler.

32091

℞ For John Kolb

Resorcin.	4
Mag. Oxid.	6
Bism. Subnit.	12
Tr. Cardam. Co.	40
Aq. Dest. q.s. ad	200

M. ft.
Sig.—Tablespoonful in water every four hours.

Mills.

32092

℞ For S. F. McCoy

Liq. Plumb. Subacet.	f℥iss
Cupr. Sulph.	
Zinc. Sulph. āā	℥ss
Aq. Dest. q.s. ad	f℥ii

M. ft. mist.
Sig.—Apply externally as directed.

Davidson.

32093

℞ For Mrs. Smith

Pot. Sulphurat.	
Zinc. Sulph. āā	gr. xl
Aq. Dest. q.s.	f℥ii

M. ft. mist. sec. artem.
Sig.—Apply freely at night.

Strong.

Note.—The sulphurated potassa must be of good quality. Prepare separate solutions of each chemical in one ounce of water, filter each through cotton, and pour the solution of zinc sulphate into the potassa solution.

32094

℞ For Mrs. J. C. Cleveland

Sp. Æth. Nitrit.		
Tr. Guaiac.	āā	f℥i
Acac.	q.s.	
Aq. Dest.	q.s. ad	f℥ii

M. ft. mist. sec. artem.
Sig.—f℥ii t.i.d.

Haines.

32095

℞ For Helen R. Hart
Camph.
Menthol. āā gr. xv
Tr. Opii Camph. f℥ss
Tr. Benz. Co. q.s. ad f℥iii
M. ft. mist.
Sig.—Teaspoonful to eight ounces of boiling water, inhale steam three times daily as directed.
Hays.

32096

℞ For Henry Morgan
Calamin. Præp. ℥iv
Zinc. Oxid.
Bism. Subnit. āā ℥iii
Sod. Bicarb.
Amyli āā ℥i
Mucil. Acac. q.s.
Aq. Dest. q.s. f℥vi
M. ft. lotio
Sig.—For external use.
Wilson.

32097

℞ For George Taylor
Acid. Bor. ℥ss
Calamin. Præp. ℥i
Zinc. Oxid. ℥i
Phenol. min. x
Aquæ q.s. ad f℥viii
M. ft. mist.
Sig.—External use.
Strong.

32098

℞ For Miss Jones
Zinc. Oxid. 8
Calamin. Præp. 4
Phenol. Liq. 0 8
Adep. Lan. Hyd. 30
Liq. Calc. Hydrox. q.s. 90
M. ft. lotio
Sig.—Apply locally. Ferry.
McNeil.

Note—The addition of a small amount of tragacanth is helpful.

32099

℞ For Mrs. Brice
Menthol. gr. v
Phenol. gr. x
Zinc. Oxid. ℥ii
Acid. Bor. ℥ii
Resorcin. ℥i
Ol. Oliv. f℥iv
Liq. Calc. Hydrox. q.s. f℥viii
M.
Sig.—Apply locally.
Strong.

Note—By the neutralization of the boric acid and the addition of tragacanth, a presentable mixture can be dispensed.

32100

℞ For Miss Brinton
Lot. Calamin. f℥iv
M. ft. mist.
Sig.—Use locally.
Blue.

32101

℞ For Mary Lyon
Tr. Aconit.
Tr. Bellad. āā f℥iv
Menthol. gr. iv
Ol. Sinap. Vol. min. v
Lin. Chlorof. q.s. ad f℥iv
M. ft.
Sig.—Rub well into parts.
Fleming.

32102

℞ For G. S. Townes
Tr. Bellad. f℥ii
Tr. Capsic. min. vii
Tr. Opii f℥ii
Methyl. Salicyl. f℥ii
Lin. Sapon. q.s. f℥iv
M.
Sig.—Use as a liniment.
Reiner.

32103

℞ For E. J. Strickler
Iodi. gr. xxx
Methyl. Salicyl. f℥iv
Ol. Anisi f℥ii
Adipis Lan. Hyd. ℥i
Ol. Oliv. q.s. f℥vi
M. ft. lin. Dispensed without a shake well label.
Sig.—Rub into chest every night.
Klenk.

32104

℞ For James Carroll
Menthol.
Camphor. āā gr. iii
Liq. Petrolat. q.s. f℥i
M. ft. sol.
Sig.—Use as a nasal spray
Grant.

Note—If menthol and camphor are triturated together they form a liquid known as a eutectic solution, but this, when added to liquid petrolatum, forms a more or less cloudy solution. If the ingredients are separately added to the liquid petrolatum and dissolved by agitation, a clear solution results.

32105

℞ For Bruce Martin
Menthol. gr. iii
Ol. Sassaf. min. x
Petrolat. Liq. f℥ii
M. ft. sol.
Sig.—Five drops in each nostril twice a day.
Wood.

32106

℞ For George
Ol. Santal. f℥ii
Sig.—Three drops on sugar every three hours.
Beard.

32107

℞ For George Fry
Menthol.
Camph. āā gr. ii
Epineph. Hydrochlor. (in oil) f℥i
Ol. Oliv. q.s. ad f℥ss
M. ft. sol.
Sig.—gtt. iii in each nostril every three hours.
Smith.

32108

℞ For John Sterling
Camph.
Menthol. āā gr. i
Ol. Pin. Pumil.
Ol. Eucalypt. āā min. xxx
Ol. Cinnam. min. ii
Petrolat. Liq. q.s. ad f℥ii
M. ft. sol.
Sig.—Spray nose and throat as directed.
Baldwin.

32109

℞ For Mrs. Fuller
Acetanil.
Sod. Bicarb. āā gr. xxii
Ammon. Carb. gr. xi
M. ft. pulv. no. x.
Sig.—One every two to four hours.
Weaver.

32110

℞ For Miss Snyder
Sod. Bicarb.
Sod. Phos. Exsic.
Sod. Sulph. Exsic. āā ℥ss
M. ft. pulv.
Sig.—½ teaspoonful in *hot* water before meals.
Roberts.

32111

℞ For Sarah Martin
Mag. Oxid. gr. x
Bism. Subcarb. gr. xv
M. ft. chart. no. i.
Mitte tales xxv
Sig.—One powder well mixed with water ten minutes before meals t.i.d.
True.

32112

℞ For J. C. Webster
Ung. Hydrarg. Fort. gr. v
M. ft. chart. no. i
Mitte tales xii
Sig.—Use one at night.
Brown.

32113

℞ For Mrs. Smith
Ol. Caryophyl. gt.i
Ol. Menth. Pip. min.v
Mag. Carb. ℥iv
Sod. Bicarb. ℥iv
Bism. Subnit. ℥ii
Mag. Salicyl. ℥ii
M. ft. pulv.
Sig.—⅓ teaspoonful in water after meals.
Carpenter.

32114

℞ For Mr. Fritz
Pancreat.
Sod. Bicarb. āā ℥i
Ol. Menth. Pip. min. i
M. ft. pulv. no. xxiv
Sig.—Take one one-half hour after meals.
Blue.

32115

℞ For George Fry
Calc. Iodobehen.
Lactos. āā gr. xl
Cacao Præp. q.s.
M. ft. in chart. no. xx
Sig.—One every three hours.
King.

32116

℞ For Mrs. Wilson
Mag. Oxid. ℥ii
Calc. Carb. Præc.
Bism. Subcarb. āā ℥iv
M. ft. chart. no. xxiv
Sig.—One powder t.i.d. one hour p.c.
Paul.

32117

℞ For Mr. Gregory
Ext. Hyosc. gr. ½
Acetphen. gr. iii
Bism. Subcarb. gr. xii
Mag. Oxid. gr. x
M. ft. pulv. no. i. ft. chart. no. xxiv
Sig.—One after lunch and dinner.
Ross.

32118

℞ For Blanche Snyder
Pepsin. Sacchar.
Sod. Bicarb. āā ℥iss
Ol. Menth. Pip. gtt.i
M. ft. chart. no. xii
Sig.—One powder p.c.
Wagner.

32119

℞ For Mary Hart
Cerii Oxal. 10|0
Bism. Subcarb. 20|0
Mag. Carb. 40|0
M. ft. pulv.
Sig.—Take one-half teaspoonful every four hours in water.
Bradley.

32120

℞ For Mrs. Hadley

Acid. Bor.	℥vi
Alum. Exsic.	℥i
Phenol.	℥i
Methyl. Salicyl.	f℥i
Ol. Menth. Pip.	f℥ss

M. ft. pulv.
Sig.—℥ii in Oii of hot water.

Clark.

32121

℞ For Frank Dill

Phenolphthal.	gr. x
Sod. Bicarb.	℥i
Bism. Subcarb.	℥iii

M. ft. chart. no. xvi
Sig.—One p.c.

Gregory.

32122

℞ For Baby

Hydrarg. Chlor. Mit.	gr. i
Quin. Æthylcarb.	gr. xv
Sod. Bicarb.	℥i
Ol. Anisi	gtt.i
Lactos.	℥i

M. ft. chart. no. xv
Sig.—One, three or four times daily.

Strong.

32123

℞ For Mrs. Keller

Iodof.	℥v
Coumar.	gr. xv
Acid. Bor. q.s. ad	℥xiii

Misce bene.
Sig.—To be used as a dusting powder.

Taylor.

32124

℞ For John Grove

Spec. Lax.	℥iii

Sig.—Make a tea using one or two teaspoonfuls, and take on retiring.

Martin.

32125

℞ For P. S. Hamilton.

Menthol.	
Camph. āā	℥i
Methyl. Salicyl.	f℥i
Sod. Bicarb.	
Sod. Bor. āā	℥iii

M.
Sig.—Add a teaspoonful to two quarts of hot water and use locally.

Blue.

32126

℞ For Mrs. Mitchell

Creosot. Carb.	℥i

M. ft. cap. no. xx
Sig.—One every three hours.

Morgan.

32127

℞ For Miss Wiley

Strych. Sulph.	gr. ⅜
Methenam.	℥ss
Terpin. Hyd.	℥ss

M. et div. in cap. no. xxx
Sig.—One every two hours.

McConnell.

32128

℞ For Mr. Wilkins

Strych. Sulph.	gr. ⅔
Aloin.	gr. iv
Ext. Bellad.	gr. i
Pulv. Rhei.	℥i
Pulv. Digit.	℥ss

M. ft. cap. no. xx
Sig.—One t.i.d.

Robertson.

32129

℞ For Mr. Taylor

Asafœt.	℥i
Sod. Bicarb.	℥ii
Pancreat.	℥ii

M. ft. cap. no xlviii
Sig.—A capsule with water one hour after meals.

Whyte.

32130

℞ For Miss Gordon

Guaiacol. Carb.	℥i
Sod. Bicarb.	℥iv

M. ft. cap. no. xxx
Sig.—One every four hours.

Williams.

32131

℞ For John Horton

Ol. Ricin.	min. x

Ft. cap. no i
Mitte tales no. xxx
Sig.—Two as required.

Veneziale.

32132

℞ For Frank McCall

Phenyl. Salicyl.	℥i
Quin. Sulph.	gr. xl
Ext. Casc. Sagr.	gr. xv

M. ft. cap. no. xii
Sig.—One, morning and afternoon.

Graham.

32133

℞ For Mrs. Miller

Hydrarg. Chlor. Mit.	gr. ii
Sod. Bicarb.	
Pepsin.	
Acetphen. āā	gr. xxx
Ext. Bellad.	gr. ⅛
Phenolphthal.	gr. vi

M. ft. cap. no. xii
Sig.—Take one every hour.

Hollingshead.

32134

℞ For John Seaman

Pulv. Acetan. Comp.	gr. xxx
Camph. Monobrom.	gr. xl
Sod. Salicyl.	ʒii
Methenam.	ʒii
Sod. Bicarb.	gr. xl
Strych. Sulph.	gr. ⅔
Sp. Glyceryl. Nitrat.	min. xv
Quin. Sulph.	gr. xx
Res. Podoph.	gr. ii
Pepsin.	gr. xxx

M. ft. cap. no. xl

Sig.—Two capsules every three hours.

Reiner.

32135

℞ For Miss Kent

Betanaph.	gr. xl
Sod. Bicarb.	ʒiv
Ext. Hyosc.	gr. ii
Ext. Cannab.	gr. ii

M. ft. cap. no. xx

Sig.—Take as directed.

Logan.

32136

℞ For M. Black

Phenyl. Salicyl.	ʒi
Pancreat.	ʒiss

M. et ft. cap. no. xx

Sig.—One capsule after meals.

Kerns.

32137

℞ For Edward Muldoon

Sod. Carb. Monohyd.	ʒi

M. ft. cap. no. xii

Coat with salol.

Sig.—One at night.

Morrison.

32138

℞ For Miss Wharton

Cret. Præp.	
Sod. Bicarb.	
Zingib. Pulv. āā	gr. xxiv

M. ft. caps. no. xii

Sig.—One every three hours.

White.

32139

℞ For Miss Peacock

Quin. Hydrochl.	gr. ½
Camph.	gr. ½
Acid. Acetylsal.	gr. ii

M. ft. cap. no. i

Mitte tales no. xviii

Sig.—One every three hours.

Fox.

32140

℞ For Mary Lowe

Quin. Sulph.	gr. xl
Digitalini Germanici	gr. x
Methenam.	ʒii

M. ft. cap. no. xxx

Sig.—One before meals.

Brown.

32141

℞ For Mr. Newton

Res. Podoph.	gr. 1/10
Phenyl Salicyl.	gr. iiss
Sod. Salicyl.	gr. iiss

M. ft. cap. no. i

Mitte tales no. xxx

Sig.—One every four (4) hours.

Summers.

32142

℞ For Mr. Robinson

Ext. Nuc. Vom.	gr. iv
Pulv. Digit.	gr. xvii
Glyceryl. Nitrat.	gr. 1/6
Phenyl. Salicyl.	gr. xv
Pulv. Rhei	gr. xl
Sod. Bicarb.	ʒiss

M. ft. cap. no. xx

Sig.—One after meals.

Stevens.

32143

℞ For Chas. Philips

Strych. Sulph.	gr. 1/40
Phenyl. Salicyl.	gr. iii
Acetphen.	gr. iv

M. ft. cap. no. i; ft. no. xvi

Sig.—One every three hours.

Reilly.

32144

℞ For Mr. Palmer

Sod. Nitrit.	gr. xl

M. ft. cap. no. xx

Sig.—One a.m. and p.m.

Bland.

32145

℞ For F. R. Smith

Strych. Sulph.	gr. 1/30
Caff. Cit.	gr. v
Acetphen.	gr. xl
Acid. Acetylsal.	gr. c

M. et div. in cap. no. xx

Sig.—One capsule four times a day.

Stahl.

32146

℞ For Miss Seltzer

Cinchophen.	ʒi
Sod. Bicarb.	ʒiss

M. ft. cap. no. xii

Sig.—A capsule every two hours.

Reed.

32147

℞ For P. S. Hamilton
Acid. Acetylsal.
Quin. Sulph. āā gr. iii
Caff. gr. ii
Pulv. Ipecac. et Opii gr. iv
M. ft. cachet no. i
Mitte no. xv
Sig.—One t.i.d.
Blue.

32148

℞ For Mrs. Daly
Ferr. Sulph. Exsic. ℥i
Ext. Nuc. Vom.
Ext. Casc. Sagr. āā gr. xv
M. ft. pil. no. lx
Sig.—One pill half an hour after meals.
Stuart.

32149

℞ For Wm. Smith
Pulv. Digit.
Pulv. Scill. āā gr. x
Hydrarg. Chlor. Mit. gr. i¼
M. div. pil. no. ix
Sig.—One pill every three hours.
Brice.

32150

℞ For Mr. Sullivan
Aur. et Sod. Chlor. gr. ss
Ext. Nuc. Vom. gr. iii
Ext. Tarax. ℥i
M. ft. pil. no. xxx
Sig.—One pill three times daily after meals.
Fox.

32151

℞ For Irene Dalton
Ferr. Reduct.
Quin. Sulph.
Aloes Purif. āā gr. xlv
Strych. Sulph. gr. i
Ext. Gentian. q.s.
M. ft. pil. no. lx
Sig.—One pill three times a day after eating.
Stokes.

32152

℞ For Wm. R. Dager
Hydrarg. Iod. Flav. gr. vi
Ext. Gentian. gr. lx
M. ft. pil. no. xl
Sig.—One pill after meals.
Sloan.

32153

℞ For Mrs. Mitchell
Mass. Ferr. Carb. ℥i
Arsen. Triox. gr. i
M. et div. in pil. no. xl
Sig.—One pill three or four times a day.
Strong.

32154

℞ For Mr. Gregory
Arg. Nit. gr. iv
Ext. Bellad. gr. iii
M. ft. pil. no. xxiv
Sig.—One t.i.d. a.c.
Ross.

Note—Powder the silver nitrate and mix it intimately with eighteen grains of fullers' earth. Triturate the powdered extract with six grains of fullers' earth. Mix the two powders, mass with rosin cerate and divide into pills.

32155

℞ For Miss Jones
Ferr. Reduct.
Quin. Sulph. āā gr. xxiv
Ext. Nuc. Vom. gr. iii
M. ft. pil. no. xxiv
Sig.—One pill t.i.d.
Smith.

32156

℞ For Bruce Martin
Mass. Hydrarg. gr. v
Ft. pil. no. i
Mitte no. x
Sig.—Two at night.
Wood.

32157

℞ For Arthur H. Atkins
Arg. Nit.
Ext. Hyosc.
Manna. āā gr. ⅓
M. pil. xxiv
Sig.—One t.i.d.
Henry.

32158

℞ For Frank Martin
Ext. Rhei
Ferr. Reduct. āā gr. lx
Arsen. Triox.
Strych. Sulph. āā gr. i
Quin. Sulph. gr. lx
M. ft. pil. no. xl
Sig.—One before each meal.
Edwards.

32159

℞ For Mr. Martin
Pil. Hyoscin. Hydrobr. gr. $\frac{1}{200}$
Mitte no. xii
Sig.—One pill at five and at nine p.m.
Black.

32160

℞ For Mr. King
Hydrarg. Iod. Flav. gr. viii
M. ft. pil. no. xx
Sig.—One t.i.d.
Roberts.

32161

℞ For John Hartman
Pot. Bicarb.
Hydrarg. Chlor. Mit. āā gr. v
Ext. Casc. Sagr. gr. xv
Aloe. gr. iv
M. ft. pil. no. x
Sig.—One after meals.
Hunt.

32162

℞ For Mrs. Owens
Pil. Strych. Sulph. gr. $\frac{1}{30}$
M. ft. pil. no. i
Mitte tales no. lx
Sig.—One three times daily after meals.
Sailer.

32163

℞ For C. E. Paul
Sod. Phenolsulph. 4|
Acac.
Syrup. āā q.s. ad
M. ft. pil. no. xxv
Sig.—One, night and morning.
Brewster.

32164

℞ For M. F. Kyle
Aloe. gr. iss
Ext. Bellad. gr. $\frac{1}{8}$
Ext. Nuc. Vom. gr. $\frac{1}{4}$
M. ft. pil. no. i
Mitte no. xlviii
Sig.—One pill hor. som.
Meyers.

32165

℞ For Mr. Wallace
Menthol. |01
Acid. Benz. |13
Ext. Glycyrrh. 3|25
M. ft. troch. no. x
Sig.—Use as required.
Brinton.

32166

℞ For J. F. Brill
Ol. Cubeb. f℥ss
Ol. Eucalypt. min. x
Menthol. gr. v
Bals. Peruv.
Tolu āā gr. xx
Glycyrrh. q.s.
M. ft. troch. no. l
Sig.—One as needed.
Smith.

32167

℞ For Frank Page
Hydrarg. Oxid. Flav. gr. i
Petrolat. ℥i
M. ft. ung.
Sig.—Eye salve to be used at night.
Palmer.

32168

℞ For Miss Ramsey
Zinc. Oxid.
Pic. Carbon. āā ℥ss
Amyli.
Petrolat. āā ℥iv
M. ft. ung.
Sig.—Use locally.
Smith.

32169

℞ For Mrs. Miller
Menthol. gr. x
Ol. Eucalypt. f℥i
Adipis Lan. Hyd. ℥i
M. ft. ung.
Sig.—Apply as directed.
Edwards.

Note—Replace about 15 per cent of the hydrous wool fat with white petrolatum. Dissolve the menthol in the oil, incorporate the solution with the white petrolatum and then add the hydrous wool fat.

32170

℞ For R. E. C.
Hydrarg. Ammon. gr. x
Bals. Peruv. ℥ii
Adipis. Lan. Hyd. q.s. ℥ii
M. ft. ung.
Sig.—Apply freely.
Lenox.

32171

℞ For George Safford
Pic. Pin.
Sulphur. Sublim. āā gr. v
Hydrarg. Oxid. Flav. gr. viii
Petrolat. q.s. ℥i
M. ft. ung.
Sig.—Apply externally as directed.
White.

32172

℞ For Harry Boyd
Pot. Sulphurat.
Zinc. Sulph. āā gr. xx
Aq. Dest.
Adipis Lan. Hyd. āā q.s. ℥i
M. ft. ung.
Sig.—Apply locally.
Harris.

Note—Mix the ingredients each separately with a fluidrachm of water, mix and incorporate with the hydrous wool fat. Avoid the use of metallic utensils.

32173

℞ For Baby Ruth
Iod. gr. xx
Methyl. Salicyl. f℥ii
Ol. Anis. f℥ii
Adipis. Lan. Hyd. ℥i
Ol. Oliv. q.s. f℥vi
M.
Sig.—Rub into chest every night. (Dispense without shake well label.)
Brown.

Note—Finely powder the iodine, dissolve it in the hydrous wool fat, and add the other ingredients.

32174

℞ For M. J. Pierce

Ext. Stramon.	gr. xv
Acid. Tan.	gr. xx
Adipis Benz. q.s.	℥ss

M. ft. ung.
Sig.—Apply locally.

Hart.

32175

℞ For Pauline Mayer

Zinc. Sulph.	
Pot. Sulphurat. āā	℥ii
Petrolat. Alb. q.s.	℥ii

M. ft. ung.
Sig.—Apply locally.

Lawson.

32176

℞ For Miss Miller

Phenol.	gtt.v
Hydrarg. Chlor. Mit.	℥ii
Ung. Aq. Ros. (mineral oil) q.s. ad	℥i

M. ft. ung.
Sig.—Apply evenly as directed.

Franklin.

32177

℞ For John Miller

Acid. Bor.	4
Sod. Chlorid.	08
Menthol.	02
Ol. Eucalypt.	01
Petrolat. Alb.	64

M. ft. ung.
Sig.—Use three times daily.

Hunt.

32178

℞ For J. C. Webster

Zinc. Oxid.	3
Sulph. Sublim.	4
Ter. Sil. Purif.	2
Petrolat. Alb.	22

M. ft. ung.
Sig.—Apply twice daily.

Brown.

32179

℞ For Miss White

Acid. Salicyl.	gr. xxv
Mentholis	gr. vi
Zinc. Oxid.	℥ss
Adip. Benz. q.s. ad	℥ii

M. ft. ung.
Sig.—Rub in well as directed.

Franklin.

32180

℞ For George Leonard

Acid. Salicyl.	gr. v
Resorcin.	gr. xx
Adipis Benz. Adipis Lan. Hyd. āā	℥iv

M. ft. ung.
Sig.—Apply locally.

Strickler.

32181

℞ For John Miller

Hydrarg. Oxid. Rub.	1
Aq. Dest.	6
Adipis Benz. Petrolat. āā	25

M. ft. ung.
Sig.—Apply as directed.

Morris.

32182

℞ For S. T. McNeil

Phenol.	gr. x
Hydrarg. Chlor. Mit.	gr. xx
Zinc. Oxid. Amyli āā	℥ii
Ung. Aq. Ros.	℥iv

M. ft. ung.
Sig.—Apply locally t.i.d.

Lewis.

32183

℞ For Mrs. Bailey

Resorcin.	gr. vi
Acid. Bor.	gr. xv
Ung. Zinc. Ox.	℥ii
Ung. Aq. Ros. q.s.	℥iv

M. ft. ung.
Sig.—Apply as directed.

Mullen.

32184

℞ For Mr. Reed

Bitum. Sulphon.	℥ss
Ung. Hydrarg. Fort. Ung. Bellad. āā	℥i
Ung. Aq. Ros. q.s. ad	℥ss

M. ft. ung.
Sig.—Apply locally.

Raymond.

32185

℞ For G. F. Tucker

Phenol.	gr. x
Hydrarg. Ammon.	gr. v
Ung. Zinc. Oxid.	℥i

M. ft. ung.
Sig.—Apply as directed.

Brown.

32186

℞ For Mary Owen

Oleores. Capsic.	gr. xv
Petrolat.	℥iii

M. ft. ung.
Sig.—Use locally.

Frantz.

32187

℞ For Mr. Turner
Phenol. min. iii
Acid. Salicyl. gr. xviii
Resorcin. gr. xxv
Adipis Benz.
Adipis Lan. Hyd. āā ʒiv
M. ft. ung.
Sig.—Locally at night.
Strickler.

32188

℞ For Mr. Fritz
Camph.
Menthol. āā ʒi
Ol. Tereb. fʒii
Ol. Sinap. Vol. min. x
Ext. Bellad. ʒii
Adipis Lan. q.s. ʒii
M. ft. ung.
Sig.—Locally.
Arthur.

32189

℞ For Mr. Wallace
Quin. Sulph. gr. iii
Ol. Theobrom. q.s.
M. ft. supp. no. i
Mitte no. vi
Sig.—One every four hours.
Brinton.

32190

℞ For Mr. King
Bitumen. Sulph. ʒi
Ext. Hamamel. ʒiv
Arg. Prot. Mit. gr. xl
Ol. Theobrom. q.s.
M. ft. supp. no. xl
Sig.—As directed.
Roberts.

32191

℞ For H. E. Smith
Quin. Hydroch. gr. v
Ol. Theobrom. q.s.
M. ft. suppos. no. l
Mitte tales vi
Sig.—As directed.
King.

32192

℞ For Geo. Trent
Asafœt. ʃ03
Ol. Theobrom. q.s.
M. et ft. suppos. no. i
Mitte tales x
Sig.—One every three hours.
Green.

32193

℞ For C. E. Renshaw
Bitum. Sulph. gr. xxxvi
Ol. Theobrom. q.s.
M. ft. suppos. no. vi
Sig.—One night and morning.
Harrison.

Note—Incorporate the sulphonated bitumen with the grated cacao butter and form suppositories by compression.

32194

℞ For Eliza Wood
Ext. Hyosc. gr. ii
Iodof. ʒi
Ol. Neroli min. iv
Ol. Theobrom. q.s.
M. ft. suppos. no. vi
Sig.—Use one before retiring.
Brown.

32195

℞ For Harry C. Abel
Ext. Bellad. Fol. gr. i
Ol. Theobrom. ʒii
M. ft. suppos. no. viii
Sig.—One every four hours, as directed.
Wilson.

32196

℞ For B. L. Hunt
Alum. gr. v
Zinc. Sulph. gr. iv
Acid. Bor. gr. x
Ol. Theobrom. ʒiiss
M. ft. vaginal suppos. no. vi
Sig.—Use as directed.
Burton.

32197

℞ For John Gracy
Acetanil. gr. x
Ol. Theobrom. q.s.
M. ft. urethral suppos. no. ii
Sig.—Use as directed.
Haney.

32198

℞ For Mr. Brinton
Arg.-Prot. Mit. gr. xxx
Ol. Theobrom. q.s.
M. ft. suppos. (rectal) no. xii
Sig.—Use as directed.
Smith.

Note—Dissolve the mild silver protein in the smallest possible quantity of water. Incorporate this syrupy liquid with the grated cacao butter and form suppositories by compression.

CHAPTER CXIII

MEDICINAL FOODS

The N. N. R. recognizes certain manufactured food products which are helpful in the treatment of special diseases. The professional pharmacist should be familiar with the conditions under which these are used and should be prepared to supply representative types when called for by the physician. The following descriptions and lists are taken in abstract from the N. N. R. (1925).

Medicinal foods are preparations of alimentary substances designed to supply special needs in the nutrition of the sick. The estimations of the nutritive values of these medicinal foods are here based on the calorific values of their carbohydrate, fat, and protein contents, and do not include the calorific values of any alcohol or glycerin that they may contain. In these computations the following factors are used as the equivalents in large calories of 1 Gm. of foodstuff: for carbohydrate, 4.1; for fat, 9.2; for protein, 4.1. The protein content of these foods has generally been estimated by multiplying the nitrogen content by 6.25. It is not, however, conceded that all of the nitrogen represents nutritional nitrogenous matter. They may be divided into the following classes; liquid mixed foods, protein foods, carbohydrate foods, and diabetic foods.

PROTEIN FOODS

Dry protein, predigested or not, may be used to increase the protein content of soups, gruels and other liquid foods. The predigestion of protein may be of value in conditions in which the digestive power of the stomach is lacking. In such cases meat fiber fails of digestion and may be irritating to the intestine. Predigested protein is also of value for use in rectal alimentation.

Dose—The dosage of dry protein is determined by the tolerance of the patient and by his nutritive needs. Each gram of dry protein yields about 4.1 calories.

The dry proteins are presented in the following principal forms: meat, predigested and in the form of a dry powder; casein, usually rendered more soluble by partial conversion to sodium caseinate; legumes, such as flour made from the soy bean; mixtures containing dry protein mixed with carbohydrate or other nutrients.

Calcium Caseinate, N. N. R.—*Calcii Caseinas*—Casein from cow's milk rendered partially soluble by combination with calcium, and containing not less than 1.4 per cent nor more than 2.1 per cent of calcium.

Uses—The diarrheal diseases of infancy are now generally treated by dietetic measures. A useful food may be made from the curd of milk (casein) and diluted milk, the resultant mixture containing a moderate amount of fat, a small amount of sugar and a large amount of protein (casein) and salts, particularly salts of calcium. To obtain such a food a mixture of calcium caseinate and diluted milk is used.

Dose—For infants and children, calcium caseinate is administered in a mixture of milk and water or milk and gruel, approximately ½ oz. (10 Gm.) being used, 1 pint (500 cc.) of solution, and the mixture boiled. For adults, it may be mixed with milk, skimmed milk or buttermilk in the proportions of ⅔ oz. (20 Gm.) to 1 quart (1000 cc.) of diluent.

Calcium caseinate is a yellowish-white, fluffy powder, free from "sour" or rancid odor, and having a characteristic, slightly saline taste; permanent in the air.

On agitation with warm water, calcium caseinate partially dissolves, forming a pseudo-solution or turbid suspension; insoluble in alcohol, ether or chloroform.

Casec—A brand of calcium caseinate manufactured by Mead Johnson and Company.

Larosan-Roche—*Stoeltzner's Casein Calcium*—A brand of calcium caseinate, containing 1.75 per cent of calcium, manufactured by F. Hoffmann-LaRoche and Company.

Protolac—A brand of calcium caseinate manufactured by the Dry Milk Company.

Casein, N. N. R.—*Caseina*—The protein separated from milk by the action of acids or enzymes and purified. It contains not less than 15 per cent of nitrogen, calculated on the moisture-free material.

Uses—Casein is used as a food, being added to other ingredients of the diet when it is desired to increase the content of protein in the diet. This occurs occasionally in the feeding of infants, in the nutrition of adult convalescents, and undernourished persons, and in the dietotherapy of diabetes. Casein is readily digested, furnishes phosphorus in addition to the usual amino-acid derivatives of proteins, and represents a protein of good nutritional quality. Casein is also used in the preparation of special foods for diabetics or others for whom a regimen poor in carbohydrate or fat may be desired.

Dose—The quantities which may be desirable to use vary widely in accord with the purpose of the feeding. Hence the dosage cannot be designated in definite terms.

Casein is soluble in ammonia water and in aqueous solutions of the fixed alkali hydroxides; insoluble in water, alcohol, ether, chloroform, or benzene. A suspension of casein in water slightly reddens blue litmus paper, but casein has both acidic and basic properties.

Dry Peptonoids, N. N. R.—A medicinal food prepared from beef, milk and wheat, containing 40 per cent of protein and 51.5 per cent of carbohydrate.

Uses—See general article, Dry Protein Foods. The nutritive value of 500 Gm. of dry peptonoids corresponds approximately to 1876 calories, of which 820 are produced by protein and 1056 by carbohydrate. The largest dose usually given (16 Gm.) is, therefore, equivalent to about 60 calories.

Dose—For an adult, from ¼ to ½ ounce (8 to 16 Gm.), taken in water, milk, wine, broths, soups, etc.; also in gruels, in which case it should first be dissolved in a small quantity of water.

Manufactured by the Arlington Chemical Company.

CARBOHYDRATE FOODS

Prepared carbohydrate foods are used mostly in infant feeding. They are made by the action of amylolytic enzymes on starch or by other modes of conversion by which the starch is changed into dextrin, maltose or glucose. The calorific value of these foods is determined on the assumption that 1 Gm. of the dry carbohydrate is equivalent to 4.1 calories.

Dextrose, U. S. P.—(See page 895).

Borcherdt's Malt Sugar, N. N. R.—A mixture containing approximately: maltose 87.40 per cent; dextrin 4.35 per cent; protein 4.40 per cent; ash 1.90 per cent, and moisture 1.95 per cent.

Uses—Borcherdt's malt sugar may be used where maltose is indicated in the feeding of infants, particularly in the treatment of constipation. The nutritive value of 500 Gm. of Borcherdt's malt sugar corresponds to approximately 1985 calories.

Dose—It may be used in all milk mixtures in the same proportions as lactose (sugar of milk), that is, 1 ounce (30 cc.) of Borcherdt's malt sugar (2 tablespoonfuls) to a 20 ounce mixture.

Manufactured by Borcherdt Malt Extract Company.

It is a pale brownish-yellow powder having a malt odor and a sweet taste. It is somewhat hygroscopic and soluble in water.

Dextri-Maltose No. 1, Mead's, N. N. R.—A mixture of maltose, 51 per cent; dextrin, 42 per cent; sodium chloride, 2 per cent and moisture 5 per cent.

Dextri-Maltose No. 2, Mead's, N. N. R.—A mixture of maltose, 52 per cent; dextrin 43 per cent; and moisture 5 per cent.

Dextri-Maltose No. 3, Mead's, N. N. R.—A mixture containing: maltose, 51 per cent; dextrin 41 per cent; potassium bicarbonate, 3 per cent, and moisture, 5 per cent.

It is a pale yellowish-white, granular, odorless powder, having a faintly sweetish taste. It is somewhat deliquescent on exposure to the air. It is soluble in water.

Uses—On the claim that maltose is more readily assimilable than other forms of sugar, Mead's dextri-maltose is proposed to supplement the carbohydrate of cow's milk.

Extract of Malt, U. S. P.—(See page 462).

Borcherdt's Malt Extract (Plain), N. N. R.—A preparation essentially similar to extract of malt, U. S. P., but containing 10 per cent. of glycerin.

Manufactured by Borcherdt Malt Extract Company.

Borcherdt's Malt, Cod Liver Oil and Iron Iodide—Each 100 cc. contains ferrous iodide 0.88 Gm. (4 grains per fluidounce), cod liver oil, 25 cc. and Borcherdt's malt extract (plain), 75 cc.

Borcherdt's Malt Cod Liver Oil and Phosphorus—Each 100 cc. contains phosphorus, 0.009 Gm. (1/6 grain per fluidounce), cod liver oil, 25 cc. and Borcherdt's malt extract (plain), 75 cc.

Dose—From 8 to 15 cc. (2 to 4 fluidrachms), three times a day, after meals.

Borcherdt's Malt Extract with Cascara Sagrada—Each 100 cc. represents cascara sagrada 12.5 Gm. (60 grains per fluidounce) in Borcherdt's malt extract (plain).

Borcherdt's Malt Extract with Cod Liver Oil—Each 100 cc. contains cod liver oil, 25 cc., and Borcherdt's malt extract (plain), 75 cc.

Borcherdt's Malt Extract with Creosote—Each 100 cc. contains creosote, U. S. P., 0.83 cc. (4 minims per fluidounce) in Borcherdt's malt extract (plain).

Borcherdt's Malt Soup Extract—A mixture obtained by adding potassium carbonate 1.1 Gm. to each hundred grams of malt extract, according to the formula of Dr. Keller, Universitäts-Kinderklinik, Breslau, Germany.

Malt Extract (Unmedicated)-P. D. and Co., N. N. R.—A preparation essentially similar to extract of malt, U. S. P., but containing 10 per cent of glycerin.

Manufactured by Parke, Davis & Company.

Malt Extract with Cod Liver Oil—P. D. and Company—Each 100 cc. contains Norwegian cod liver oil, 25 cc. and malt extract (unmedicated)-P. D. and Company, 75 cc. with chocolate and extract of vanilla as flavoring agents.

Maltine, N. N. R.—A preparation essentially equivalent to extract of malt, U. S. P., but containing 3.88 per cent of alcohol.

Manufactured by The Maltine Company.

Maltine with Cascara Sagrada—Each hundred cubic centimeters represents cascara sagrada 12.5 Gm. (60 grains per fluidounce) in maltine as a vehicle.

Maltine with Cod Liver Oil—Maltine, 70 per cent and cod liver oil, 30 per cent.

Maltine with Creosote—Each hundred cubic centimeters represents creosote, U. S. P., 0.83 cc. (4 minims per fluidounce) in maltine as a vehicle.

Maltine Ferrated—Each hundred cubic centimeters represents iron pyrophosphate, 1.65 Gm. (8 grains per fluidounce) in maltine as a vehicle.

Maltine Malt Soup Extract—Maltine containing potassium carbonate 1.1 Gm. in each hundred grams according to the formula of Dr. Keller, Universitäts-Kinderklinik, Breslau, Germany.

Malto-Yerbine—A liquid containing in each hundred cubic centimeters an extract of 6.6 Gm. (30 grains per fluidounce) of eriodictyon (yerba santa), also flavoring composed of the essential oils of anise, cassia, coriander and caraway in maltine as a vehicle.

Borcherdt's Dri-Malt Soup Extract, N. N. R.—Each one hundred grams contains: maltose, 71.1 Gm.; dextrin, 13.5 Gm.; protein, 8.7 Gm.; salts, 2.9 Gm., and moisture, 3.8 Gm. The nutritive value of 500 Gm. of Borcherdt's dri-malt soup extract corresponds approximately to 1812 calories, of which 1734 calories are yielded by carbohydrate.

Uses—Borcherdt's dri-malt soup extract is intended for use in preparing the malt soup of Dr. Keller, Universitäts-Kinderklinik, Breslau, Germany.

Borcherdt's Dri-Malt Soup Extract with Wheat Flour—A powder obtained by evaporating to dryness by a special process a mixture of 100 Gm. of malt soup extract and 50 Gm. of wheat flour.

Uses—Borcherdt's dri-malt soup extract with wheat flour is designed for use in preparing the malt soup of Dr. Keller, Universitäts-Kinderklinik, Breslau, Germany.

Manufactured by Borcherdt Malt Extract Company.

Loeflund's Malt Soup Stock, N. N. R.—A preparation essentially similar to extract of malt U. S. P., but containing a small amount of potassium carbonate. It contains in 100 Gm.: maltose, 54.26 Gm.; dextrin, 17.60 Gm.; protein, 3.73 Gm.; inorganic salts, 2.11 Gm., and water, 22.30 Gm.

Actions and Uses—Loeflund's malt soup stock is designed for use in preparing the malt soup of Dr. Keller, Universitäts-Kinderklinik, Breslau, Germany.

Distributed by Britt, Loeffler and Weil.

Mead's Dry Malt Soup Stock, N. N. R.—A mixture containing in 100 Gm.: maltose, 23.5 per cent; dextrin, 23.5 per cent; wheat flour, 46.5 per cent; potassium bicarbonate, 1.5 per cent, and moisture, 5 per cent.

Uses—Mead's dry malt soup stock is designed for use in preparing the malt soup of Dr. Keller, Universitäts-Kinderklinik, Breslau, Germany.

Manufactured by Mead, Johnson and Company.

Lacto-Dextrin, N. N. R.—A mixture composed of lactose, 73 per cent; dextrin, 25 per cent; and desiccated lemon juice 2 per cent.

Uses—The administration of lacto-dextrin is proposed as a means of promoting the growth of the normally present aciduric organisms, B. acidophilus and B. bifidus in the alimentary tract so as to make them the predominating organisms.

Dose—From 50 to 120 Gm. (2 to 4 ounces) dissolved in four times its bulk of hot water, three times a day preferably half an hour or an hour before meals. The nutritive value of 500 Gm. of lacto-dextrin corresponds approximately to 1900 calories.

Manufactured by the Battle Creek Food Company.

MODIFIED MILK PRODUCTS

Albumin Milk-Hoos, N. N. R.—*Dry Protein Milk*—A modified milk preparation having a relatively high protein content and a relatively low carbohydrate content. Each 100 Gm. contains, approximately, protein, 30 Gm.; butter fat, 25 Gm.; lactose (milk sugar), 15 Gm.; ash, 4 Gm., and small amounts of free lactic acid.

Uses—When suitably mixed with water, albumin milk-Hoos is said to be useful for correcting intestinal disorders of infants and children.

Dose—For the majority of conditions, albumin milk-Hoos should be administered in small quantities according to age and condition of the patient, after a period of starvation of from twelve to forty-eight hours. Suitable carbohydrates may gradually be added to the preparation as indicated by the clinical conditions.

Louis Hoos, distributor.

Mead's Powdered Protein Milk, N. N. R.—A modified milk preparation having a relatively high protein content and a relatively low carbohydrate content. Each 100 Gm. contains approximately protein 37 Gm., fat 31 Gm. (beef tallow 15 Gm., cocoanut oil 15 Gm., cod liver oil 1 Gm.), free lactic acid 3 Gm., lactose 19 Gm., and ash 4.6 Gm.

Uses—When suitably mixed with water, powdered protein milk is said to be useful for correcting intestinal disorders of infants and children.

Uses and Dose—The same as for Albumin Milk.

Powdered Protein Milk-Merrell-Soule, N. N. R.—*Dry Protein Milk*—A modified milk preparation having a relatively high protein content and a relatively low carbohydrate content. Each 100 Gm. contains approximately protein, 38 Gm.; butter fat, 27 Gm.; free lactic acid, 3 Gm.; lactose, 24 Gm., and ash, 5 Gm.

Uses and Dose—The same as for Albumin Milk.

Manufactured by the Merrell-Soule Company.

FOODS FOR DIABETICS

The essential purpose of dietetic treatment of diabetes is to abolish glycosuria, hyperglycemia and acidosis by the reduction of the carbohydrate intake. Foods containing not more than 10 per cent of sugar-forming carbohydrate have generally been regarded as permissible; those containing higher amounts must be used with greater caution. It is therefore necessary that the carbohydrate content of foods for diabetics should be accurately stated. There is no foundation for the claims that special forms of starch, such as oatmeal, toasted bread, or certain proprietary preparations, are any better assimilated than other kinds of starch.

The place of carbohydrates other than glucose and starch, *e.g.*, levulose, inulin, lactose (milk), is not quite so thoroughly investigated, but it is safe to conclude that their superior assimilability is apparent rather than real. They may sometimes be useful for special purposes in the hands of specialists; but, in general, they should be reckoned with as are the ordinary forms of carbohydrate.

Since in diabetes it is the carbohydrate metabolism which is first and most profoundly altered, it is necessary to know the percentage of utilizable carbohydrate in every food that the patient eats. In all except the milder forms of diabetes, it is also essential to know the quantities of protein and fat, as well as the amount of carbohydrate. It is therefore particularly necessary to know the carbohydrate content of every food used in the treatment of diabetes, and only somewhat less important to know their contents of protein and fat.

It has long been known that sugar can be formed from protein and consequently the protein of the diet must be carefully restricted in quantity; but this requirement has been widely ignored by practitioners. Since the diabetic foods which are low in carbohydrate are generally correspondingly high in protein, they cannot be given to the patients in unrestricted amounts.

Another requirement more recently emphasized is the restriction of fat and the total calorific value of the diet. Often diminution of fat is more important than decrease of carbohydrate as a means of combating acidosis. Foods for diabetics are generally concentrated foods, formerly prized on account of their high food value, but now sharply restricted on this very account. Diabetics should not be treated by the use of mere lists of permissible and forbidden foods; the total diet should be exactly prescribed in carbohydrate, protein, fat, and total calories in accordance with the ability of the individual patient to digest these foods. The chief function of a diabetic bread is to provide a palatable, breadlike vehicle for butter, cheese or the like. A high food value is not important or even desirable. The less utilizable carbohydrate such articles contain, the more general may be their use. A high protein content limits the use of such articles in severer cases, since in such cases the tolerance for protein must be considered as well as that for carbohydrate. Uniformity of composition from month to month, reliable analytical data, a maximum of surface for a minimum of carbohydrate and protein, palatability, low price and availability are points of chief interest in appraising

usefulness of such articles. For the purpose of avoiding too high a ration, bulky substances of low nutritive value are useful in the diet. Such are green vegetables and bran; and such use of cellulose or other indigestible material for the purpose of making up a sufficiently bulky and satisfying diet is largely replacing the former employment of concentrated foods for diabetics. Foods classed in this list contain, as a rule, not more than approximately 10 per cent of the nutriment in the form of utilizable sugar-forming carbohydrates.

Cellu Flour, N. N. R.—*Cellulose Flour-C. F. M.*—Commercially pure cellulose in the form of flour.

Uses—Cellu flour is used as a means of filling out reduced diets as in the Allen treatment for diabetics. It is a non-nutritive food substitute used to give bulk to foods, thus serving to satisfy hunger without furnishing nourishment. Purified and bleached wood pulp, straw pulp or cotton fiber is further treated to facilitate grinding to flour.

Cellu flour is white to grayish white in color; odorless and tasteless.

Dose—Cellu flour, after admixture with bran, baking powder, eggs, "India gum", or liquid petrolatum in varying proportions may be used for the preparation of imitation bread, muffins, cookies, griddle cakes, pie crust, etc. These preparations may be seasoned with salt, spices or saccharin.

Manufactured by The Chicago Dietetic Supply House.

Diaprotein Prepared Casein Flour, N. N. R.—Casein to which has been added 4 per cent of a leavening mixture composed of sodium bicarbonate, monocalcium phosphate and sodium aluminum sulphate.

Uses—This flour is employed in cases such as diabetes, in which carbohydrate is contraindicated.

Dose—Diaprotein prepared casein flour is adapted for the preparation of bread, cake, muffins, biscuits, etc.

Manufactured by The Diaprotein Company.

Gluten Food A, Barker's, N. N. R.—A gluten flour prepared from wheat, containing not more than 4 per cent of carbohydrate and 87 per cent of protein.

It is a granular powder, practically without odor or taste. It is insoluble in water.

Uses—Barker's gluten food A is indicated when a diet practically free from carbohydrate is desired, especially in severe forms of diabetes. It can be taken uncooked or made into muffins.

The nutritive value of 500 Gm. of Barker's gluten food A corresponds approximately to 1845 calories, of which 1785 are yielded by protein, 80 by carbohydrate and 30 by fat.

Manufactured by Herman Barker.

Gluten Food B, Barker's, N. N. R.—A gluten flour prepared from wheat, containing not more than 7 per cent of carbohydrate and 85 per cent of protein.

It is a granular powder, practically without odor or taste. It is insoluble in water.

Uses—Barker's gluten food B is indicated when a diet relatively free from carbohydrate is desired. It may be used uncooked or made into muffins.

The nutritive value of 500 Gm. of Barker's gluten food B corresponds approximately to 1917 calories, of which 1742 are yielded by protein, 145 by carbohydrate and 30 by fat.

Manufactured by Herman Barker.

Gluten Food C, Barker's, N. N. R.—A gluten flour prepared from wheat, containing not more than 12 per cent of carbohydrate and 83 per cent of protein.

It is a granular powder, practically without odor or taste. It is insoluble in water.

Uses—Barker's gluten food C is indicated when a diet relatively free from carbohydrate is desired. It can be taken uncooked or made into muffins.

The nutritive value of 500 Gm. of Barker's gluten food C corresponds approximately to 1970 calories, of which 1700 are yielded by protein, 240 by carbohydrate and 30 by fat.

Manufactured by Herman Barker.

Hepco Flour, N. N. R.—A flour prepared from the soy bean, having approximately the following composition: protein, 42.9; carbohydrate, 22.4, of which less than one-half readily yields sugar; fat, 20.8; ash, 5.1; fiber, 4.2, and water, 4.6.

Uses—It is claimed that clinical trials have shown that the carbohydrate in hepco flour is, in the main, not sugar producing and that therefore hepco flour is a suitable food material in cases in which carbohydrate is contraindicated, as diabetes and amylaceous dyspepsia. It has also been suggested for use in the diet in obesity. The nutritive value of 500 Gm. of this flour corresponds approximately to 2,300 calories, of which 880 are yielded by protein, 460 by carbohydrate (on the assumption that all the carbohydrate is utilized), and 960 by fat.

Manufactured by Waukasha Health Products Company.

Hoyt's Gluten Special Flour, N. N. R.—A gluten flour containing protein, 80 per cent, fat, 1 per cent and starch, less than 5 per cent.

Uses—Hoyt's gluten special flour may be given when a diet relatively free from carbohydrate is desired, especially in diabetes. It does not make a satisfactory bread, but may be used to prepare muffins, flat cakes or gruel.

The nutritive value of 500 Gm. of Hoyt's gluten special flour corresponds approximately to 1810 calories, of which 1640 are yielded by protein, 45 by fat, and 125 by carbohydrate.

Manufactured by the Pure Gluten Food Company.

Intarvin, N. N. R.—An artificial fat made from fatty acids having an odd number of carbon atoms. Intarvin is composed of the glyceryl ester of margaric acid admixed with small quantities of glyceryl esters of pentadecylic, palmitic and stearic acids, 82 per cent; liquid petrolatum, 12 per cent; water, 6 per cent.

Uses—Intarvin is proposed for use in diabetes mellitus on the ground that fatty acids containing an odd number of carbon atoms do not yield ketone bodies on oxidation in the normal or diabetic organism, and that for this reason it may with advantage replace the natural fats in the diet.

Dose—From the total number of calories required for the day, the number supplied by the diet is deducted; the remainder is the number of calories per day to be furnished by intarvin. The caloric value of intarvin is 8 calories per gram—approximately 120 calories per heaping tablespoonful.

Intarvin is best taken in its natural granulated form, followed by a drink of water, tea or coffee. It may also be taken mixed with other food, such as salads, coffee, sweet cream or tomatoes.

Lister's Prepared Casein Diabetic Flour, N. N. R.—Milk casein to which has been added a leavening mixture consisting of sodium bicarbonate and acid calcium phosphate and also some sodium chloride, and saccharine 0.057 Gm. per one hundred grams.

Uses—This flour is employed in conditions in which carbohydrate is contraindicated, such as diabetes.

The nutritive value of 500 Gm. of Lister's prepared casein diabetic flour corresponds approximately to 1900 calories of which 1735 are yielded by protein and 165 by fat.

Dose—Lister's prepared casein diabetic flour is adapted for the preparation of muffins, biscuits, cookies, cakes, etc.

Manufactured by Lister Bros., Inc.

Nutrivoid Flour, N. N. R.—A vegetable product composed chiefly of unassimilable carbohydrates (mannans). It contains fat, 0.92 per cent; protein, 4.31 per cent; non-utilizable carbohydrate, 85.37 per cent.

Uses—Nutrivoid flour is used as a means of filling out restricted diets as in the Allen treatment of diabetes. It is a non-nutritive food substance, used to give bulk to food, thus serving to satisfy hunger without furnishing nourishment. Being unassimilated, it adds roughage to the diet and thus aids peristalsis.

Dose—Nutrivoid flour, after admixture with bran and baking powder, eggs, "India gum" or liquid petrolatum in varying proportions, may be used for the preparation of imitation bread, muffins, cookies, griddle cakes, pie crusts, etc. These preparations may be seasoned with salt, spices or saccharin.

Manufactured by the Nutrivoid Diabetic Flour Company.

Soy Bean Gruel Flour, N. N. R.—A flour prepared from the soy bean, having approximately the following composition: protein, 44; fat, 20; sucrose, 10; ash, 4.3; fiber, 2, and water, 4.6.

Uses—Soy bean gruel flour may be used for preparing muffins. It is indicated in cases in which a diet relatively free from carbohydrate is desired, as in diabetes and amylaceous dyspepsia. It has also been suggested for use in the diet in obesity. The nutritive value of 500 Gm. of this flour corresponds approximately to 2027 calories, of which 902 are yielded by protein, 205 by carbohydrate, and 920 by fat.

Manufactured by Cereo Company.

MEAT EXTRACTS

Extracts of meat, as originally sold, were obtained by boiling lean beef in water, skimming off the separated fat, filtering from the coagulated protein and concentrating to a paste. The industry developed through a mistaken notion as to the exact nature of the nitrogenous bodies which went into solution, and before the days of clear ideas on protein chemistry.

In principle, the process of manufacture is still the same; but the "extract" is now largely a by-product. Much of it is obtained by boiling down the thin liquid resulting from the cooking of meat in the canning processes, the same water being used for a number of batches of meat. In the stockyards industries, the trimmings and waste too small for the canning process are often converted into extract. Frequently, hearts, livers, lungs, brains and, indeed, anything which will yield an extract are boiled up for the purpose, giving a product of variable composition.

Roughly speaking, these extracts contain about 20 per cent of water, 20 per cent of inorganic salts, and 60 per cent of organic matter. The average results obtained from a considerable number of analyses of American products are represented by these figures:

Water	20 per cent
Inorganic salts	22.5 per cent
Gelatin and albumose	16.5 per cent
Flesh bases	26.4 per cent
N-free extractives	14.6 per cent

As the figures indicate, the food value of the extracts is rather low, and entirely disproportionate to the high prices at which they are sold. The high selling price is excused by the prevalence of the old notion, carefully fostered, that about 30 pounds of beef must be boiled down to obtain 1 pound of extract. The food value is measured by the albumose and gelatin derivatives present, and to some extent by the nitrogen-free extractives. The percentage amounts of these are often lower than those given above, while the creatin and similar derivatives are higher.

Meat extracts have some value on account of their flavor, in the preparation of soups and bouillons. They are condiments, rather than foods. To use them as foods, in place of meat, as was attempted in the early days of their manufacture, is perhaps even dangerous because of the content of inorganic salts, especially potassium salts. The classification of these products as foods should be discouraged, but their use as appetizers or condiments in the preparation of foods for the sick may still be admitted.

MEAT JUICES

Meat juices proper are obtained by warming chopped meat to a temperature short of the coagulating point of the muscle proteins present (not above 55° C.) and forcing out the juice by means of strong pressure. These juices as usually made, with or without the addition of water, are intended for immediate consumption. It is difficult to prepare them in a stable form for later use, for their sterilization and filtration eliminate most of the protein. Preservation has also been attempted by the addition of considerable quantities of salt, glycerin or alcohol, all of which are objectionable.

Most, if not all, commercial "meat juices" are apparently made by very different methods from the foregoing. In place of being actual protein solutions they are suspensions of blood, finely divided meat powder, peptone-like bodies and other animal derivatives, preserved by aid of glycerin, alcohol and salts. The name "meat juice" is incorrect when applied to such mixtures, whatever their nutritive value may be, and properly speaking, under this designation they are misbranded. It is possible to prepare mixtures of this description which possess considerable food value, but the method of preservation is of the utmost importance.

The essential value of meat juice lies in its food content, which consists, in the case of home-made cold process products, of a liberal percentage of soluble meat protein. The latter may be valuable as food but can scarcely be assumed to furnish any other *unique* therapeutic advantage.

The non-protein portion of the juice represented in beef extract may promote appetite and secretion and perhaps have some ill-defined or indefinable stimulating effect.

PART XII

CHAPTER CXIV

HOMEOPATHIC PHARMACY

HOMEOPATHY was founded by Dr. Samuel Hahnemann, a German physician, born in Meisen, Upper Saxony, on April 10th, 1755.

It was Hahnemann who formulated the system of therapeutics—*Similia similibus curantur*—"like cures like", which is the basis of homeopathic medicine. He first announced his system about 1796.

He made his first "provings" with cinchona, and later "proved" many remedies, such as arsenic, ipecac, belladonna, arnica, nux vomica, veratrum album, hyoscyamus, etc. Hahnemann gave explicit directions for the preparation of homeopathic remedies, and the fundamental rules for all his tinctures and dilutions are found in "Hahnemann's Materia Medica Pura".

His method of making tinctures from the fresh plants, was more complicated than the present homeopathic method; he originally made his tinctures according to a classification based upon the proportion of diluent or menstruum used, compared with a unit quantity of drug, as follows:

Class 1. Tinctures prepared with equal parts by weight of plant juice and alcohol.

Class 2. Tinctures expressed by the aid of two parts of alcohol added to three parts of plant tissue.

Class 3. Tinctures prepared with two parts by weight of alcohol to one part of plant tissue.

Class 4. Tinctures prepared with five parts by weight of alcohol added to one part of plant tissue.

Other numerical classes followed a similar principle of increasing the amount of alcohol in proportion to the amount of drug.

The present method is much simpler, and specifies 10 per cent drug strength for most of the remedies.

Essentials of Homeopathic Pharmacy—The pharmacy necessary in connection with homeopathy differs in many details from other and older methods. Although accuracy is the basis of every method, it is doubly important in homeopathic pharmacy, the distinctive feature of which is its simplicity. Drugs when prepared as medicines for homeopathic use, are never mixed or compounded, but to render them available for use, each, in its natural state is, after proper subdivision, added singly to some vehicle which will serve the purpose of a preservative, as well as a means of extension or dilution.

Cleanliness is of the utmost importance in preparing homeopathic remedies, and the most conscientious care is required in handling drugs of different kinds, and in keeping them from contact with each other. Care must be observed in storing to protect from vapors, odors and the dust from other substances and also in keeping them in cool, airy, dry, and darkened places.

Nomenclature—In the Homeopathic Pharmacopœia of the United States, Third Revision, 1914, issued by the American Institute of Homeopathy, the retention of older botanical names is due to the technical terminology used for

nearly a century, which, like the names of animals yielding medicinal substances, it was deemed unsafe to change. As a rule, the Latin titles as heretofore used in the literature of homeopathy are retained; the generic names of plants and animals are adopted as leading ones, excepting where usage has adhered to the specific name; *e.g.*, Chamomilla is retained in preference to the use of the present botanical genus name Matricaria. The species name, however, has been added in all cases.

The English derivations from Latin titles are also preferred, owing to long usage, such as Aconite instead of Monkshood. The English titles of the chemical salts accord with the latest approved rules of chemical nomenclature. The common English names, such as iron, gold, silver, and lead have been omitted, however, as it has been preferred to arrange them under Ferrum (ferric and ferrous), Aurum, Argentum, and Plumbum, respectively. The common synonyms of medical literature are retained, and the alkaloids and neutral proximate principles are not specially distinguished by Latin terminology. Instead of Strychnia or Strychnine, the homeopath writes *Strychninum*, and for Quinine the older form of *Chininum* is retained. The German nomenclature is used for a great many of the drugs. Thus Cinchona is called *China*; Worm Seed, "*Cina*"; Calomel, "*Mercurius dulcis*"; and Mercury, "*Mercurius vivus*"; Sodium bromide, "*Natrum Bromatum*", etc.

Drugs and Medicinal Substances—A brief definition of the subjects, according to the tenets of Homeopathy may be of interest.

Drugs are defined as substances which have the power of disturbing the health of the living organism. Each drug is capable of exerting this power in a manner peculiar to itself, and therein differs and may be distinguished from other drugs in their tests (provings) upon the normal organism.

The toxic or pathogenic property or power of drugs under certain conditions known to the physician, becomes a curative agent in disease. Hence, substances which are primarily toxic or pathogenic, are secondarily medicines when prescribed in disease, and prepared for that purpose by the pharmacist.

Derivation of Drugs—The drugs from which the materia medica is derived represents all great natural divisions, such as animal, plant, and mineral, and also many artificial products of chemistry. There are about six hundred and ninety official remedies in the Homeopathic Pharmacopœia, but of the thirty-two or more animal substances official, only a few are in common use.

Plants used as homeopathic medicines are much more numerous. Next to them in frequency of use come the chemical preparations, metals, and minerals. Animal substances should be prepared from perfect and healthy specimens and in their pure, unadulterated state, unmixed with any other substance. They should be protected against light, air, and moisture, if they are to be preserved before being made into tinctures or triturations.

With few exceptions, as nux vomica, ipecac, china and cina, the drugs are used and preparations made from them while fresh and undried. Every homeopathic pharmacist gathers many fresh drugs at the season when most active, and according to the rules laid down in the Homeopathic Pharmacopœia. Thus, if he is to collect whole plants, they are to be collected in the flowering season during sunny weather. They should be carefully cleaned by shaking, gentle rubbing, or brushing, without the contact of much water, or still better, only clean specimens are to be selected.

The Unit of Medicinal Strength—To avoid the varying strengths advised by Hahnemann for different drugs and to secure uniformity in strength (drug power) of all preparations and attenuations, thereby making dilutions and triturations of equal degree correspond in medicinal strength, the revision

committee has in all cases made the dry, crude drug, the unit taken as the basis for calculation.

It should be understood, however, that the freshly collected undried drugs are still required in the preparation of tinctures, and the plant moisture is to be regarded as a part of the vehicle or menstruum, it being evident that the water contained in the plant is but a solvent and forms no part of its medicinal substance.

Adopting this rule in the tincture-making processes, the rule of the British Homeopathic Pharmacopœia has been followed, thereby securing uniformity of strength.

In every instance, the dry, crude substance is taken as the starting point from which to calculate its strength, and with very few exceptions, the mother tinctures contain all of the soluble matter of one grain of the dry plant in ten minims of the tincture.

The tincture, therefore, represents ten per cent of medicinal substance, or, in other words, the soluble constituents of one-tenth of the amount of crude drug, represent the 1× (1/10) corresponding in strength with the 1× trituration. Uniformity is thus secured and the signs 1× or 1/10, in connection with any form of attenuation will always represent a drug power of one-tenth. The sign 2× will show the presence of 1/100 part drug substance, and 3× will show 1/1000 part.

Preparations of Drugs—General Principles—Starting with crude drugs, the next step is to prepare them for medicinal use. There are two fundamental forms, the fluid and the dry form, to be governed by the following directions and principle.

All substances soluble in the proper menstrua or vehicles may be made into solutions or tinctures and their dilutions, and also may be made into triturations with milk sugar, but insoluble or only partially soluble substances may only be made into triturations.

Aqueous solutions are made of substances which are soluble in water but not in alcohol, or, when soluble in alcohol, are subject to chemical change or decomposition. These are to be dissolved in the proportion of 1/10, 1/100, 1/1000, depending upon the degree of solubility of the substance. Aqueous solutions are, as a rule, unstable and will keep but a short time. They should be freshly made.

Solutions of fluids in alcohol: These are equivalent to tinctures, and are made of substances which yield either wholly or in part their medicinal properties to alcohol. This applies to liquids like turpentine, oils, etc. These should be made on the decimal scale; that is, in proportion of one part by weight of medicinal substance to be added to sufficient alcohol to make ten parts by volume, and hence equal to the first decimal dilution to be marked 1×. If not soluble in the proportion of one to ten, they should be prepared by adding one part, by weight, of drug to ninety-nine parts, by volume, of alcohol, and the product marked 2×. Such solutions are also to be made of alcohol of known strength in order that they may be employed in making the succeeding dilution.

If liquid acids or drugs contain water, this should also be deducted from that contained in the solvent and the anhydrous acid or drug taken as the unit of strength.

Homeopathic Tinctures

Tinctures are alcoholic solutions of solids or semi-solids. Most tinctures are made from plants or their parts and their treatment deserves special mention. It is very important that tinctures should be of uniform strength,

instead of varying greatly on account of the variability of water contained in the same plant at different seasons and under difficult conditions of growth.

Fresh, succulent plants and other substances containing water should be treated according to the fundamental rule, that the dry crude drug is taken as the starting point from whence to calculate the strength of the tincture. Hence the pharmacist is to proceed by first taking a suitable quantity of the fresh plant or substance containing water, weighing it, evaporating on a water bath until dry and thereby determining the percentage of water present in the fresh plant. Allowance must be now made for this in the preparation of the menstruum.

The dry sample of crude material is then taken as the unit of strength, the tincture being made to represent one part of this dry crude material in each ten parts of completed preparation. It is, however, understood that the fresh green plant is to be used in the preparation of the tincture.

Having determined the amount of dry substance obtainable from a given quantity of the fresh moist material, this is to be compared with the formula for this tincture in the Homeopathic Pharmacopœia. If the weight shows less moisture than permitted by the formula, add enough distilled water to the moist magma to equal the standard weight. If, on the contrary, the amount of moisture exceeds that permitted by the standard formula, deduct enough from that intended for the dilution of the solvent alcohol to reduce it to the standard weight. Or, when for practical reasons this cannot be done, resort to the slower method by cautious drying in moderate temperature, or evaporating enough of the drug moisture to reduce it to the standard of the formula.

In this process, both in the case of deficiency and of excess of water in the drug, it is to be remembered that the tincture finally consists of alcohol, the necessary proportion of water, plus that of the drug substance dissolved. The preparation of tinctures is then continued according to one of the following processes of maceration or percolation.

Maceration—This process is preferable in the treatment of large quantities of drug material needing ample time for the extraction of medicinal properties. If the drug substance can be finely sliced or reduced to pulp in a glazed mortar, this should be done, otherwise it may be used without cutting or crushing as directed under its special head in the Homeopathic Pharmacopœia.

Having ascertained the excess or deficiency of water, strictly according to the rule given above, place the material, reduced to magma, or in its natural state if unreducible, into a macerating jar or wide-mouthed bottle, and add the prescribed quantity of solvent, making it cover the whole mass if possible. The jar or bottle should be carefully stoppered or sealed to prevent evaporation, placed in a dark room of ordinary temperature, and shaken every day. The time necessary for the extraction and solution of the medicinal substance is variable, and it is safe to allow the process of maceration to continue from two to four weeks, according to the nature of the material. The clear liquid is then decanted, the residue transferred to a clean linen cloth or bag, pressed, and the liquids mixed.

Percolation—This process is rarely used in homeopathic pharmacy and the methods have been described in Chapter XXIII.

Dilutions or Liquid Attenuations—The homeopathic axiom calls for the utmost simplicity in prescribing and preparing drugs, as only one medicine is used at a time; that is, one medicine is never mixed with another medicine. It is a principle of Homeopathy that a very small quantity of medicine will produce effects, provided it is well diluted with menstruum or solvent, since it is

assumed that the immense increase in points of contact more than compensates for the minuteness of the quantity.

The process of dilution by a progressive scale of one part of tincture to one hundred parts of vehicle, known as the centesimal scale, was recommended by Hahnemann and adopted by him as the standard. Under this rule, each attenuation contains just 1/100 part as much of the drug substance as the preceding attenuation. In order to secure intermediate grades of strength, there has been introduced the method of diluting in the proportion of one in ten, in place of one in one hundred, thus constituting the decimal scale. The great advantage offered in the use of this scale has led to its almost universal acceptance and adoption for the preparation of dilutions and triturations.

Attenuation or extension is accomplished in the process of dilution, as well as in that of trituration, with lactose or sugar of milk, by the interposition of the vehicle between either the molecules of the fluid or the particles of the solid drug to be attenuated. This interposition is molecular in the case of soluble substances. In dry triturations there occur only the inter position of lactose between the minutest particles attainable by trituration of hard, insoluble substances.

In the decimal scale the original quantity of medicine is divided progressively by ten, so that the first decimal (1×) contains 1 to 10, the second decimal (2×), 1 to 100, the third decimal (3×) 1 to 1000 of the original substance which is suspended in, or attenuated, or expanded by the diluent which is usually alcohol or other menstruum. As solutions and tinctures according to the rules are to contain one part of drug substance in ten parts by volume of diluent, each tincture (with few exceptions) is equal in medicinal strength to the first decimal dilution (1 to 10 or 1×).

Where certain drugs are insoluble in the proportion of one to ten and require more solvent, like arsenicum album, phosphorus, sulphur, etc., their original solutions or tinctures, should be prepared in the proportion of one to one hundred, or one to one thousand, dependent on the degree of solubility, and the resulting solutions or tinctures are to be regarded as the second decimal (2×) or third decimal (3×), respectively.

To Make Dilutions or Attenuations of Soluble Substances—Take a new, well-cleaned vial, of a capacity of four drachms or more, measure into it 1 cc. of the tincture to be diluted, and, with a file, mark on the vial the height of the liquid. Then add 9 cc. of the alcohol and likewise mark the height of the whole on the vial; cork it well with a well-washed, flawless cork, and shake thoroughly until the contents are well mixed. Pour this dilution into another clean, well-corked vial and mark it with the name of the medicine, followed by the sign 2×, indicating the second decimal solution.

The first vial bearing the marks is now used as the measuring vial for subsequent dilutions. These are to be made in the same manner, by pouring 1 cc. of the preceding dilution into the measuring vial up to the lowest mark, giving at least ten forcible shakes for each attenuation, and then adding 9 cc. of alcohol to the highest mark, shaking, turning into another vial, labeling and marking it 3×, and so on as far as desired.

Dispensing alcohol of 87 per cent is used from the 3× upwards, unless otherwise directed in Part Two of the Homeopathic Pharmacopœia.

Belladonna ϕ 1/10	1 volume
Distilled Water	4 volumes
Dispensing Alcohol	5 volumes
Equal to	10 volumes

This produces Belladonna 1–100 or 2×.

If tinctures are not made in accordance with the formula of 1–10, and if their medicinal strength is known, the volume of the diluent will have to be calculated accordingly. If the tincture is made in proportion of 1–100, add 9 volumes of solvent to 1 part of the tincture, and mark the dilution 3×. If the tincture is in proportion of 1 to 1000, the first dilution made as above is to be marked 4×, etc.

Dilutions from Triturations—The first dilution prepared from a trituration is 8× and should be made by dissolving one grain of the 6× trituration in 50 minims of distilled water, and adding thereto 50 minims of dispensing alcohol. The next dilution (9×) should be made by adding to each minim of the 8× dilution 9 minims of dispensing alcohol, etc. Each attenuation should be shaken thoroughly at least ten times.

Homeopathic Triturations

Triturations consist of any medicinal substance triturated as intimately as possible with lactose. The method of Hahnemann is still adhered to with the exception of using one part of the drug to 9 parts—instead of 99 parts of lactose, and instead of adhering to the one-hour rule, the time to be allotted to triturations is determined by the nature of the substance triturated and by the fineness to which it is possible to reduce it. If an insoluble substance, this can best be determined by the microscopic test as will be shown. Mortars and pestles should be as clean as it is possible to make them by steam or by washing them with water and rinsing with alcohol, especially for non-volatile or insoluble substances like copper, lead, sulphur, etc.

First Trituration—Add 1 part by weight of the drug to 9 parts by weight of finely powdered lactose and triturate until the largest drug particles do not exceed 1–500 of an inch in diameter: This rule is inapplicable to moist and soluble substances and relates chiefly to those which are hard and practically insoluble, such as metals and minerals. Most of the metals require many hours of trituration before this degree of fineness is reached. The product is to be designated as the first decimal trituration, 1 in 10 (1×).

Second Trituration—This is made by adding 1 part by weight of the 1× trituration to 9 parts by weight of lactose, and by continuing the process of trituration until the largest drug particles have been reduced to no more than 1–2000 of an inch in diameter, except in case of drugs with which experiment has demonstrated the impossibility of attaining this degree of fineness.

The *Third, Fourth* and subsequent triturations are to be made in the same manner, that is, by grinding one part by weight of the preceding trituration with 9 parts by weight of lactose, until the largest particles of the third trituration do not exceed 1–4000 of an inch in diameter, with some few exceptions where experiment has demonstrated the impossibility of reaching this degree of fineness.

Tincture Triturations—These are prepared directly from strong tinctures, consequently they contain the soluble constituents only of the drugs and should therefore be clearly distinguished from triturations made to include the entire drug substance. They can be designated by adding a minus sign above the figure denoting strength; for example $1\bar{\times}$ indicating that this preparation contains less of drug material.

In making, add 10 cc. of strong tincture and 10 Gm. of lactose, mix carefully in a mortar, and cover with white paper until the moistened powder is nearly dry; then triturate gently until quite dry.

Forms of Vehicles for Prescriptions

These, like all other conditions of homeopathic pharmacy, should be governed by simplicity and usefulness to the physician and patient. For this purpose pharmacists have employed certain forms made of sucrose or cane sugar and lactose, or milk sugar. These may be used simply as medicated powders or as pellets (globules), tablets, cones, etc. These are made sufficiently small to serve as a convenient vehicle for dosage.

Trituration Tablets—This form may be also given to triturations themselves; and as these tablets are always of known weight, they serve the purpose of measuring the dose and save the physician trouble and time. This method of prescribing is very popular with the homeopathic physician.

Medications—Medicated powders are prepared by adding to each 10 Gm. of lactose, 1 cc. of the next lower than the desired strength of dilution, mixing the same in a mortar, and triturating until fully dry. The resulting powder will represent the degree of strength next above the dilution used in its preparation and should be so marked.

Medicated Globules also called *pellets* or *pilules*, are made of cane sugar. They are formed into small globular masses of different sizes, designated according to the diameter of ten globules measured in millimeters. They should be made of the purest materials, should be perfectly white and odorless and able to withstand all the tests prescribed for sucrose or cane sugar.

Globules are medicated by placing them in a vial, and adding the dilution in sufficient quantity and allowing them to stand a sufficient length of time to saturate them; any excess of liquid being poured off.

Medicated Cones, also called *disks*, are made of sucrose and rendered more absorbent with the addition of a small amount of egg albumen, which makes them light and porous. They are formed in hemispherical masses, and are designated according to size by the diameter of the base in millimeters. The common size (number six) should absorb about two drops of dispensing alcohol. They should be medicated by adding a sufficient quantity of the dilution to saturate them, pouring off the excess of the liquid.

Homeopathic Prescriptions

(1) The name of the medicine is to be plainly written, preferably in Latin or in one of the names in the Special Part Two of the Homeopathic Pharmacopœia.

(2) The form should next be stated as indicated in the examples given below, defining carefully by the signs in use whether a tincture, dilution, or trituration is desired. This is done by adding the abbreviation, "Tinct." or "ϕ", "dil.", "trit.", or, in case of either of the latter, to the number of the dilution or trituration the sign "×" or "c" (decimal or centesimal scale) as an exponent, "*e. g.*", "3×", "6×", "3c", etc.

(3) If the medicated, molded form is desired, this is also to be plainly stated in words, *e. g.*, tablets, pellets, etc.

(4) The quantity should also be stated explicitly in the usual signs of metric or apothecaries' weights.

(5) The dose and its frequency of repetition is plainly to be written under the head of Signa or Directions.

Abbreviations: Homeopathic prescriptions are often abbreviated, sometimes to an extreme, the nomenclature permitting this without ambiguity.

Example of Homeopathic Prescriptions:

℞ Bryonia ϕ gtt. xx
Aquæ dest. f ʒiv
Misce.
Signa: One teaspoonful every two hours.

℞ Belladonna ʒ x dil. min. xx
Aquæ dest. f ʒii
Misce.
Sig: One teaspoonful every hour.

℞ Nux vomica 6× 3 iv
on pills no. xxxv
Misce.
Signa: Take five pills every two hours.

℞ Chininum ars. 3× trit. ℥ i
Sacch. lact ℥ ii
M. ft. pulv. no. xxiv
Sig: One powder every two hours.

℞ Ferrum phos. 2× T. T. ʒii
Signa: One tablet every hour.

PART XIII

THE PHARMACIST IN COMMUNITY HEALTH SERVICE

CHAPTER CXV

HOUSEHOLD PESTS AND THEIR ELIMINATION

"A PRESENT help in trouble" might be the phrase which the general public applies to the pharmacist when annoyed by the several varieties of household pests. When the house fly arrives, the housewife no longer energetically wields the fly swatter, but hies herself to the drug store to ask for one of the several deadly preparations that may be used as a spray to kill flies. With the coming of March it is to the drug store that she goes to get naphthalene, camphor, or some other remedy for the exterminating of those fabric pests called moths. Or, it may be, that the pantry has suddenly been invaded by roaches or ants, or, upon moving into a new home the disgusted homemaker will discover that the house is inhabited by more than her family, perhaps by bedbugs or fleas. Under such circumstances her unfailing help is the pharmacist. So it may readily be seen that a knowledge of household pests, their life history, and a means of controlling and eradicating them is most necessary.

The demands from the public for methods of elimination have been so insistent that the United States Department of Agriculture and the United States Public Health Service have issued a number of Bulletins in which are set forth the life history of the several pests and the best known methods of control. Liberal quotations from these Bulletins are included in this Chapter by permission, and a bibliography is added.

In practically every instance the first step in destruction of these annoying pests is to find the breeding places and also the sources of food supply and to eliminate these. Other measures usually must follow but much of the difficulty is overcome when these two points have been taken care of.

Insects play a definite rôle in the transmission of disease. Many of the most serious ills of man are conveyed from person to person through the medium of mosquitoes, flies, lice, ticks, and other forms of vermin. How the transmission of disease is effected, the particular insects acting as carriers, and the means of combating such pests have all become matters with which the public is concerned.

Flies

Recently it has been possible to convict the fly of many of the crimes and misdemeanors of which it is guilty. We now know that flies, instead of being harmless insects, of moment only when they invade our food supplies, are in reality highly dangerous, and that a single fly may be responsible for the development of typhoid fever or other illness of a serious nature.

Kinds of Flies—There are many kinds of flies, not all of which have the same structure, habits, or methods of reproduction.

The varieties of interest in connection with public health are the house fly, the blue bottle or blow fly, the green bottle fly and the stable fly. Of these the house fly is the most important. This insect is ordinarily present in

all parts of the world and lives in practically any climate adapted to man. Nine-tenths of the flies found within or near dwellings belong to this group, although a number of other species so closely resemble house flies in appearance that differentiation may be impossible by other than experts. The favorite haunt of the house fly is the dwelling of man, and it is seldom found away from human habitations.

Reproduction—Flies are extremely prolific. The stages in the life cycle occupy at the most but a few days, and sexual maturity is reached within three or four days from the date of birth. As the eggs deposited by the female usually number a hundred or more, an enormous increase in the fly population is possible within a short period of time.

Nearly all flies breed in organic filth. A favorite medium is horse manure, but decaying vegetables, fermenting kitchen refuse, human excreta, and putrefying animal matter offer sites which are nearly as well adapted to the conditions necessary for propagation. The barn manure pile may be the place of origin of thousands of flies, the unprotected and unscreened privy serves as an excellent nidus for their growth, while fermenting foodstuffs and other waste food products scattered about the yard may also assist in their propagation.

The breeding season varies with the climate, usually beginning during May in the North, but more often in early April or March in the South; propagation continues until late September. The fly population is usually greatest during August and September, after which it very rapidly diminishes.

Carriers of Disease—Flies may transmit disease in either of two ways. The first method is by mechanical transference, whereby the insect becomes contaminated with the parasites or microörganisms of disease as a consequence of frequenting filth and places where these agents abound, thus carrying pathogenic organisms directly to food or drink partaken of by man. This is by far the most common method of conveyance.

The second method of disease transmission is by inoculation; that is, the actual injection into the system by the insect of pathogenic organisms or parasites.

Typhoid fever is the most common and important infection of man conveyed by flies.

Food purchased in fly-ridden markets may be a source of contamination, and if eaten uncooked may lead directly to illness. Cooked food of whatever nature may be contaminated subsequent to the cooking, constituting a serious menace to health. Irrespective, then, of the precautions we exercise as individuals, we are all more or less exposed to the infection of typhoid fever through common sources. Further, as a result of the laxity of others, even when we ourselves may have exercised every precaution necessary to prevent the development of flies, our lives are frequently endangered.

Eradicative Measures—The most successful method of ridding a community of flies is to institute a continued campaign for that purpose. It is only by the united efforts of all residents, supplemented by the support of the health department and civic organizations in general, that progress in fly eradication is possible.

How to Exclude and Destroy Flies—The principal effort to control this dangerous insect must be made at the source of supply—its breeding places. Absolute cleanliness and the removal or destruction of anything in which flies may breed are essential.

The Use of Screens—A careful screening of windows and doors during the summer months, with the supplementary use of sticky fly papers, is a protective measure against house flies known to everyone. As regards screening

it is only necessary here to emphasize the importance of keeping food supplies screened or otherwise covered so that flies can gain no access to them. This applies not only to homes, but also to stores, restaurants, milk shops, and the like.

Traps—The most common form of trap is the conical or cuboidal wire-gauze affair, baited with saccharine substances and arranged in such a manner that the insect passes through a small opening into a large space from which it is unable to emerge. As traps go, they are generally effective, but flies, like animals, are often reluctant to enter places from which they can not escape.

Poisons—Of substances poisonous to flies, formalin is perhaps most useful. It should be diluted with about 40 parts of water and placed in saucers about the room, at the same time removing all other liquids. After being denied all fluids for several hours the flies will drink the formalin solution and die, but the success of the plan is wholly dependent upon the complete removal of other liquids. A modification of this plan is to make the dilution with milk, placing a piece of bread in the saucer on which the flies may alight.

A fly poison about equal in efficiency to the formalin solution mentioned above can be prepared with sodium salicylate. A solution should be made by adding three teaspoonfuls of sodium salicylate (a powder) to a pint of water. As this solution is somewhat repellant to flies, three tablespoonfuls of brown sugar should be added.

A convenient container that will automatically keep the solution available for flies to drink may be easily made. A thin-walled drinking glass is half filled with the liquid poison. A saucer or small plate in which has been placed a piece of white blotting paper cut the size of the dish, is put bottom up over the glass. The whole is then quickly inverted, a match placed under the edge of the glass, and the container is ready for use. As the solution dries out of the saucer more liquid flows into the dish, always keeping the paper moist.

Of other fly poisons, mention should be made, merely for the purpose of condemnation, of those composed of arsenic. Fatal cases of the poisoning of children through the use of such compounds are far too frequent, and owing to the resemblance of arsenical poisoning to summer diarrhea and cholera infantum, it is believed that the cases reported do not by any means comprise the total. Arsenical fly-destroying devices must therefore be rated as extremely dangerous and should never be used, even if other measures are not at hand.

Sticky fly papers may serve a useful purpose.

Fumigation with sulphur dioxide gas, generated by burning ordinary brimstone, is a valuable insecticidal measure, but unfortunately is injurious to fabrics and to painted and other surfaces. The sulphur should be used in quantities not less than 1 pound per 1000 cubic feet of space, moistened with alcohol, and ignited, care being taken that the metal container is placed in a pan of water. Pyrethrum, or insect powder, may also be burned, but it is expensive and only temporarily stupefies the insects.

Fly Sprays—Probably the most efficient method so far developed for the destruction of flies about the home is the use of liquids sprayed about the room. Many of these have been offered within recent years. They consist of a special petroleum solvent, slightly lighter and less oily than kerosene, which has been percolated through from 5 to 10 per cent of good quality Dalmatian or Japanese insect powder. The percolate is subsequently perfumed with some odorous substance such as methyl salicylate. For spraying a tin pump-sprayer is used, the room should be closed for a short time, and sufficient liquid should be used to make the spray apparent throughout the room. These products are distinctly toxic to insects and one should be selected which will cause the death of the flies within a few moments.

Fly-swatting campaigns, of themselves, are not sufficient for the elimination of flies. Usually they are inaugurated only at the height of the fly season when a perceptible diminution in the number of insects present is not possible.

Mosquitoes

Mosquitoes are man's inveterate tormentors and foes. At the seaside, on the undrained prairies of the West and Northwest, in the far North, by woodland pool and mountain meadow, these bloodthirsty brigands in countless myriads waylay the individual on business or pleasure bent.

Swamps, ponds, and marshes, however, are not the only places which breed mosquitoes. A little rain water in an old tin can or undrained roof gutter if neglected will supply mosquitoes for a town or city neighborhood spreading discomfort, causing insomnia and tempting to profanity.

If mosquitoes were merely a bothersome plague there would be ample justification for unrelenting warfare against them; but when we consider that a certain kind of mosquito found in houses in the South will convey yellow fever from infected to healthy persons and that certain other kinds, by disseminating malaria, render many regions of great fertility almost uninhabitable, no argument for fighting them is necessary.

Protection from Bites—Spirit of camphor rubbed upon the face and hands or a few drops on the pillow at night will keep mosquitoes away for a time, and this is also a well-known property of oil of pennyroyal or oil of citronella. None of these substances is effective for more than a short time; that is to say, a single application will not last through the night. Oil of tar, oil of peppermint, lemon juice, and vinegar have all been recommended as mosquito repellents. An excellent mixture suggested by C. A. Nash, of New York, is as follows:

Oil of citronella	1 ounce
Spirit of camphor	1 ounce
Oil of cedar	½ ounce

Ordinarily a few drops on a bath towel hung over the head of the bed will keep the common house mosquitoes away. Where they are very abundant and persistent a few drops rubbed on the face and hands will suffice. Even this mixture, however, loses its efficiency toward the close of a long night. It is the habit of the yellow-fever mosquito (Stegomyia Aedes calopus Meig), to begin to bite at daylight. By that time the average person is sleeping very soundly, and the effects of the mixture will usually have passed largely away. It follows that in the Southern States, where this mosquito occurs, these protective mixtures are not supposed to be as effective as they are in the North. As a matter of fact, however, this last mixture, could it be applied shortly before dawn, would be as effective as under other circumstances.

A mixture recommended by E. C. Gane, of New York, is as follows:

Castor oil	1 ounce
Alcohol	1 ounce
Oil of lavender	1 ounce

This mixture was prepared for the purpose of avoiding the odor of the oil of citronella.

Oscar Samostz, of Austin, Texas, recommended the following formula:

Oil of citronella	1 ounce
Liquid petrolatum	4 ounces

This mixture greatly retards the evaporation of the oil of citronella.

Mr. B. A. Reynolds has used successfully in New Orleans 20 minims of oil of citronella to the ounce of petrolatum or lanolin.

A 5 per cent solution of potassium sulphate has been recommended, also oil of cassia. Pure kerosene has also been used extensively in the Philippines.

Screens and Canopies—Such obvious measures as the screening of houses, the use of netting for beds, and the wearing of veils and gloves after nightfall in badly infested regions need no detailed consideration. Screening of houses cannot be too carefully done, and adjustable, folding, or sliding window and door screens seem never to be tight; even with well-fitted screens there are often opportunities for mosquitoes to enter; constant care and vigilance alone will prevent this. In certain seasons in mosquito regions, mosquitoes will attempt to make their way through screens and are often able to do so. When the insects are very numerous, wire screens should be painted lightly with kerosene or oil of citronella.

With bed canopies there should be ample material to admit of a perfect folding of the canopy under the mattress, and the greatest care should be taken to keep the fabric well mended. It often happens in mosquito regions that little care is taken of the bed nettings in the poorer hotels, and it is necessary for perfect protection that a traveler in the Southern States should carry with him a pocket " housewife " and should carefully examine his bed netting every night, prepared to mend all tears and expanded meshes. Veils and nettings for camping in the Tropics or other regions where mosquitoes abound are absolutely necessary. Light frames are made to fit helmet-like over the head and are covered with mosquito netting. Similar frames, readily folded into a compact form, are made to form a bed covering at night, and every camping outfit for work in tropical or malarial regions should possess such framework and plenty of mosquito netting as an essential part of the outfit.

The size of the mesh in mosquito bars and window screens is important. Twenty meshes to the inch can be relied upon to keep mosquitoes out, but 15 to the inch admits some of them.

Smudges and Fumigants—Anything that will make a dense smoke will drive away mosquitoes, and various smudges are used by campers. For household use a number of different substances have been tried.

Pyrethrum Powders—Pyrethrum powders, known to the trade as Dalmatian insect powder, Persian insect powder and Buhach, are very effective when fresh and pure. Pyrethrum powders are usually used dry, and are puffed or blown into crevices frequented by insects, or puffed or blown into the air of a room in which there are mosquitoes. The burning of the powder in a room at night is common practice. The powder is heaped up in a little pyramid which is lighted at the top and burns slowly, giving it a dense and pungent smoke. Often the powder is moistened and molded roughly into small cones, and after drying it burns readily and perhaps with less waste than does the dry powder. Mosquitoes are stupefied by the smoke and fall to the floor, where they may be swept up and burned. With open windows and constant currents of fresh air this fumigation is not especially effective, and it is necessary, for protection, to sit in a cloud of smoke. The powder may be placed upon a metal screen above the chimney of a kerosene lamp, with the result that the vapor of the volatile oil will be dissipated. This is said to be very effective. It is economical in powder, and the odor is slight. Another method of burning the powder is to puff it from an insufflator into a burning gas jet. In New Orleans it has been found that in order thoroughly to clear houses of mosquitoes Pyrethrum must be burned at the rate of nearly 1 pound of powder to every 1000 cubic feet of space.

Mim's Culicide—This mixture is made of equal parts by weight of phenol or carbolic acid crystals and camphor. The phenol crystals are melted over a gentle heat and poured slowly over the camphor, resulting in the production of a clear, somewhat volatile liquid with an agreeable odor. This liquid is permanent, if kept in tightly closed containers. Volatilize 3 ounces of this mixture over a lamp of some kind for every 1000 cubic feet of space. A simple apparatus for doing this may be made from a section of stovepipe cut so as to have three legs and an outlet for draft, an alcohol lamp beneath and a flat-bottom basin on top. The substance is inflammable, but the vapor is not explosive. The vapor is not dangerous to human life except when very dense, but it produces a headache if too freely breathed. Rooms to be fumigated should be made as nearly air-tight as possible.

Sulphur Dioxide—Burning sulphur, in a small pot, at the rate of 2 pounds of sulphur for each 1000 cubic feet of space, is efficient against mosquitoes where fumigation in the case of possible disease-bearing mosquitoes is desired.

Catching Adult Mosquitoes—An interesting home-made apparatus in common use in many parts of the United States is very convenient and effective. It consists of a tin cup or a tin-can cover nailed to the end of a long stick in such a way that a spoonful or so of kerosene can be placed in the cup, which may then, by means of the stick, be pressed up to the ceiling so as to inclose one mosquito after another. When covered over in this way the captured mosquito will attempt to fly and be caught in the kerosene. By this method perhaps the majority of the mosquitoes in a bedroom—certainly all of those resting on the ceiling—can be caught before one retires.

Remedies for Mosquito Bites—The most satisfactory remedy seems to be moist soap. Wet the end of a piece of ordinary toilet soap and rub it gently on the puncture, and the irritation will soon pass away. Ammonia, alcohol, and glycerin, have also been recommended.

Abolition of Breeding Places—Stagnant water is necessary for breeding, and all possible places should be eliminated.

Where a rain-water tank is necessary it should be screened. The waste places in the immediate vicinity should be carefully searched for tin cans, bottles, and wooden or tin boxes in which water can accumulate and all such receptacles should be destroyed or carried away. The roof gutters of every building should be carefully examined to make sure that they are not clogged so as to allow the water to accumulate in pools. Where the branches of tall trees over-hang roofs this is especially likely to occur by the agency of falling leaves or twigs. The chicken pans in the poultry yard, the water in the troughs for domestic animals, the water cup of the grindstone are all places in which these mosquitoes will breed and water should not be allowed to stand in them for more than a day or so at a time.

Even in the house mosquitoes breed in many places where they may be overlooked. Where the water in flower vases is not frequently changed, mosquitoes will breed. They will breed in water pitchers in unused guest rooms. They will breed in the tanks in the water-closets in pipes and under stationary washstands where these are not frequently in use, and they will issue from the sewer traps in back yards of city houses during dry spells in the summer time when the sewers have not recently been flushed by heavy rains. In warehouses and on docks they breed abundantly in the fire buckets and in water barrels. Of course such places as these cannot be abolished, but should be treated in accordance with measures indicated in another section.

Fountains and ornamental ponds are frequent breeding places, and here the introduction of fish, is usually all-sufficient. It is necessary, however, to keep

the edges of such ornamental ponds free from vegetation where the larvæ may find refuge, and to choose aquatic plants whose growth will not permit of mosquito-larvæ protection.

Public dumps are great breeding places, because here are found old bottles, cans, boxes, bits of tin or iron vessels, and other objects in which water may accumulate for a time. Even a very small amount of water will make a breeding place for very many mosquitoes. It is quite possible for a broken portion of a pint bottle to contain enough water to yield literally thousands of mosquitoes.

Drainage measures really form a part of the consideration of the treatment of breeding places. Drainage on a small scale for the purpose of doing away with mosquitoes has been practiced for a long time, and in many parts of the country large-scale drainage with mosquito abolition in view is going on, notably in New Jersey and in California and results of great value have been reached.

While it is obviously best to abolish breeding places in the ways mentioned, it often happens that it is not possible to drain, and at least as a temporary expedient it becomes desirable to treat the water so as to kill the mosquito larvæ. Many substances have been tried, and, aside from certain proprietary mixtures, nothing has given such good results as the use of oils. Efforts to find oils that can be used to better advantage than petroleum have failed. Common kerosene of low grade, or of the grade known as fuel oil, is the most satisfactory as regards efficiency and price.

As to quantity, under still conditions, an ounce of kerosene to 15 square feet of surface space is about the right proportion, and in the absence of wind such a film will remain persistent for 10 days or slightly longer. Not only are larvæ and pupæ destroyed by the kerosene film, but many adult mosquitoes alighting on the surface of the water to drink or to lay their eggs are killed by it.

Small ponds can be sprinkled with an ordinary watering pot with a rose nozzle or pouring it out of a dipper or cup will be satisfactory.

In Panama a larvicide is being used which is made as follows: One hundred and fifty gallons of phenol is heated in a tank to a temperature of 212° F. Then 150 pounds of powdered or finely broken resin is poured in. The mixture is kept at a temperature of 212° F. Thirty pounds of caustic soda is then added and the solution is kept at the same temperature until a perfectly dark emulsion without sediment is formed. The mixture is thoroughly stirred from the time the resin is added until the close of the operation. One part of this emulsion to 10,000 parts of water is said to kill Anopheles larvæ in less than half an hour, while 1 part to 5000 parts of water will kill them in from 5 to 10 minutes. At a larvicide plant at Ancon 46,000 gallons of this mixture was made at a cost of $0.1416 per gallon. Although this mixture has been used to a large extent in Panama, crude oil was also used for streams having a fair velocity.

Natural Enemies of Mosquitoes—The common goldfish and silverfish destroy mosquito larvæ and should be put in artificial ponds. Top-minnows of several species have been introduced successfully in several localities and are great feeders upon mosquito larvæ.

There are many predatory aquatic insects that feed upon mosquito larvæ; others that catch the adults. Certain birds prey upon the adults, and bats also eat them.

Moths

Clothes moths are the prime offenders among fabric pests and there is no pest more hated by the housewife. The moths or "millers" most common about houses have a wing spread of about half an inch and are yellowish or buff-colored.

Harmless Moth Miller the Parent of a Destructive Worm—The moths, or millers as they are often called, have imperfectly developed mouth parts and could not feed upon fabrics if they desired. Their purpose in life is merely to lay eggs that develop into the worms or larvæ, which alone can cause destruction. Only the worm or larva of the clothes moth is capable of destroying fabrics.

Food of Clothes Moths—Clothes moths feed upon wool, fur, hair, feathers, and all fabrics manufactured from them. They also relish dried animal matter such as dead insects, including the dead of their own species, and untreated skins, beef meal, casein, etc. A single piece of hair-stuffed or feather-stuffed furniture may keep a house well stocked with clothes moths for years. Clothes moths almost never injure household fabrics or wearing apparel in daily or weekly use, or articles that are brushed, cleaned, or beaten once or twice a month. Furniture, on the other hand, may be in constant use and still be badly infested.

Clothes-moth eggs hatch most readily in warm summer weather in from four to eight days. During colder weather hatching may not take place for three weeks. In steam-heated buildings hatching does not require a much longer time than that taking place in warm summer weather.

The Larva—Of all the stages, the larva or worm stage—the only stage in which clothes moths damage fabrics—is the most susceptible to outside influences upon its growth.

While it is true that wearing apparel is not damaged by clothes moths if in daily or weekly use, the occasional appearance of moths in steam-heated houses in late winter makes it clear that moth eggs may be laid on susceptible articles at any time they are not in use and that if laid away without precautionary measures being taken to safeguard them they may be quite unexpectedly damaged in storage.

Remedies Recommended—There are effective methods for the control of fabric pests by the use of which the losses due to them can be reduced to a minimum. The fumigation of houses is not feasible or necessary for all, but careful attention to the details of cleaning, brushing, and, if possible, to sunning of fabrics immediately before they are stored with naphthalene or paradichlorobenzene or wrapped tightly in paper with these crystals is an effective and inexpensive remedy within the reach of everyone. Various effective remedies are enumerated here, together with a statement regarding conditions under which they are most effective.

The remedies here listed for the killing of fabric pests, or for protection against them, have been thoroughly tested and are in general use by the public. They can be recommended without reservation if used with an intelligent understanding of their good or bad qualities and in accordance with directions.

(1) Constant watchfulness. This must be the watchword for successful control. No treatment known to kill clothes moths already in fabrics will have any lasting effect in keeping other clothes moths from infesting the fabrics later if they are left exposed about the house. There is no treatment known that is practical that will render wearing apparel absolutely immune to attack.

(2) Thorough brushing, beating, and, if possible, sunning fabrics before any treatment is applied. These are important under all circumstances.

(3) Careful wrapping in unbroken paper.

(4) Naphthalene. Very effective in the form of flakes or moth balls for protecting clothing in closets, trunks, and tight chests.

(5) Paradichlorobenzene. Equal in effectiveness to naphthalene and used in the same manner.

(6) Camphor. For use in tight chests and trunks, but not as good as Nos. 4 and 5.

(7) Pyrethrum powder. Not as good as Nos. 4, 5, and 6.

(8) Cold storage. Rather expensive, but a certain method of protection against clothes-moth injury during the period in storage.

(9) Hydrocyanic acid gas. Excellent for fumigating entire houses or single *tightly sealed* rooms, but dangerous except when applied by an expert or careful and well-informed person.

(10) Sulphur fumes. Sulphur fumes generated by burning sulphur candles, purchased at drug stores. Likely to bleach wall paper and fabrics and will tarnish metals.

(11) Carbon disulphide. Excellent for fumigation of closets which can be tightly sealed, trunks, chests, and other tight containers. The gas is inflammable.

(12) Carbon tetrachloride. Excellent for fumigation of single rooms, closets, trunks, chests, and other tight containers.

(13) Cedar chests. Excellent for protecting clothing if used according to directions.

(14) Dry heat. Dependable if it can be applied.

(15) Hot water.

(16) Soap solution.

(17) Treatment of cracks and hiding places with gasoline, benzene, and kerosene.

(18) Dry cleaning.

Brushing, Beating, and Sunning—Too much emphasis cannot be placed on the value of frequent brushing, beating, sunning, and cleaning of articles subject to clothes moths attack. If clothing is thoroughly brushed every two weeks, it is doubtful if moths can affect it seriously. Carpets and rugs cleaned by strong vacuum cleaners and thoroughly brushed on both sides, or electrically cleaned, are freed from infestation if the work is properly done. Clothing dry-cleaned is also freed from infestation by the process. Once freed from infestation, clothes should be protected, if they are not to be used during the warm season, by being wrapped in paper or placed in tight chests or treated closets.

Careful Wrapping in Unbroken Paper—The public is familiar with " moth-proof " paper bags of various types that appear upon the market each summer. These bags if not torn and if properly used are excellent for keeping moths from reaching clothing. They are of no value in killing moths that may be in the clothing when it is placed in the bag, and those made of plain paper are just as good as those containing tar.

If these paper bags are not carefully sealed about the hanger, and spaces of one-fourth inch or more are left open, the moths have no difficulty in crawling into such openings, and if they do the bags are useless.

Ordinary firm wrapping paper is satisfactory, or several thicknesses of newspapers will serve. Clothes moths do not eat into paper to reach clothing. For this reason, if woolens and other fabrics subject to moth attack are cleaned and freed from moths by any of the methods mentioned above, they will remain safe if wrapped at once and tightly in several thicknesses of firm wrapping paper or in newspapers. Hats and other articles that will be damaged by tight wrapping can be protected by placing them in ordinary *unbroken* cardboard boxes, hat boxes, etc., and then sealing the covers of the boxes with gummed paper.

Naphthalene—Naphthalene is one of the safest and best materials for protecting fabrics against moth injury. To get definite results it must be used in tight chests, trunks, or other containers where the fumes given off by the slow evaporation of the crystals will be confined. If used in bureau drawers, in closets frequently opened, in pockets of clothing hung in closets, or in boxes which permit the fumes to escape, naphthalene is only partly effective and cannot be depended upon for absolute protection. The fumes of naphthalene will not injure man in the proportion in which he would be ordinarily subjected to them.

Naphthalene should be used at the rate of about 1 pound to each 6 to 10 cubic feet of space. One pound of good naphthalene flakes scattered between the folds of clothing in a trunk of average size should kill all stages of clothes moths. In tight chests of ordinary size the fumes given off by the slow evaporation of 1 pound of naphthalene will kill both young and well-grown larvæ of clothes moths and prevent moth eggs from hatching. If a good grade of naphthalene is used in tight containers there is no doubt as to the efficiency of naphthalene fumes. Too many persons expect naphthalene scattered about closet shelves or bureau drawers to be effective. It is not entirely so under such circumstances. If chests or trunks are not very tight much can be done toward making them so by sealing the cracks with adhesive paper or by papering them on the inside. If there is opportunity for the fumes to escape, use from 2 to 3 pounds of naphthalene to each 6 to 10 cubic feet of space.

Paradichlorobenzene—Paradichlorobenzene is a white, crystalline substance, which vaporizes slowly at ordinary temperatures, forming a gas apparently heavier than air. This gas is non-poisonous to man, but poisonous to clothes moths and other fabric pests when they are exposed to it in tight containers. The fumes do not injure fabrics. Paradichlorobenzene is similar in general appearance to naphthalene flakes. It appears to be quite as effective as naphthalene when used in accordance with directions for the use of naphthalene, and in the same amounts. It is a relatively new remedy which bids fair to become as well known in moth control as naphthalene.

Camphor—Camphor is used in the manner recommended for naphthalene and paradichlorobenzene, but is less effective than naphthalene. If of good quality and used at the rate of from one-half to 1 pound to each 5 cubic feet of space in tight containers, camphor will protect. All stages of clothes moths are killed by the fumes given off by the camphor; hence camphor, to be most effective, should be broken into small pieces and used in tight containers which will confine the fumes. While camphor does kill some eggs and larvæ when sprinkled in small pieces upon infested cloth in open containers such as bureau drawers, pockets in clothing, etc., it is not to be depended upon except where the fumes given off by evaporation can be closely confined with the clothing to be protected.

Pyrethrum Powder or "Insect Powder"—Pyrethrum powder if fresh, will kill clothes-moth larvæ. Clothing should be thoroughly dusted with the powder and placed in a tight container such as a chest or trunk, or wrapped well in unbroken paper. Pyrethrum powder soon loses its protective value on exposure to air, hence is not considered particularly effective for long storage, and is inferior to naphthalene or paradichlorobenzene. It is not always easy to obtain fresh pyrethrum powder.

Eulan—This substance is now offered for permanent moth-proofing. It is sold by the Interstate Chemical Company of New York and was developed in the laboratories of Boyer and Company of Germany. It is said to be a complex fluoride and is claimed to be non-poisonous. It is being used in the treatment

of fabrics before they are made into clothing, curtains, upholstery, etc., and renders them free from the attack of moths. Goods so treated are spoken of as being "*Eulanized*". It is also being sold in bulk for the use of the householder, 1½ ounces in a gallon of water producing a solution into which woolen articles of clothing may be dipped for permanent moth-proofing. Such articles are said to remain free from attack even after washing or dry cleaning. This solution may also be sprinkled on other clothing, carpets or upholstery, but the material must be well-wetted. Another proprietary article is Larvex. This is used and sold similarly to Eulan.

Cold Storage—The best method of protecting against injury by fabric pests of all kinds is cold storage. It is the best method because it eliminates all error on the part of the owner. Once in cold storage no injury can take place.

Fumigation of Entire Establishment with Hydrocyanic Acid Gas or Sulphur Fumes—In large houses with many carpets or rugs, much upholstered furniture and other fabric furnishings, and in tourist hotels and houses used only during the winter months but closed through the long, hot summer season, fabric pests may become very abundant and so generally established that they can not be reached easily by the local treatments recommended further on.

Fumigation by two methods can be used for the treatment of houses or hotels as a single unit—namely, with hydrocyanic acid gas and with sulphur fumes. *Formaldehyde fumigation is worthless for control of clothes moths or other fabric pests, notwithstanding general belief.* It is a good disinfectant for use after contagious diseases, but should never be employed for controlling fabric pests.

Hydrocyanic Acid Gas—Fumigation with hydrocyanic acid gas is the best known method of controlling fabric pests as well as other household pests, including the *bedbug*. It kills speedily and effectively.

Hydrocyanic acid gas is deadly to humans if breathed in concentrated form, and should be used only by an intelligent, careful, and well-informed person who understands the element of danger as well as the excellent features of the gas. Hydrocyanic acid gas should not be used in an apartment house, office building, or city block of houses unless neighboring parties are notified and are ready to vacate if necessary during the period of fumigation. For information on the method of fumigating with hydrocyanic acid gas write to the United States Department of Agriculture at Washington, D. C., for Farmers' Bulletin 699 or Reprint No. 673 of the United States Public Health Service.

Sulphur Fumes—Fumigation with sulphur fumes is a remedy well known to the public. Sulphur fumes will kill clothes moths, but must be used at the rate of about 13½ ounces of sulphur to each 1000 cubic feet of space. Fumigation should continue for a period ranging from 18 to 24 hours. *Remember* that there is some danger of fire in the careless use of sulphur candles, also that sulphur fumes may have a bleaching effect upon delicate fabrics and wall paper, and that they tarnish metals. Directions for burning sulphur candles usually are supplied by the manufacturer or the dealer.

Carbon Disulphide Fumigation—Carbon disulphide is an excellent fumigant for single rooms, closets, trunks, chests, and other tight containers. It is sometimes called "*high-life*". When exposed to the air it evaporates quickly, producing a foul-smelling gas about two and three-fourths times as heavy as air. While the liquid is not explosive or inflammable, the gas formed upon evaporation is. Because of this inflammable nature of the gas it must be kept away from fire in any form. The gas can be detected easily by its foul odor, but this odor disappears after thorough ventilation of rooms and fumigated articles. If used carefully and intelligently and in the proper

amounts carbon disulphide speedily and surely kills fabric pests in tight containers.

When used in small amounts about houses in accordance with directions, there is but little more danger than in the use of gasoline or benzine, with which the public is more familiar. For complete information regarding carbon disulphide and its use, write to the United States Department of Agriculture for Farmers' Bulletin 799.

Carbon Tetrachloride Fumigation—Carbon tetrachloride is a good fumigant for single rooms, closets, trunks, chests, and other tight containers. It is like carbon disulphide in that its gas is heavier than air. When carbon tetrachloride is used at the same rate as carbon disulphide, it is about one-half or one-third as effective. It has the great advantage over carbon disulphide that its gas is neither explosive nor inflammable, hence there is no fire risk in its use. Carbon tetrachloride is purchased at drug stores or from chemical firms in cans containing 1 or more pounds of liquid, and costs from 10½ to 30 cents a pound, according to the quantity purchased. It should be used at the rate of 8 to 12 pounds, or more, per 1000 cubic feet of space if containers are very tight. When the temperature is 70° F. or above, good results in killing clothes moths should follow if the quantities given above for carbon disulphide for the respective spaces are trebled. Since the gas is heavier than air, the liquid should be exposed in shallow dishes at the top of the container to be fumigated.

Cedar Chests—Chests made of the heartwood of red cedar, such as are found on the market, not only are so tightly constructed that the moths can not enter them when closed, but the aroma of the wood kills the newly hatched or young larvæ of the clothes moths.

The value of cedar chests in protecting clothing lies in the fact that they kill the newly hatched or young larvæ or worms of clothes moths. Cedar chests cannot be depended upon to kill the moths or millers, their eggs, or the worms after they are one-half to full grown or after they are 3 or 4 months old. Neither will the chests kill all the pupæ or chrysalids.

Dry Heat—Heat is now recognized as an effective agent in killing insects. All fabric pests will be killed in a very short time if rooms can be heated to a temperature of 130° F. long enough to permit all articles in the room to be thoroughly heated through to this temperature. Experimental work has demonstrated that even lower temperatures will kill the larvæ of clothes moths. All larvæ exposed in an incubator to 128°, 120°, and 110° F. died in 6, 11, and 31 minutes, respectively. At 105° F. 20 per cent were dead at the end of 31 minutes, while at 110° F. 30 per cent were dead at the end of 11 minutes. This killing power of heat can be readily utilized by ironing fabrics with very hot irons, or exposing them in super-heated rooms before they are put away for the summer.

The rays of the sun in summer can often be used to kill or drive clothes moths from fabrics. Thus clothes-moth eggs on flannel, exposed to the bright sun at 128°, 125°, 120°, and 110° F. were killed at the end of 6, 6, 11, and 31 minutes, respectively. Exposure to the sun at 110° and 105° F. for 31 and 11 minutes, respectively, did not kill the eggs. Well-grown larvæ of clothes moths in garments exposed for several hours to the hottest rays of the sun usually become restless and spin down from the garment. The old-time custom of sunning clothing to kill moths is based upon excellent experience.

Hot Water—Water boils at 212° F. At 115° a person finds water almost too hot to hold his hand in it. Fabrics that will not be injured by water can be freed of living clothes-moth eggs and larvæ by being dipped for 10 seconds

in water heated to 140° F. Care, however, must be exercised to have and keep the water at this, or a greater, temperature. Larvæ and eggs in flannel dipped for 10 seconds in water heated only to 122° F. remained unaffected.

Laundry Soap—Clothing washed with a strong solution of neutral laundry soap will be freed from clothes-moth larvæ and eggs, and if wrapped tightly in paper as soon as taken from the drying line, will remain free from moth attack.

Treatment of Cracks and Hiding Places with Gasoline, Benzine, or Kerosene—Any effective method of control for clothes moths and other fabric pests must take into due consideration the fact that woolen lint, hair, etc., accumulate in floor cracks, behind base boards, and in other such places. In this "dust" carpet beetles and clothes moths can and do subsist and migrate thence to other parts of the house. It is desirable, therefore, to reduce these hiding places as much as possible by the use of crack fillers such as can be purchased at paint shops, and treating them with kerosene, gasoline, or benzene. *Persons are warned against the careless use of these three liquids because of their inflammable nature.* If the premises are fumigated, clothes moths and other fabric pests in floor cracks and similar places are killed and the more laborious treatment by liquids is not necessary.

Impractical or Worthless Remedies—Below are listed certain worthless remedies, besides others not recommended to the housewife because of difficulty of application, partial effectiveness, impracticability, or lack of full information regarding their value.

Worthless Substances—The following substances often recommended for clothes-moth control are worthless:

Tobacco extracts containing nicotine and tobacco powder when used at reasonable strengths
Lavender flowers (scattered on)
Cayenne pepper
Allspice (dusted)
Angelica root (dusted)
Black pepper
Pyrethrum stems (dusted)
Lime, air-slaked (dusted)
Powdered sulphur (dusted)
Salt (dusted)
Quassia chips (dusted)
Borax (dusted)
Colocynth pulp (dusted)
Eucalyptus leaves (dusted)
Hellebore, white (dusted)
Formaldehyde (sprayed 1 to 10)
Sodium bicarbonate (dusted)
Sodium carbonate (dusted)
Lead carbonate (dusted)
Lead oxide (dusted)
Red cedar leaves (dried and placed in clothing)

Impractical Remedies—The following substances have considerable value if fresh or properly used, but they are impractical for one or more reasons and are not recommended, especially as among the remedies that can be recommended very highly there are a number that are easily within the reach of all.

Cedar Chips and Cedar Shavings—Ordinarily only partially effective, and never effective against adults or the half-grown to full-grown larvæ of clothes moths and carpet beetles. They soon lose their value and often become valueless before they are purchased by the retailer. Since the average purchaser of cedar chips and shavings has no certain method of determining their strength, it is better not to depend upon them to secure weak material and suffer loss from moths.

Gasoline—Gasoline sprayed on flannel kills clothes-moth eggs. Dipping clothing in gasoline will kill clothes moths and articles so dipped and coming direct from the dry-cleaning process may be considered freed, temporarily at least, from moth infestation. Of course as soon as garments are dried after

treatment they are subject to reinfestation. The use of gasoline for the treatment of wearing apparel most subject to moth attack is not advised for the average home because of the danger from fire.

Carpet Beetles

Carpet beetles, or so-called 'Buffalo moths', are common household pests usually associated in their destructive work with clothes moths.

Protection against carpet beetles can be secured in tight chests and trunks by the use of the crystals of naphthalene, paradichlorobenzene, or camphor, or by the fumigants carbon disulphide and carbon tetrachloride. Where infestation is general throughout a house or is serious in closets, it may be advisable to fumigate with hydrocyanic acid gas, carbon disulphide or sulphur, but none of these fumigation methods should be employed except by a person well informed regarding them. The foregoing remedies and others, such as cold storage, red cedar chests, heat and the treatment of infested floor cracks, are discussed under moths.

Bedbugs

Their Presence Explained—The presence of the bedbug in a house is not necessarily an indication of neglect or carelessness; for, little as the idea may be relished, this insect may gain access in spite of the adoption of all reasonable precautions. It is very apt to get into the trunks and satchels of travelers, or into baskets of laundry, and may thus be introduced into homes. Unfortunately, also, it is quite capable of migrating from one house to another and will often continue to come from an adjoining house, sometimes for a period of several months, gaining entrance daily. Such migration is especially likely to take place if the human inhabitants of an infested house leave it. With the failure of their usual source of food, the migratory instinct of the bedbugs is developed, and, escaping through windows, they pass along walls, water pipes, or gutters, and thus gain entrance into adjoining houses. In these or other ways anyone's premises may be temporarily invaded.

Origin; Common Names; Distribution—As with nearly all the insects associated with man, the bedbug has had the habits now characteristic of it as far back as the records run. It was undoubtedly of common occurrence in the dwellings of the ancient peoples of Asia. The Romans were well acquainted with it giving it the name Cimex. It was supposed by Pliny—and this was doubtless the common belief among the Romans—to have medicinal properties and it was recommended, among other things, as a specific for the bites of serpents. It is said to have been first introduced into England in 1503, but the references to it are of such a nature as to make it very probable that it had been there long before. Two hundred and fifty years later it was reported to be very abundant in the seaport towns, but was scarcely known inland.

One of the old English names was "*wall-louse*". It was afterward very well known as the "*chinch*", which continued to be the common appellation for it until within a century or two, and is still used in parts of this country. The origin of the name "bedbug" is not known, but it is such a descriptive one that it would seem to have been very naturally suggested. Almost everywhere there are local names for these parasites, as, for illustration, around Boston they are called "*chintzes*" and "*chinches*", and from Baltimore comes the name "*mahogany flat*", while in New York they are styled "*red coats*", and in the west "*crimson ramblers*".

The bedbug has accompanied man wherever he has gone. Ships are very apt to be infested with it and have been the chief means of its wide distribu-

tion. It probably came to this country with the earliest colonists; at least Kalm, writing in 1748–1749, stated that it was plentiful in the English colonies and in Canada, though unknown among the Indians.

General Characteristics—The bedbug belongs to the order Hemiptera, which includes the true bugs or piercing insects, characterized by possessing a piercing and sucking beak.

The "Buggy" Odor—The most characteristic feature of the bedbug is the very distinct and disagreeable odor which it exhales, an odor well known to all who have been familiar with it as the "buggy" odor.

Habits and Life History—The bedbug is normally nocturnal in habits and displays a certain degree of wariness, caution, and intelligence in its efforts at concealment during the day. Under the stress of hunger, however, it will emerge from its place of concealment in a well-lighted room at night, so that under such circumstances keeping the gas or electric light burning is not a complete protection.

The Bite of the Bedbug—The bite of the bedbug is decidedly poisonous to some individuals, resulting in a slight swelling and disagreeable inflammation.

To allay the irritation set up by the bite of the bedbug, peroxide of hydrogen, or dioxogen, may be used with good results.

Tincture of iodine either at ordinary or double strength is also a good counterirritant for use in cases of flea, mosquito, bedbug and other insect bites, but should be used with caution on the tender skin of small children and on those who are affected with or disposed to eczemic disorders.

The Bedbug and Human Diseases—In common with other insects which attack man and warm-blooded animals, it is entirely possible for the bedbug and its close allies to be transmitters of contagious human diseases, and already these insects have been shown to be possible carriers or transmitters of a considerable series of diseases, including infantile Kala-azar of Northern Africa and Southern Europe, relapsing fever of Africa and Europe, the Chagas fever of Brazil, tropical sore, plague, and possibly leprosy. In the case of these, and perhaps other diseases, the bedbug shares the responsibility of transmitter with other biting insects, such as body lice and fleas.

Remedies—Undoubtedly the most efficient remedy for the bedbug is to fumigate the infested house or rooms with hydrocyanic acid gas. This gas will penetrate into every crevice in the house or room where the bedbugs conceal themselves and has an immediate effectiveness which gives it an important recommendation, especially when the infestation is considerable or of long standing. This method of fumigation should be intelligently employed, as the gas is deadly poisonous. A bulletin giving directions for such fumigation has been issued by the Department of Agriculture, and was referred to under clothes moths.

The fumes of burning sulphur are also a very efficient means of control where the conditions are such that this method can be used, readily destroying the insect in all stages, including the egg. The treatment is inexpensive compared with the use of hydrocyanic acid gas and offers much less risk of danger to human beings. There is, however, a considerable risk of injury to household fabrics, furnishings, and wall papers from the strong bleaching quality of sulphur fumes. Two pounds of sulphur are recommended for each 2000 cubic feet of space, and the building should be closed for the treatment for at least 5 or 6 hours, or preferably for 24 hours. Sulphur candles may be used where available, or the sulphurous gas or fumes can be generated by burning the sulphur in a dish placed in the center of the room, and for protection set within a larger vessel. Thorough-going precautions must be taken to prevent acci-

dental overflowing or the starting of a fire, and after the fumigation the house should be given a thorough airing.

Other gases have been experimented with, such as formalin and the vapors of benzene, naphthalene, and camphor, but these gases are of little value. Similarly, insect powders are of little value, largely from the difficulty of getting them into the crevices and other places of concealment of the insects.

Of these simple methods of control perhaps the most efficient is in very liberal applications of benzene or kerosene, or any other of the lighter petroleum oils, introduced with small brushes or feathers, or by injecting with syringes into all crevices of beds, furniture or walls where the insects may have concealed themselves. Corrosive sublimate is also of value, and oil of turpentine may be used in the same way. The liberal use of hot water, wherever it may be employed without danger to furniture, etc., is also an effectual method of destroying both eggs and active bugs.

A remedy for the bedbug has been devised by Mr. R. H. Pettit as a substitute for hydrocyanic acid gas and sulphur, and is reported to have proved very successful. The preparation of this insecticide and its application is described as follows:

Alcohol is drawn through Pyrethrum in a funnel until the powder is well washed and a large part of the resinous principle extracted. To do this, the powder is placed in a large funnel with filter-plate and a layer of cotton wool at the bottom. An aspirator is attached and the alcohol is at first slowly and later rapidly sucked through six or eight times, during which operation it becomes highly colored. To this liquid as a basis, are added several oils to give permanence to the application. Both alcohol and Pyrethrum evaporate so quickly that it was thought best to carry in some heavier volatile oils whose effects would last several days or even weeks. The formula when completed stands as follows:

To the extract made by washing 400 Gm. of Pyrethrum with 2000 cc. of strong alcohol, are added:

50 Gm. of camphor.
150 cc. of cedar wood oil.
25 Gm. of citronella oil.
25 Gm. of lavender oil.

The application is best made with a large sized sprayer, one holding a pint or more and working with a piston instead of a rubber bulb. * * * To obtain the best results, repeat the treatment after about two weeks. We have tried this mixture repeatedly, and with uniformly gratifying results. Usually one application, if thoroughly made, put a period to the complaints, about eight or ten ounces being required in an average sleeping room. The odor remains some little time in a room, but is not disagreeable to the average person.

Ants

There are now in North America a considerable number of species of ants which under favoring conditions may inhabit dwelling places or other heated buildings.

The little red ant is the best known house species.

While ants are annoying because of their presence in foods, they do not disseminate disease.

Repellents—That it is possible to drive ants away from household supplies by the use of repellents, particularly camphor and naphthalene flakes or

powdered moth balls, has been asserted. The use of most of such repellent substances, however, in connection with food supplies, is impractical, and careful tests have indicated that such substances have only slightly repellent properties and bring comparatively little benefit.

The collection of ants by the use of attractive baits is frequently recommended. Perhaps as convenient a bait as any consists of small sponges moistened with sweetened water and placed in situations where they can be easily reached by the ants. These sponges may be collected several times daily and the ants swarming on them destroyed by immersion in hot water. It is reported also that a syrup made by dissolving borax and sugar in boiling water and distributed on sponges will effect the destruction of the ants in numbers. Remedies of this kind, however, are of doubtful value. They may be useful at the outset when the colonies are few and small and when most of the individuals may, by these means, be secured and destroyed. Very frequently however, the distribution of such baits will simply result in a more wide exploitation of a good forage ground and an actual increase of the ant nuisance.

A more efficient remedy, where it can be safely used, is a syrup poisoned with sodium arsenate, the idea being that the ants will collect this poison syrup and convey it to their nests, so that not only the ants which collect the syrup are ultimately killed, but the inmates of nests feeding on it also succumb. The formula for the preparation of this syrup is as follows: One pound of sugar dissolved in a quart of water, to which should be added 125 grains of sodium arsenate. The mixture should be boiled and strained, and on cooling used with sponges, as already described. The addition of a small amount of honey is said to add to the attractiveness to ants of this mixture. *Naturally the greatest precautions should be taken in preparing this syrup and in safeguarding it afterwards to prevent its being the cause of poisoning to human beings or domestic animals.*

Lawn Ants—In the case of lawn ants where only a small area with few nests are concerned, drenching the nests with boiling water or injecting a small quantity of kerosene or coal oil will be effective, and similar treatment will apply to nests between or beneath paving stones

Cockroaches

Roaches are among the commonest and most offensive of the insects which frequent human habitations.

Habits—In houses roaches are particularly abundant in pantries and kitchens, especially in the neighborhood of fireplaces, on account of the heat. For the same reason they are often abundant in the oven rooms of bakeries or wherever the temperature is maintained above the normal. They conceal themselves during the day behind baseboards or furniture, or wherever security and partial protection from the light are afforded. Their very flat thin bodies enable them to squeeze themselves into small cracks or spaces where their presence would not be suspected and where they are out of the reach of enemies. Unless routed out by the moving of furniture or disturbed in their hiding places, they are rarely seen, and if discovered make off with wonderful celerity, with a scurrying, nervous gait, and usually are able to elude all efforts at their capture or destruction. It may often happen that their presence, at least in the abundance in which they occur, is hardly realized by the housekeeper unless they are surprised in their midnight feasts. Coming into a kitchen or pantry suddenly, a sound of the rustling of numerous objects will come to the ear, and if a light be introduced often the floor or shelves will

be seen covered with roaches hastening to places of concealment. In districts where the large American roach occurs they sometimes swarm in this way at night in such number that upon entering a small room in which they are congregated one will be repeatedly struck and scratched on the face and hands by the insects in their frantic flight to gain concealment.

The domestic roaches feed on almost any dead animal matter, cereal products and food materials of all sorts. They are also said to eat their own cast skins and egg cases, and it is supposed that they will attack other kinds of roaches, or are, perhaps, occasionally cannibalistic. They will also eat or gnaw woolens, leather (as of shoes or furniture), and frequently are the cause of extensive damage to the cloth and leather bindings of books in libraries and publishing houses. The sizing or paste used on the cloth covers and in the binding of books is very attractive to them. The surface of the covers of cloth-bound books is often much scraped and disfigured, particularly by the German cockroach, and the gold lettering is sometimes eaten off to get at the albumen paste. On shipboard the damage is often very extensive on account of the vast numbers of cockroaches which frequently occur there, and there are reliable accounts of entire supplies of ship biscuits having been eaten or ruined by roaches.

The damage they do is not only in the products actually consumed, but in the soiling of everything with which they come in contact. They leave, wherever they occur in any numbers, an offensive, sickening odor, well known as the "roachy" odor which is persistent and can not be removed from shelves and dishes without washing with soap and boiling water. Food supplies so tainted are beyond redemption.

The roaches are normally scavengers in habit and may at times be of actual service in this direction by eating up and removing dead animal material.

One other redeeming trait has been recorded of them, namely, that they will prey upon that other grievous pest of houses, the bedbug.

The cockroach, however, is far too great a nuisance itself to warrant its recommendation as a means of eradicating even the much more disagreeable insect referred to.

Roaches undoubtedly are often spread from house to house by being introduced with supplies, furniture, goods, etc.

Remedies—Roaches may be controlled by the use of (1) poisons and repellents; (2) fumigants; and (3) trapping.

Poisons and Repellents—As just noted, roaches often seem to display a knowledge of the presence of poisons in food, and, not withstanding their habit of eating practically all sorts of food, a very little arsenic in baits seems to be readily detected by them.

Sodium Fluoride—One of the most effective simple means of ridding premises of roaches is dusting with commercial sodium fluoride, either pure or diluted one-half with some inert substance such as powdered gypsum or flour. Numerous practical tests conducted in lunch rooms, bakeries, milk-bottle exchanges, etc., have shown that with the use of this substance roaches can be completely exterminated with very little trouble and cost and with none of the possible dangers which attend the use of hydrocyanic acid gas, another efficient means of control referred to under the subject of fumigation. With the use of a dust gun or blower the sodium fluoride can be thoroughly dusted over the shelves, tables, floors, and the runways and hiding places of the roaches.

Borax—Powdered borax enters into the composition of many of the so-called roach powders. This substance may be used either pure as a poison or repellent, or mixed with some other substance to render it attractive to the

insects. Several correspondents have reported great success from the use of a mixture consisting of 1 part powdered borax to 3 parts of finely pulverized chocolate, this mixture to be freely sprinkled about the infested premises.

Pyrethrum—Another common remedy consists in the liberal use of Pyrethrum powder or Buhach. This is at best only a temporary expedient, but if persisted in considerable relief will be gained. To be at all effective it must be fresh and liberally applied. The roaches are often paralyzed by it rather than killed outright, and the morning after the application all paralyzed and dead roaches should be swept up and burned.

Sulphur—Flowers of sulphur dusted about where roaches abound has also proved very effective as a repellent.

Phosphorus—Of the proprietary substances, perhaps one of the oldest and most efficient is a form of phosphorus paste. It consists of sweetened flour paste containing 1 to 2 per cent of phosphorus, and may be distributed on bits of paper or cardboard placed in the runways of the roaches.

All phosphorus pastes are deadly poisons if taken internally.

Fumigants—Hydrocyanic Acid Gas—Hydrocyanic acid gas fumigation is a thoroughly effective means of ridding premises of roaches, but involves considerable cost, difficulty of application, and the necessity of taking *extreme precautions on account of the deadly effect of the gas on higher animals, including human beings.* (See article on *Moths*, page 1843.)

Carbon Disulphide—Wherever roaches infest small rooms or apartments which may be sealed up nearly air-tight, and also on shipboard, the roach nuisance can be greatly abated by the proper use of carbon disulphide. This substance, distributed about a pantry or room in open vessels, will evaporate, and, if used at the rate of 1 pound to every 1000 cubic feet of room space, will destroy roaches. Unless the room can be very tightly sealed up, however, the vapor dissipates so rapidly that its effect will be lost before the roaches are killed. The hatches of ships, especially of smaller coasting vessels, may be battened down, a very liberal application of carbon disulphide having been previously made throughout the interior. If left for 24 hours the roaches and all other pests will unquestionably have been destroyed.

Pyrethrum Fumes—A safer remedy of the same nature consists in burning Pyrethrum in the infested apartment. The smoke and vapors generated by the burning of this insecticide are often more effective in destroying roaches than the application of Pyrethrum in the ordinary way as a powder. There is no danger of explosion, and the only precaution necessary is to see that the room is kept tightly closed for from 6 to 12 hours.

Trapping—Various forms of traps have been employed very successfully. These devices are all so constructed that the roaches may easily get into them and can not afterwards escape. The destruction of the roaches is effected either by the liquid into which they fall or by being doused with hot water.

The House Centipede

The house centipede, particularly within the last 20 or 25 years, has become altogether too common an object in dwelling houses in the Middle and Northern States for the peace of mind of the inmates. The creature is not a true insect, but belongs to the Myriapoda, commonly known as centipedes or "thousand legs", and is sometimes called the "skein" centipede, from the fact that when crushed or motionless it looks, from its numerous long legs, like a mass of filaments or threads.

The Bite—The popular belief is that this centipede is extremely poisonous, and, as it belongs with the poisonous group of centipedes, it can not be ques-

tioned but that the bite of the creature is probably somewhat poisonous as well as painful, though the seriousness of the results will be dependent, as in all similar cases, on the susceptibility of the patient. Prompt dressing of the wound with ammonia will greatly alleviate the disagreeable symptoms.

Remedies—It can be best controlled by promptly destroying all the individuals which make their appearance, and by keeping the moist places in houses free from any object behind which it can conceal itself, or at least subjecting such locations to frequent inspection. In places near water pipes, or in storerooms where it may secrete itself and occur in large numbers, a free use of fresh pyrethrum powder is to be advised.

The Silverfish

The silverfish is that glistening, silver or pearl gray insect with three long tail-like appendages, that one finds when books, papers, clothing, etc., are suddenly moved. From the dark recesses thus exposed to light the silverfish glides quickly out of sight, often thwarting all attempts to catch it. In fact, this insect is an adept at dodging, and when actually in contact with the fingers, the slick, shining body easily slips from the grasp. On account of its glistening body, its quick, gliding movements, and its ability to appear and as quickly and mysteriously disappear, it has received a number of popular names, among which are *silverfish, slicker, silver louse, silver witch, sugarfish, woodfish,* and *bristle-tail.* It occurs in both Europe and America, and, like most of the insects of the household, is well-nigh cosmopolitan in its distribution.

There are a number of different kinds of silverfish, perhaps the most common, aside from the subject of this paper, being the "*firebrat*". This is a heat-loving species that is to be found in greatest numbers about fireplaces and bake ovens and may be distinguished from the common silverfish by the dusky markings on its back.

Habits and Injury—Because the silverfish always shuns the light and has the ability to run very rapidly to places of concealment, it is not often seen and may become very abundant and cause considerable injury before its presence is noticed. The rapidity with which it runs and the slipperiness of its body, due to the scales that clothe it, make it almost impossible to catch the silverfish without crushing or damaging it.

The silverfish is one of the most serious pests of libraries, particularly in the bindings of books. Frequently it eats off the gold lettering to get at the paste beneath, or gnaws off the white label slips glued on the backs of books. Heavily glazed paper and museum labels are sometimes disfigured or destroyed by the feeding of the pest upon their surfaces. In some cases books printed on heavily sized paper will have the surface of the leaves a good deal scraped, only those portions covered by the ink being left unattacked.

The silverfish also will eat any starched clothing, linens, or lace or muslin curtains, and has been known to do very serious damage to silks which had probably been stiffened with sizing. By eating the paste from the back of wall paper the silverfish sometimes causes the wall paper to scale off. The pest has been reported feeding upon carpets, plush coverings of furniture, and even upon certain vegetable drugs.

It is seldom that the silverfish causes damage except where its food has been left undisturbed for long periods packed away in drawers, closets, bookcases, or other such places. The pest multiplies rapidly in houses closed for the summer. It likes warmth and does little damage during winter in the North, although in the South it is active throughout the year ,much as are cockroaches.

Remedies—As stated, silverfish cause injury to clothing, books, etc., in their attempts to get at the starch or glue in them. Advantage may be taken of this craving for fabrics and other articles containing these substances to poison the insects by slipping into all the crevices where they occur—in bookshelves and backs of mantels, under washboards, and in the bottoms of drawers—pieces of cardboard on which a thin boiled starch paste, poisoned with powdered white arsenic, has been spread and dried. In making the paste the following formula should be used: Flour, 1 pint; white arsenic, ½ to ¾ ounce; water. The arsenic should be added to the flour and sufficient water used to make a thin paste by boiling. Complete relief has been secured by this measure. *Great care should be taken to keep the arsenic, the poison paste, and the poisoned bits of cardboard where young children will not get hold of them.*

Pyrethrum, or buhach powder, dusted upon bookshelves or other places where it can be used, is of value; but it must be renewed often, for it loses its power as an insecticide after long exposure to air.

For starched clothing and similar objects liable to injury, frequent handling and airing and the destruction by hand of all silverfish discovered are to be recommended, in addition to the remedies noted above. Little damage is likely to occur in houses except in comparatively moist situations or where stored objects remain undisturbed for a year or more.

Book-lice

Book-lice, or psocids, are the tiny white or grayish-white insects, scarcely as long as the width of an ordinary pinhead, and often much smaller, that scurry across the pages when old, musty books are opened.

Unless they are present in annoying numbers, it is probably not worth while to worry about book-lice, for many exist out of doors and can get in through cracks and through the mesh of ordinary screens. With the coming of cold weather, or in late fall and winter, book-lice die off, but may leave behind eggs that will hatch the following spring.

How to Control Book-lice in Houses—Where only a few book-lice are present, a thorough cleaning, airing, and drying of the room is all that is needed, provided the source of infestation is within the room itself. As many as possible of the objects in the room should be removed and thoroughly sunned on a bright day. The room should be heated to a temperature of 120° to 140° F. for several hours. Psocids are soft-bodied insects, and succumb to a prolonged drying due to heat. Where rooms are located on the ground floor in loosely constructed buildings in shaded and damp situations, as are many summer cottages, so many psocids come in from the outside that almost no treatment will entirely rid a room of them.

When book-lice swarm in alarming numbers over and throughout a room the breeding places should be located at once. If the source is old straw or husk fillings of mattresses, these should be removed and burned whenever possible. Thorough fumigation with the fumes of sulphur, 1 pound of sulphur being burned for each 1000 cubic feet of space, is effective. Where other pests are present, such as bedbugs, and where the bleaching effects of the fumes can be disregarded, as in barracks, 5 pounds of sulphur will prove effective. During fumigation the rooms should be kept closed as tightly as possible, and after five or six hours opened from without and thoroughly aired. Fumigation with hydrocyanic acid gas is very effective, but dangerous in the hands of inexperienced persons.

Closets, boxes, trunks, and sometimes even entire rooms, where infested

objects are kept near the floor, can be fumigated satisfactorily with carbon disulphide. (See page 1843.) In addition to cleanliness and plenty of sunlight, heat or fumigation, wherever it can be applied, will yield the best results, if the source of infestation has been removed.

Fleas

Of the approximately 500 species of fleas known to exist, less than one dozen are of special interest as pests to man and domestic animals, but any individual of one of these few species, when bent upon satisfying its appetite, fully occupies the attention of its chosen host.

The human flea, dog flea, cat flea, sticktight flea or chicken flea, and the rat fleas (which carry the bubonic plague), are the principal species that annoy man and domestic animals in the United States.

Fleas as Pests in the Household—In the eastern part of the United States the dog flea is the species of greatest importance as a household pest. Houses, particularly those vacated for some time during the summer months, have been found to be literally over-run by the pests.

In portions of the South and West the human flea is the one primarily responsible for house infestations. Although the host relationship of these two species is somewhat different, the same methods of control are applicable, for the most part, to both. When comparatively small numbers of fleas are found on people in houses, breeding places should be sought out of doors in sheds or barns frequented by dogs and cats, especially if the house is kept clean and animals do not frequent it.

Dog and Cat Fleas—Dogs and cats are infested by two very closely related species of fleas, and these appear to feed more or less interchangeably on the two hosts, as well as occasionally on man and other animals. While they cause these hosts much annoyance and, as has been pointed out, are also responsible for the infestation of dogs by tapeworms, serious injury seems to be rare. In the case of valuable dogs and cats, however, it is often desirable to rid them of fleas, and in all cases where these animals are closely associated with man the control of the fleas upon them is of importance.

The Relation of Fleas to Bubonic Plague—During recent years bubonic plague has been introduced into the United States on both the Pacific and Gulf Coasts. The infestation in California has persisted for a number of years, although closely held in check through the efforts of the Public Health Service and the State board of health. The disease around San Francisco not only persisted among the rats, but gained a foothold among ground squirrels in the counties adjacent to San Francisco Bay.

During the year 1914 the disease broke out in New Orleans, but strict quarantine measures and an energetic campaign against the rats kept the malady from spreading and limited the number of human cases.

With the reduction in numbers of rats and mice there is a correspondingly great decrease in the numbers of the species of fleas which infest them and which may play a part in carrying bubonic plague. The cleaning up of the breeding places of rats and the destruction of their nests will accomplish the extermination of a large number of fleas in the immature stages.

Persons resident in districts where plague occurs among the ground squirrels should remember that there is danger of infection from the bites of fleas which infest these animals.

Remedies for Household Infestations—As has been pointed out, the dog flea and the human flea are the two most important species invading the

habitations of man. It has also been suggested that the adult fleas feed more or less on cats and dogs and that the immature stages develop in the cracks of floors and beneath houses. It, therefore, is apparent at once that two steps are necessary to cope with the pest: (1) The destruction on the host of the adults which are producing the eggs, and (2) the clearing out of the immature stages which are breeding in or under the house.

How to Kill Fleas on Cats, Dogs, and Hogs—One of the most successful methods of killing fleas on cats and dogs is to wash the animals thoroughly in a tub containing the proper proportion of a saponified coal-tar creosote preparation, of which there are a number on the market, known as "stock dips", etc. The animal should be scrubbed thoroughly, special precaution being taken that the fleas on the head are well soaked, as many rush there to get away from the parts that are covered with the solution. After the animal has been in the bath for about 5 or 10 minutes it may be removed and allowed to dry. In the case of cats, especially if tender skinned, the preparation should be washed out of the fur with soap and warm water soon after the animal is taken out of the solution.

In addition to the destruction of all fleas present, this washing cleanses and deodorizes the fur and also aids in the healing of any wounds which are present.

The thorough washing of infested animals in kerosene emulsion is a cheap and satisfactory method of destroying fleas. Five gallons of this emulsion may be made by dissolving 2 ounces of washing soap in 1 quart of hot water and when brought to a boil removing it from the fire and adding 2½ pints of kerosene. The mixture should be agitated violently with an egg-beater or something of the sort. This should result in a milky mass from which the oil does not separate. Water is then added to make 5 gallons. Free kerosene will burn animals, and if any separates out the mixture should be reheated, care being taken to avoid spilling it on the fire or permitting it to boil over, and then it should be beaten again.

Other methods of destroying fleas on cats and dogs have been recommended. Among these the careful rubbing into the hair of powdered naphthalene or moth balls has been found effective. Pyrethrum or Persian insect powder is used in the same way. Both of these materials stupefy the insects and cause them to come to the surface of the hair or actually drop out. The animals should be treated on papers spread on the floor and the insects burned after the dusting is completed.

Recent experiments with the use of the powdered roots of certain tropical plants known as *derris* indicate that this drug when fresh is exceedingly effective in destroying fleas on animals. All fleas on a dog will be destroyed by one application of 1 gram or about three-fourths of a level teaspoonful of the powder. It is suggested that the material be mixed at the time it is used with two parts of flour or cornstarch and dusted into the hair of the animal, especially along the back and neck, with a shaker.

The skin of cats is much more easily injured with chemicals than that of dogs; hence, any preparation used should be weaker when used on cats than on dogs.

Fleas on hogs may be destroyed by dipping the animals in a vat containing one of the creosote dips used for the hog louse or by sprinkling crude petroleum on them when they are eating.

How to Destroy Fleas in Immature Stages—Following the ridding of infested animals of adult fleas, it is important to destroy the immature fleas, which are constantly becoming full grown and reinfesting animals and annoying man.

When adult fleas are very numerous it is advisable to kill them before proceeding to destroy the young. Experiments of a practical nature prove that very striking results may be accomplished by the spraying of an infested area, whether in a basement, chicken house, barn or feed lot, with creosote oil. A light spraying kills the adult fleas almost instantly and apparently has some destructive effect on the immature stages.

Creosote oil is derived from coal tar and is used as a wood preservative. It is comparatively cheap, retailing at about 50 cents per gallon. Unfortunately it is not generally available at present and it is somewhat variable in composition, especially in regard to the amount of tar acids present. The best results are secured with a product containing from "12 to 20 per cent tar acids". Where there is grass or shrubbery to be considered, kerosene emulsion should be substituted for the creosote oil, as the latter kills vegetation. Care should also be taken not to strike animals directly with the material, as it is rather caustic. In houses the use of flaked naphthalene as described in a later paragraph will permit the work of cleaning to proceed without annoyance from adult fleas.

In household infestations usually it is found that the breeding takes place in the cracks of floors or beneath carpets or in rooms which are not frequently swept, but which may be visited by pet dogs and cats. The carpets and rugs should be removed, the floors thoroughly swept, and all of the dust thus obtained burned, as it contains many of the eggs and maggots of the fleas. Then the floor should be scrubbed with strong soapsuds or sprinkled with gasoline, care being taken to avoid having fires about during the procedure. After the floor coverings are thoroughly aired and beaten they may be returned but it is desirable before putting them down to sprinkle the floor with naphthalene crystals or pyrethrum powder.

In flea-infested regions it is advisable to avoid the use of mattings and carpets. These may be supplanted by rugs or oiled floors, which facilitate frequent sweeping and make the destruction of the immature stages easier if an infestation becomes established.

Among other methods for destroying the fleas in houses the following have been tried and recommended: Scatter 5 pounds of flake naphthalene over the floor of an infested room and close the doors and windows tightly for 24 hours. After this period the naphthalene may be swept into another room, and so on, thus making the treatment inexpensive. The free use of alum, both in the powdered form sprinkled over carpets and rugs and by dipping papers in an alum solution and placing them under the rugs, is said to give satisfactory results. The fumigation of houses with sulphur fumes or hydrocyanic acid gas kills all fleas present and in addition destroys the rats and mice. When sulphur is to be employed the infested building should be closed up tightly and the material used at the rate of 4 pounds to each 1000 cubic feet of space. If the immature stages have been destroyed by the methods mentioned, 2 to 3 pounds of sulphur per 1000 cubic feet of space will be sufficient to destroy the adults.

When house infestations are derived from fleas which breed beneath or around houses, the first step is to clean out all the loose material in which fleas may be breeding and burn it. Then common salt should be scattered about and thoroughly wet down. A second wetting two or three days later usually will accomplish complete destruction, but if this is not found sufficient, one or two additional wettings may be given. Where crude petroleum is cheap and especially where water can not be applied easily, sprinkling the ground with a liberal amount of this oil will give good results. The free use of lime on the cleaned areas also apparently destroys many immature fleas. In exceptional cases lawns become infested, and fleas breed out around the roots of the

grass. It is impracticable to apply chemicals in such situations, but much may be done to check the breeding by cutting the grass exceedingly short and thus exposing the young fleas to the heat of the sun, which will usually accomplish their destruction. In certain sections it has been found feasible to destroy flea infestations in barns and hog runs by diking the infested areas and pumping water in so as to flood them entirely.

Trapping Fleas—Following the treatment of host animals and the thorough cleaning up of the premises, as has been outlined, many of the remaining adult fleas may be caught by the use of traps.

There seems to be some virtue in the use of lights at night for attracting the adult fleas. A small lamp set in a pan of water covered with a film of kerosene may be used for this purpose.

It has been found that a considerable number of fleas may be collected about a room or cellar by allowing an animal such as a guinea pig or cat to be free in the room. The fleas thus concentrated on the animal may be destroyed by the methods mentioned under the heading, "How to kill fleas on cats, dogs, and hogs". In districts where the plague is known to exist and it is desirable to catch the few fleas about the premises, this method is of some value.

Isolating and Repelling—It has been determined that the greatest horizontal distance fleas can jump is about 13 inches, and they can not jump more than one-half of this distance vertically. It is possible, therefore, to prevent them from gaining access to a bed by placing sticky fly paper about 13 inches wide on the floor around the bed, provided fleas are not breeding out under it. It is also possible to keep fleas out by placing the legs of the bed in pans of water covered with a film of kerosene, if the bedding is prevented from reaching near the floor.

Many different substances have been advocated as repellents for fleas. Among these may be mentioned such plants as pennyroyal and boughs and chips of pine. Naphthalene crystals and pyrethrum have also been employed for dusting between the sheets in order to repel the fleas from bedding, and these substances, as well as oil of pennyroyal and oil of tar, may be used about the household to drive out the fleas.

It should be borne in mind that the methods of trapping and repelling just discussed are secondary to the more important measures of destroying the breeding places and freeing hosts from fleas.

Treatment of Flea Bites—In regions in the United States where the plague is not known to occur no special concern need be felt regarding flea bites. When feeding, the fleas inject a salivary secretion which tends to produce inflammation at the site of the puncture. Usually the bites result in small inflamed spots, but occasionally, where the pests are very numerous and in the case of susceptible individuals, more general inflammation may occur, sometimes followed by swelling and, occasionally, especially after scratching, by ulceration.

Those who are especially annoyed by the bites will find that various cooling applications will give relief. A 3 per cent solution of phenol in water applied to the bites will be beneficial, and such substances as menthol, camphor, and carbolated vaseline will be found to allay the irritation. Iodine in the form of a tincture, if applied to the bites, will alleviate the irritation, but should not be used by persons afflicted with any form of eczema, or applied to the tender skin of young children, as it may stimulate the eczemic eruptions or blister the skin, causing undue annoyance.

How to Get Rid of Rats

The large number of failures to exterminate rats is due in part to the use of inefficient methods, but half-hearted effort and easy discouragement are more often responsible. Rats can not long survive a concerted and sustained onslaught. They can be eliminated from any ordinary building or farm by the intelligent and judicious use of the methods here described.

The all-important measures to be taken are the removing of food and shelter from rats, poisoning and trapping them, and under certain conditions fumigating their burrows. These measures should be undertaken not only by individual effort but also through community coöperation.

Poisoning—The most efficient means known to the department for detroying rats is by poisoning, and poison is recommended for the purpose whereever it can be used with safety. Powdered barium carbonate is an inexpensive mineral, and seems best adapted for poisoning rats.[1] It is both odorless and tasteless, and baits containing it are readily taken by these pests. It also has the advantage of being slow in its action, so that rats affected by it usually have time to leave the premises in search of water or to return to their burrows before they succumb.

The following directions for using barium carbonate have been carefully worked out and should be closely followed to obtain the best results.

Kinds of Bait—A variety of baits used separately not only gives the rat a choice of foods but tends to make it less suspicious. One kind of each of the following classes of food mixed with barium carbonate is recommended:

(1) *Meat or Other Animal Substance*—Hamburg steak, sausage, fish, liver, bacon, or cheese.

(2) *Vegetables and Fruits*—Thin slices of muskmelon, apple, tomato, or cucumber; canned corn, or squash or pumpkin seed; or mashed banana, boiled carrot, or baked sweet potato.

(3) *Cereals*—Rolled oats, bread, corn meal, flour, or cake. Kitchen scraps and garbage can be worked into the ration to advantage.

Baits should be fresh and preferably of good quality.

How to Prepare Baits—The powdered barium carbonate should be thoroughly mixed and worked into the soft baits in the proportion of 1 part of the mineral to 4 parts of the selected food. Add water when necessary to make the baits moist. Baits moistened to the consistency of soft mush are particularly acceptable to rats in dry weather.

Barium carbonate should be sifted over sliced baits and rubbed well into them with the fingers or a knife. The slices should be thin and should be moistened if necessary in order to attain as nearly as possible the 1 to 4 ratio. Soft baits may be mixed with the hands or with a spoon.

How to Distribute Poison—A teaspoonful, or its equivalent, of each of the three or more kinds of baits prepared, should be exposed in places frequented by rats. In buildings baits should be set on strips of paper or boards where they may be easily removed.

A convenient and successful method of exposing baits is to place a teaspoonful in each of a number of small paper sacks and drop them in places accessible to rats or frequented by them. The sacks should be closed by twisting the top. Bait distributed in this manner serves to allay the suspicion of rats and will be taken by them more readily than if exposed in the open. It is

[1]Other poisons commonly used are phosphorus, arsenic, and strychnine. Phosphorus is attended with danger from fire. Arsenic is uncertain in its action; while strychnine is readily detected by rats and is too rapid in its action to make its use desirable in buildings. Barium carbonate has the advantage of being not only of proved effectiveness, but also inexpensive and relatively safe.

better not to place the sacks near or at rat holes, but rather to scatter them promiscuously about. The sacks are usually carried into burrows or behind objects, where the contents are eaten in comfort and are more nearly consumed than in the open. In public places, where there is a possibility that the bait will be disturbed by people, the sacks should be labeled " POISON".

Baits of three or more kinds should be exposed in groups. Where rats are abundant, baits may be exposed at intervals of 10 to 20 feet. Uneaten baits should be picked up the following morning and destroyed. If left exposed in warm places more than one day, baits will sour, and the resulting acid will gradually transform the barium into a bitter and highly objectionable form. Continue to distribute fresh baits in less quantity each night, repeating those that are eaten freely, and replacing those less relished by others in the same class, until the rats disappear or until no further baits are taken.

In stubborn cases it may become necessary to resort to prebaiting in order to dispose of old and cunning rats. This consists in exposing unpoisoned or fresh foods every night until rats take them freely, and then substituting the poisoned baits.

Poison used in poultry inclosures should be exposed in places inaccessible to chickens, as behind or under boxes, and it should be very wet or of such nature that the rats can not drag it from cover.

Caution—Barium carbonate is a relatively mild poison, but the danger from accidents can not be over emphasized. *Keep it out of the reach of children and irresponsible persons and from domestic animals and fowls.*

Antidote—Give an emetic consisting of either mustard or salt dissolved in warm water, or induce vomiting by inserting the finger in the back of the throat. Follow vomiting with a liberal dose of Epsom or Glauber salts.

Trapping—Trapping rats, while equally as effective as poisoning, requires more skill and labor. It is recommended where the use of poison seems inadvisable.

Careful attention to detail is necessary in trapping rats, as the measure of success will depend largely upon the skill and resourcefulness with which the traps are handled.

While numbers of the more complicated traps and devices for catching rats are sometimes useful, the simple and inexpensive snap trap, sometimes called " guillotine", " spring", or " break back", has easily proved the most effective and consistent rat catcher. There is little choice between the standard makes of this style of trap, and selection should be governed by strength and apparent durability. The essential is a trigger that will release the spring at a very light touch. The trigger should also be provided with a hook or other means of holding the bait fast. Large triggers have an advantage over small ones, as they have a greater surface for the rat to step on, and especially as they are better adapted for use along walls and narrow runways, where rats may be trapped successfully without baiting.

In trapping, as in poisoning, the kinds of baits used are of prime importance and to give the rat a choice of foods and to lessen its suspicion the same principle of variety is equally applicable.

To get the best results the following directions for baiting and setting snap traps should be carefully observed.

Kinds of Bait—Rolled oats, fried bacon, bread, and toasted cheese are the baits most frequently used. Baits which will easily adhere to the trigger hook, as fried bacon, raw or cooked meats, fish, nut meats, cheese, apples, or carrots, are recommended for general use. These may be made more attractive by sprinkling rolled oats or corn meal lightly over the trap. Almost any food

suitable for human consumption will appeal to the gluttonous appetite of the rat, so that there should be no lack of variety.

Where to Set Traps—Rats rely on concealment for protection and avoid open spaces as much as possible. The best place to set traps, therefore, is close to walls, behind objects, in dark corners—anywhere that a rat in striving for concealment would run. Traps should be set in such a manner that the rat in following its natural course will pass directly over the trigger. For example, in setting along a wall the trap should extend from the wall at right angles, the trigger end close against it. Boards may be leaned against the wall, thus forming a natural runway for rats and a good setting place for traps.

How to Set Traps—Baits should be large and fastened securely to the trigger by means of the trigger hook or tied to the trigger with thread or fine wire, so that when attempting to remove them the rat will be sure to spring the trap. Traps should be set very lightly, so that they will spring easily.

After most of the rats have been caught, the others sometimes leave the premises. More often, however, the remaining rats are not frightened away, but avoid baits and prove very difficult to catch. Strategy must be used in outwitting such individuals. The most successful method is to camouflage the traps.

Traps set on the ground may be sunk slightly below the ground level. A small piece of paper or cloth should then be placed over the trigger end of the trap to prevent dirt from getting underneath and clogging the action, and the whole should be lightly covered with fine earth or sawdust.

The same method may be employed on hard floors, by burying the traps in a shallow pan of meal, sawdust, or grain. A trap set in this way may be placed in a runway without baiting, or several pieces of bait may be scattered over it. In stubborn cases, food may be exposed on pans of meal until the rats take it readily, when the traps should be set in the meal. Stones, boxes, or boards will often aid in directing an unsuspecting animal along an easy path over a trap.

General Trapping Instructions—The presence of an abundance of food makes trapping much more difficult. Before starting a trapping campaign remove all accessible food and eliminate the sources of supply.

Plenty of traps should be used. Trying to catch a hundred rats with half a dozen traps will make those not caught suspicious and dishearten the trapper long before the job is completed. A dozen or more traps for a heavily infested dwelling and from 50 to 100 or more for farms and larger buildings are not too many. It is important that a sufficient number of traps be obtained to make the campaign short and decisive. The cost of traps is little compared with the loss occasioned by rats.

Traps should be kept in good working condition and should be carefully examined before setting to insure their instant operation. They should be kept reasonably clean, and if they become very foul, should be boiled and scraped. When trapping is done on a large scale, especially in damp places where metal parts of the traps may rust, an occasional dipping in melted paraffin will lengthen their usefulness, cause them to spring more easily, and have a deodorizing effect.

Trapping rats in larger buildings and on farms should be assigned to a man with a natural aptitude for such work. When interest is taken, only slight training is necessary for some men to become proficient in the work. Such men should be encouraged to persistent effort.

Fumigants and Deterrents—*Carbon Bisulphide*—In many places rat burrows may be fumigated with carbon bisulphide and the rats thus destroyed in the ground. This method is effective in fields, along ditch banks and levees,

around farm buildings, and in dirt cellars, providing the burrow is dug in solid earth. The gas is more effective in heavy damp soils and in wet weather.

A wad of cotton or other absorbent material should be saturated with 1 ounce (2 tablespoonfuls) of carbon bisulphide and thrown or pushed as far as possible into each burrow; all burrow entrances should then be closed with moist earth to prevent the escape of the gas. A long pair of forceps is convenient for handling the absorbent material.

Caution—*Carbon bisulphide is highly inflammable and explosive and should not be approached by fire.* It evaporates rapidly and should be kept in an air-tight container.

Gasoline Engine Exhaust—Use of the exhaust of an automobile, tractor, or other gasoline engine in fumigating rat burrows is entirely practicable when there are only a small number of holes. The exhaust is directed into the rat burrow by means of a hose and the entrance around the hose is sealed with damp earth. The carburetor is adjusted to obtain a rich mixture and the engine allowed to run at moderate speed for 10 minutes or more. This method may also be used successfully in destroying rats beneath floors or in other places where a concentration of the gas can be obtained.

Naphthalene Flakes—In seed warehouses and similar structures where sacked grain is stored temporarily, or otherwise, it has been found that a liberal supply of flake naphthalene, scattered on the floor about the stacked grain and over the bags, is objectionable to rats and will keep them away. In the seed distribution work of the Bureau of Plant Industry of this department the need of a cheap repellent was felt because of the fact that the many tons of seeds sometimes on hand could not be placed in rat-proof rooms. Flake naphthalene was tried in 1912 and proved so satisfactory that it has been used continuously ever since. The flakes are scattered abundantly over bags of seed as they are stacked and also in bins and rooms containing filled packets. The naphthalene does not damage the seed in any way and can be used with impunity in any reasonably tight building. Because of its odor, the use of the naphthalene flakes is not recommended in places where food and feed-stuffs are stored, unless the nature of the material is such that it can be thoroughly deodorized by airing before use.

Rat-Proofing—Poisoning, trapping, and other extermination methods carefully applied will give relief of more or less uncertain duration, but so long as there are rats in a neighborhood and they find it possible to get inside a building, there is always the danger of reinfestation. The only sure and final remedy for the rat nuisance is rat-proof construction. Without it rats will get into a house, by gnawing if necessary, in order to locate an available and easily obtained food supply. The rat must be built out.

Most modern buildings and many older ones are so constructed as to be proof against the ingress of rats or could be made so at a relatively small cost. Owners of large warehouses, food depots, and other buildings where produce and other supplies are exposed to rat depredations have found that the cost of rat-proofing their buildings, even when the expense is considerable, is slight compared with the value of the resulting protection from loss, and that, in the long run, it is the cheapest rat insurance. Rat-proofing of buildings, wherever it can be accomplished at reasonable expenditure, is recommended as the best and most permanent means of rat riddance.

Natural Enemies of Rats—Cats that are of real value as ratters are rare. Ferrets are valuable only when handled by experienced men aided by good dogs. The use of dogs in killing rats is recommended wherever practicable—

small terriers, particularly when taught to hunt by themselves, are useful and sometimes will keep a farm free from rats.

Viruses—The control of rats by means of bacterial disease has a peculiar appeal that creates a ready market for the varied cultures already on the American market. This method, however, has proved generally unsatisfactory both in the experience of the Biological Survey and of other investigators and users, as gathered from reports from outside sources.

Community Coöperation—Organized anti-rat campaigns are increasing in popularity and are becoming the regular program not only in many municipalities and counties, but also in whole States. Such campaigns are of great value from economic, educational, and sanitary standpoints.

Assistance in planning, organizing, and prosecuting organized anti-rat campaigns will gladly be given by the Biological Survey Bureau of Agriculture, Washington, D. C., in the form of direct aid whenever practicable, by an expert for campaigns of large scope, or by furnishing plans, general instructions, publicity material, and sample posters.

Summary—Close all openings which provide entrance for rats, and screen basement windows in buildings that are otherwise rat-proof.

Insure greater cleanliness; promptly dispose of garbage and eliminate piles of trash and refuse.

Poison with barium carbonate on farms and dumps, in farm structures, warehouses, and other buildings, and, where considered advisable, in dwellings.

Trap systematically with common snap traps when the use of poison is inexpedient.

Fumigate burrows and keep efficient rat dogs to assist in reducing the infestation on farms.

Organize coöperative rat hunts and plan a definite and determined campaign of rat riddance.

Government Bulletins Available to the Public upon Request to U. S. Department of Agriculture or U. S. Public Health Service, Washington, D. C.

Flies

"The House Fly and How to Suppress It", by L. O. Howard.

"The Transmission of Disease by Flies", by E. A. Sweet, Supplement No. 29.

Lice

"Methods of Destroying Lice", United States Public Health Service, Reprint No. 293.

Mosquitoes

"Remedies and Preventatives Against Mosquitoes", by L. O. Howard, Department of Agriculture, Bulletin No. 444.

"Prevention and Destruction of Mosquitoes", by Joseph Goldberger, Public Health Service, Reprint No. 28.

"The Yellow-fever Mosquito", by Department of Agriculture, Bulletin No. 1354.

"Some Facts About Malaria", Department of Agriculture, Bulletin No. 450.

"A Preliminary Report on the Use of Creosote Oil as a Mosquito Repellent", by C. P. Coogle, United States Public Health Service, Reprint No. 820.

"Mosquitoes and Bats", by L. O. Howard, Department of Agriculture, Reprint No. 715.

"Arsenic as a Larvicide for Anopheline Larvæ", by M. A. Barber, and T.B Hayne, Public Health Service, Reprint No. 714.

"Fishes in Relation to Mosquito Control in Ponds", by Samuel F. Hildebrand, Public Health Service, Reprint No. 527.

"Screening as an Antimalarial Measure", by H. R. Carter, Public Health Service, Reprint No. 183.

Mosquitoes	"One or Several Species of Malaria Parasites", by Bruce Mayne, Public Health Service, Reprint No. 633.
	"Guide to Mosquito Identification for Field Workers Engaged in Malaria Control in the United States", by W. H. W. Komp, Public Health Service, Reprint No. 836.
	"On the Possibilities of Using Mosquito Traps in Antimalaria Work", by C. W. Metz, Public Health Service, No. 716.
	"Some Aspects of Malaria Control through Mosquito Eradication", by C. W. Metz, Public Health Service, Reprint No. 500.
	"Control of Malaria", by J. A. A. LePrince, Public Health Service, Reprint No. 260.
	"Malaria Control", by J. A. A. LePrince, Public Health Service, Reprint No. 258.
	"Malaria", by H. R. Carter, Public Health Service, Supplement No. 18.
	"Malaria Control", by R. C. Derivaux, Public Health Service, Bulletin No. 88.
	"Impounding Water in a Bayou to Control Breeding of Malaria Mosquitoes", Department of Agriculture, Bulletin No. 1098.
	"What the Farmer Can Do to Prevent Malaria", by R. H. Von Ezdorf, Public Health Service, Supplement No. 11.
Moths	"Clothes Moths and Their Control", by Department of Agriculture, Bulletin No. 1353.
Buffalo Moths	"Carpet Beetles and Their Control", by the Department of Agriculture, Bulletin No. 1346.
Bedbugs	"The Bedbug", by C. L. Marlatt, Department of Agriculture, Bulletin No. 754.
	"The Bedbug", Reprint No. 626. Public Health Service.
Ants	"House Ants", by C. L. Marlatt, Department of Agriculture, Bulletin No. 740.
Roaches	"Cockroaches", by C. L. Marlatt, Department of Agriculture, Bulletin No. 658.
Centipedes	"The House Centipede", by C. L. Marlatt, Department of Agriculture, Bulletin No. 627.
Silverfish	"The Silverfish, or 'Slicker'", by E. A. Back, Bulletin No. 902.
Fleas	"Fleas and Their Control", by F. C. Bishop, Department of Agriculture, Bulletin No. 897.
Psocids	"Book-lice or Psocids", by E. A. Back, Bulletin No. 1104.
Rats	"How to Get Rid of Rats", Bulletin No. 1302.
	"The Relative Toxicity of Strychnine to the Rat", Bulletin No. 1023.
	"Toxicity of Barium Carbonate to Rats", Bulletin No. 915.

CHAPTER CXVI

THE ATTITUDE THAT PHARMACISTS SHOULD HOLD TOWARDS VENEREAL DISEASE CONTROL AND THE ASSISTANCE THAT COULD BE RENDERED HEALTH AUTHORITIES

THE following statement was prepared by the Public Health Service of the United States:

1. Pharmacists should become fully acquainted with the pertinent laws and ordinances of the State, County, and City in which they practice, in so far as these relate to the dispensing of medicines and appliances, without a physician's prescription, for the treatment of venereal diseases, and also with reference to the sale of proprietary medicines and appliances for the same purpose. The observance of these laws by the pharmacist becomes a first consideration.

2. Pharmacists should prevail on persons applying to them for treatment to go to skilled physicians for the necessary advice and treatment and under no circumstances should they treat patients themselves.

3. The sale of appliances for the prevention of disease only, if construed to authorize the sale of disinfectants for the prevention of disease only, is a matter of particular concern for the reason that unless there are full instructions for the use of the disinfectants and unless the disinfectants have been thoroughly approved as efficient in the way in which the instructions indicate they should be used, it is likely that they would have very little if any value in preventing disease.

4. Pharmacists can best aid in the prevention of disease by referring all persons seeking advice or treatment to physicians, or to the city board of health if they are indigents. It should be kept in mind that these diseases may affect any part of the body, that blindness may result from acute infection of an adult's eyes, that syphilis is transmissible congenitally, and that inadequate and delayed treatment is the reason why so many lesions of the nervous system, the cardiovascular system, etc., develop and cause such great loss of earning capacity and so many disabilities.

CHAPTER CXVII

DISINFECTION

THE following is an abstract of an article by Thomas B. McClintic on disinfectants, their use and application in the prevention of communicable diseases.

The original was published as "Bulletin No. 42" of the Public Health Service and is reproduced by permission.

As is generally understood, disinfection is the destroying of disease-germs, thus rendering the organisms inert and harmless. Using the term in a broad sense it may be made, also, to include the destruction of disease-carrying insects, as the processes are usually carried out along the same general lines. The infective organisms of the communicable diseases are, with few exceptions, much more easily killed by disinfectants than are some of the common spore-bearing and highly resisting saprophytic bacteria usually present in all localities, but as nothing would be gained by carrying the operation to the extent of killing the latter class of non-pathogenic organisms, the process of disinfection is usually one of degree only; in other words, it is not necessarily carried to the point of complete sterilization. The specific germ of some of the infectious diseases, such as smallpox, scarlet fever, and measles, has not yet been positively demonstrated; nevertheless experience has proven that the infection of these diseases can be destroyed by the intelligent and proper use of disinfectants.

The question then naturally arises as to the best methods of accomplishing disinfection. The ideal disinfectant will in all probability never be found, and consequently there will always be encountered more or less antagonism against disinfection, for, as Rosenau aptly states, "the stress of modern activities demands disinfection processes that are instantaneous in their action, all pervading in their effect, cheap, harmless, and free from any unpleasant odors that might offend the senses of the fastidious. Such perfect disinfectants are unknown. It requires time, money, and the expenditure of well-directed and intelligent energy to accomplish satisfactory disinfection".

If the claims for some of the numerous proprietary disinfectants offered for sale upon the market were actually fulfilled, the process of disinfection would be very much simplified, but unfortunately this is not true, and in order to insure efficient results it is necessary to fall back upon the use of the old standard disinfectants that have stood the test of time and are known to be trustworthy. It should be borne in mind, too, that with the advance in medical science disinfection as intelligently applied today is far more specific than it formerly was and that the shotgun methods of former years have gradually passed into disfavor.

Without any pretense to originality, it will be endeavored to give here, in a simple and concise manner, the best methods of using disinfectants, and the special application of these methods in the eradication and prevention of some of the infectious diseases, with the hope that it may be of service, particularly to those more or less unfamiliar with the methods and technic of disinfection. The methods of disinfection, particularly the simpler ones, will first be described and then their special uses and applications will be given.

Disinfectants are usually divided into the following general classes:

(1) Physical agents, including sunlight, dry heat, burning, boiling, steaming, electricity, etc.

(2) Gaseous, including formaldehyde, sulphur dioxide, chlorine, etc.

(3) Chemical solutions, including bichloride of mercury, solution of formaldehyde, phenol (carbolic acid), tricresol, compound solution of cresol, potassium permanganate, lime, chlorinated lime, the hypochlorites, etc.

With the exception of heat, sulphur dioxide is the only one of the above-mentioned disinfectants that is used to any extent as an insecticide, while other substances used for this purpose are hydrocyanic acid gas, pyrethrum, petroleum, etc. As the uses of the physical agents, particularly the different forms of heat, are more or less familiar to all, they will not be further discussed in this paper, but the other disinfectants will be considered.

Gaseous Disinfectants

In determining the quantities of disinfectant substances to be used for gaseous disinfection, the cubic contents of the space to be disinfected is always estimated, and usually expressed in terms of a thousand cubic feet.

A room, each dimension of which is 10 feet, contains 1000 cubic feet, and the cubic contents of any space can be determined by multiplying together the length, width, and height, expressed in feet, which will give the contents in cubic feet.

To prevent the escape of the gas from the inclosure to be disinfected, fireplaces, ventilators, cracks of doors and windows, and other openings can be stuffed with cotton, paper, cloths, etc., but they are best closed by pasting them up, for which purpose strips of newspaper and a paste made from flour can be used.

All articles to be disinfected should be well exposed to the action of the disinfectant, as the penetrating powers of all gaseous disinfectants are more or less limited, therefore they should either be hung up or otherwise freely exposed to the gas.

Formaldehyde—For disinfection purposes formaldehyde gas is usually produced from the aqueous solution of the gas, the official (U. S. P.) name of which is "solution of formaldehyde". A commercial name for this solution is "formalin".

Solution of formaldehyde is supposed to contain 39 per cent of formaldehyde gas by volume, but from evaporation and deterioration it often falls short of this quantity, seldom containing more than 37 per cent of the gas. The gas, when used under favorable conditions, is one of the most powerful germicides at the disposal of the health officers. In addition to its germicidal efficiency it has the unique advantage over most other disinfectants in that it is not injurious to the ordinary household furnishings. Furniture, carpets, wall hangings, paintings, wearing apparel, and fabrics, with the possible exception of some of the very delicate anilin colors and polished steel, are unaffected by long exposures to the action of this gas.

It acts quickly as a germicide, but its powers of penetration are limited, so that it is necessary to have articles freely exposed in order to insure thorough disinfection. On account of lack of penetrating power it is evident that formaldehyde gas can not be depended upon to disinfect mattresses, upholstered furniture, or articles of that class requiring deep penetration; consequently after exposing them to formaldehyde gas they should be either burned, boiled, steamed (under pressure), or soaked in a disinfectant solution in order to make sure of destroying all possible infection.

Unfortunately the germicidal powers of formaldehyde are markedly affected by climatic conditions. With the temperature and humidity of the ordinary summer in the United States its efficiency as a surface disinfectant is unquestioned, but when the temperature is about or below 50° F., or the moisture in the atmosphere is below 60 per cent of saturation, the efficiency of formaldehyde is very much reduced. The temperature and humidity being below the points stated, polymerization of a portion of the formaldehyde takes place and its power of penetration, which at best is only slight, is still further diminished. These effects of low temperature and humidity may in part be overcome in room disinfection by artificial heating and at the same time boiling water in the room, by sprinkling the floors with water, and also by using an increased quantity of formaldehyde.

Formaldehyde gas is useless as an insecticide and is practically never used for that purpose. Flies and mosquitoes are killed by it only after a long exposure to the gas in concentrated form. It is non-toxic to the higher forms of animal life, including man, but produces in them an irritation of the respiratory, nasal, and ocular mucous membranes, thus causing coughing, sneezing, and "watering" of the eyes. Unless the exposure is prolonged these effects, however, are only temporary and pass off when no longer exposed to the gas.

Formerly formaldehyde gas was largely produced by means of generators, lamps, autoclaves, etc., methods requiring special apparatus and a certain amount of mechanical skill in operating, but those methods have now largely been supplanted by simpler ones which can be used in any household. In view of this fact the instrumental methods will not be dealt with in this paper, but the following methods of evolving the gas will be described:

(1) Formaldehyde-permanganate method.
(2) Formaldehyde-sheet-spraying method.
(3) Formaldehyde-aluminum sulphate-lime method.
(4) Paraformaldehyde.

Regardless of which method is used, everything should be in readiness before the disinfection process is started. All trunks and drawers should be opened and most of the contained articles hung up or otherwise exposed in the room, particularly if there is a possibility of their being infected. All cupboards, closets, and bookcases should be opened.

Fireplaces, ventilators, and cracks of doors and windows to be closed should, with the exception of the doors of exit, be closed before the disinfection process is started.

To get rid of the formaldehyde gas remaining after disinfection it is usually sufficient to open doors and windows and allow it to blow out. Ammonia was formerly used to a limited extent for neutralizing the gas, but, as it often causes a portion of it to precipitate in the form of a powder, which, when heated or moistened, will again give off a certain amount of formaldehyde gas, ammonia is now seldom used for that purpose. Even when the formaldehyde is allowed to blow out the odor of the gas is often perceptible for several days following disinfection. This, however, causes no trouble or inconvenience.

After disinfection with formaldehyde the quarters can usually be occupied an hour or two after opening the doors and windows.

Formaldehyde-Permanganate Method—When solution of formaldehyde is poured upon crystals of potassium permanganate a vigorous reaction takes place, accompanied by strong ebullition of the liquid and sufficient heat to produce a large quantity of formaldehyde gas, water vapor, etc. The time required for the reaction to begin, or at least to become apparent, varies from

a few seconds to a minute or two, depending upon the temperature. The reaction is apparently over in a few minutes and with proper proportions of substances the residue in the vessel is almost dry.

A convenient and efficient proportion to use is two parts of solution of formaldehyde to one part of permanganate, or in the proportion of a quart of the former to a pound (pint) of the latter. By using a greater proportion of permanganate than this, slightly more gas may be evolved, but in addition to requiring an increased expenditure of permanganate the danger of fire is also increased, as formaldehyde gas in a comparatively dry state is inflammable. The increased oxidation resulting from the additional permanganate is therefore more liable to cause combustion of the gas than when the proportions are used as just stated.

For mixing the solution of formaldehyde and permanganate a large galvanized-iron pail is very suitable. Pots or earthen vessels, usually being thick, are not as suitable as thin pails, on account of absorbing much heat from the reaction. The pail, though, may be heated before mixing the formaldehyde solution and the permanganate. On account of the vigorous ebullition during the reaction a 10-quart pail should be used for mixing 10 ounces of formaldehyde solution and 5 ounces of permanganate. Even then a few drops of the mixture may be thrown over, so that it is well to place the pail in a large tin pan or upon something to protect the carpet or floor. To prevent this sputtering over there is some advantage in using a pail with a flared top. As the process is attended with slight danger of fire, the reaction, which is quickly over, should be watched through a window or the pails placed upon a non-inflammable surface.

With this method the formaldehyde gas is evolved so quickly and in such a large volume that it is unnecessary, in houses with well-fitting doors and windows, to paste up cracks unless only a portion of the house is to be disinfected and the remainder is to continue to be occupied.

Closets, drawers, trunks, etc., should be opened, and when everything is in readiness the permanganate is placed in the pail and the formaldehyde solution poured over it. In disinfecting an entire house all inside communicating doors, halls, etc., should be opened and at least one pail placed in each room and hall, unless the rooms are very small. Large rooms may require more than one pail unless a pail proportionately large is used.

The quantity of formaldehyde solution and permanganate to be used per 1000 cubic feet of room space depends upon conditions. If the atmosphere is warm and humid 10 ounces of formaldehyde solution and 5 ounces of permanganate is sufficient, while if it is dry and cold double these quantities should be used. The pails should be placed about in the room or rooms as stated and the necessary quantity of permanganate weighed and placed in them; the formaldehyde solution for each pail should then be measured into a wide-mouthed cup or vessel and placed by the pail in which it is to be used. Do not use narrow-necked bottles or the pouring will require too much time. Although the reaction of formaldehyde solution with permanganate takes place quickly, by making preparations as advised one operator can "set off" a number of pails, there being nothing to do except to pour the formaldehyde solution over the permanganate. Of course the mixing should begin in the rooms most distant from the door of exit.

The time of exposure—that is, the time the premises should be kept closed—should be at least two and, preferably, four hours. At the end of this time the doors and windows are opened and the gas allowed to blow out.

Formaldehyde-sheet-spraying Method—This is a very simple and inexpensive method of evolving formaldehyde gas from formaldehyde solution and when properly used under favorable conditions is efficient. Formaldehyde solution, sheets, and a means of spraying the solution upon the sheets, are all that is required in the way of appliances. The sheets should be hung up over a cord or line and allowed to hang at an angle of about 45°, and it is of advantage, too, to slightly dampen them with water before hanging them up, as the formaldehyde solution will then be quickly absorbed and lessen its tendency to run off the sheets.

The formaldehyde solution should be evenly sprayed upon the sheets, which can be done with any spraying device, a very simple one being a flower watering pot provided with a sprinkler. The spraying should be done rather quickly, as the gas soon begins to be given off. The process should be carried out in each room. Not over 10 ounces of formaldehyde solution should be used for every 30 square feet of sheet surface. The area of a sheet is found by multiplying its length by its breadth.

This method is particularly applicable where a long exposure may be allowed, as the gas is gradually given off and the percentage of formaldehyde remains comparatively high during a relatively long time. This method should not be used at temperatures below 60° F., as the formaldehyde solution polymerizes on the sheets and very little gas is liberated. With fairly close-fitting doors and windows, pasting of cracks is unnecessary, unless a strong wind is blowing. However, large openings like fireplaces, openings into chimneys, ventilators, etc., should be closed either by pasting or with bunches of old rags.

As this method should be used only during warm months, 10 or 12 ounces of formaldehyde solution for each 1000 cubic feet of air space is sufficient.

The time of exposure should be from four to six hours. Open the doors and windows and, when possible, remove the sheets. The sheets are not injured in any way by the formaldehyde solution.

Formaldehyde-Aluminum Sulphate-Lime Method—In this method 2½ pounds of commercial aluminum sulphate are dissolved in 2 quarts of hot water and allowed to stand for a few hours. To 1 quart of this solution, 3 quarts of formaldehyde solution are added. To evolve formaldehyde gas from this latter solution it is poured over unslaked lime in the proportion of 10 ounces of the solution to 1 pound of lime. Just before using the lime it should be broken into small particles. It should slake easily in cold water. The lime should be placed in a pail or vessel and the solution poured over it. A few minutes after pouring the formaldehyde-aluminum-sulphate solution over the lime, the latter begins to slake and continues for 20 to 30 minutes during which time formaldehyde, steam, etc., are given off. The percentage of formaldehyde gas liberated by this method is relatively small as compared with the formaldehyde-permanganate method, but since a small quantity of formaldehyde is efficient when used under favorable climatic conditions this method will then give efficient results. This method, though, should *not* be used in cold, dry weather.

About 15 ounces of formaldehyde-aluminum sulphate solution, made as described above, and 1½ pounds of lime should be used for each 1000 cubic feet of air space. Cracks should be pasted up and fireplaces and ventilators closed, as the percentage of gas given off is relatively small. The time of exposure should be from four to six hours. The process should be carried out in each room.

This method of evolving formaldehyde gas has no advantages, but several

disadvantages, as compared with the formaldehyde-permanganate method, and is now seldom used. It is not as efficient as the sheet-spraying method.

Paraformaldehyde—Paraformaldehyde can be used, particularly for disinfecting small inclosures, under the same conditions of heat and moisture as already stated with regard to the other methods.

Paraformaldehyde is one of the polymeric forms of formaldehyde. It is a white powder and readily burns with a blue flame. For disinfecting purposes it should be heated to convert the paraformaldehyde into formaldehyde gas, but *under no condition* should it be allowed to burn, as the combustion destroys practically all of the formaldehyde. A good method of producing formaldehyde gas from paraformaldehyde is to place the paraformaldehyde in a metal utensil under which a lamp or alcohol flame can be placed. A special lamp or device can be obtained for the purpose, but an ordinary pint tin cup will suffice for heating therein an ounce or two of paraformaldehyde. The paraformaldehyde is placed in the cup and a flame applied underneath. The flame should not be too strong, for should the paraformaldehyde ignite no formaldehyde gas will be produced and there will be no disinfection. The space to be disinfected should be tightly closed and all cracks pasted up. For each 1000 cubic feet of air space two ounces of paraformaldehyde should be used. The time of exposure should be about four hours. If necessary, the flame under the utensil containing the paraformaldehyde can be left burning during the time of exposure.

A solution of paraformaldehyde can be made and used in the same manner that formaldehyde solution is used in the formaldehyde-permanganate method. For disinfecting 1000 cubic feet of space 2 ounces of paraformaldehyde are dissolved in 8 ounces of boiling water. This solution is then poured over 5 ounces of potassium permanganate contained in a 2-gallon pail, the details of procedure being the same as have been described for the formaldehyde-permanganate method.

There are many forms of candles and other preparations of paraformaldehyde made and sold upon the market for disinfection purposes, but bear in mind that any preparation of paraformaldehyde requiring that the preparation be ignited and burned in order to produce formaldehyde gas is useless for disinfection purposes, as the formaldehyde is destroyed by the combustion.

In using those preparations of paraformaldehyde that are heated to produce the gas, due allowance must be made for other ingredients than paraformaldehyde contained therein, and therefore a larger quantity should be used than when using pure paraformaldehyde, as at least 2 ounces of paraformaldehyde should be used for each 1000 cubic feet of space to be disinfected. For the reasons stated the use, for disinfection purposes, of proprietary preparations of unknown strengths should so far as possible be avoided.

Sulphur Dioxide—In the presence of moisture, sulphur dioxide is an efficient surface disinfectant. Its powers of penetration are limited and it will not kill spores, but when used under favorable conditions it will kill the contagion of most of the infectious diseases not due to spore-bearing organisms. Dry sulphur dioxide (SO_2) is practically without germicidal powers, but in the presence of moisture this gas is converted into sulphurous acid gas (SO_3) and sulphuric acid (H_2SO_4), upon which efficient disinfection with sulphur gas depends. While these converted products are destructive to germ life, they are also injurious to household furnishings, fabrics, etc., which is one of the greatest drawbacks to the use of sulphur gas as a disinfectant. These injurious effects and the feeble germicidal properties of the gas in the dry state, have greatly limited its uses, particularly in household disinfection, but it is still especially applicable for

destroying rats, flies, fleas, and other vermin that spread contagion, since it is highly fatal to animal life. It is, therefore, applicable and largely used for disinfecting holds of ships, stables, barns, granaries, freight cars, and structures of this character. Sulphur, either as flowers or in rolls or sticks, can usually be obtained at any drug or crossroads store.

In the presence of moisture sulphur dioxide attacks and causes oxidation of most of the metals, which, however, can be prevented by previously smearing petrolatum upon the exposed surfaces; it bleaches and injures cotton, linen, and woolen fabrics, curtains, etc.; it injures flour, except in the closed ("headed up") barrel; it softens paint and varnish, particularly if they have been recently applied; it injures soap, coffee, tea, sugar, rice, matches, etc., when they are freely exposed to it; it injures clocks; and it discolors wall paper if moisture is present.

The moisture necessary in destroying germ life with sulphur dioxide can usually be artificially produced without difficulty, as it can be added in the form of steam (sulphur furnace), and in the pot method it is automatically produced from the water in the pan in which the sulphur pot is placed. However, when using sulphur dioxide as a disinfectant in damp weather or in disinfecting holds of ships which are usually damp, the artificial production of moisture is unnecessary.

The inclosure to be disinfected with sulphur gas should be made as tight as possible, therefore the cracks of doors, windows, and keyholes should be pasted up; fireplaces, ventilators, radiators, and all openings should be tightly closed, either by pasting them up or in some other manner. This should all be done, except the door of exit, before starting the disinfection. For pasting, strips of paper and a paste made from flour can be used. After the disinfection is over, the pastings can be moistened with water and washed off. It is necessary, to avoid injury to the articles enumerated above, to remove them from the space to be disinfected. Brass or any metal furnishings are not injured, provided they are given a thin coating of petrolatum.

The principal methods of using sulphur dioxide are:

(1) The pot method.
(2) Liquid sulphur dioxide.
(3) Sulphur candles.
(4) Sulphur furnace (requiring special apparatus).

The Pot Method—This is the cheapest and simplest method of producing sulphur dioxide. The only materials required are pots, sulphur, and a small quantity of alcohol. Sulphur burns when liberally sprinkled with alcohol and lighted. It can also be started burning by placing a shovelful of hot coals of fire into it. As sulphur dioxide is produced by combustion of the sulphur, and as the combustion is dependent upon the available oxygen of the air, it will readily be seen that the rapidity of production of the sulphur gas will be governed by the area of the burning surface. It is therefore very important for rapid production that broad shallow pots be used.

Ordinary "Dutch ovens", iron buckets, etc., may be used, but the best pot for the purpose is one with a flat bottom, 12 to 18 inches in diameter, and with sides about 4 inches high. A dish pan answers the purpose very well.

Theoretically the complete combustion of 1 pound of sulphur in a space of 1000 cubic feet produces 1.15 per cent of sulphur dioxide, though 1 per cent is about what is produced in actual practice. Therefore, as 5 per cent is required to kill non-spore-bearing organisms, it is necessary to burn 5 pounds of sulphur for each 1000 cubic feet of space to be disinfected.

After estimating the cubic space to be disinfected the sulphur should be weighed, allowing 5 pounds for every 1000 cubic feet of space.

Sufficient pots should be available so that a depth of not more than 1½ to 2 inches of sulphur will have to be placed in each pot, although necessity sometimes requires a greater depth than this. The sulphur should be sloped toward the center so as to form a crater or depression in the center.

When using stick sulphur a portion of it should be pulverized or broken up. The pots should be distributed in the rooms to be disinfected according to the size of the rooms and number of pots. They may be placed upon the floor, tables, stoves, hearths, etc.

It should be borne in mind that the burning sulphur causes the pots to become very hot, and to avoid danger from fire it is necessary to place them upon objects not combustible or injured by heat. As already stated, this is best accomplished by placing them in pans containing an inch or two of water, as, besides the protection, the heat produces moisture from the water, which is necessary in sulphur disinfection. Pans not being available, the pots may be placed upon earthen or metal surfaces and efficient disinfection done, provided the atmosphere is reasonably damp. Theoretically, about 3 ounces of water should be volatilized for each pound of sulphur burned. The sprinkling of the sulphur with alcohol and lighting should not be done until everything is in readiness. A convenient and safe method of lighting the alcohol in the pots is to strike a match and before the head is entirely ignited to throw it into the pot. This will cause the alcohol to ignite. After lighting, the sulphur fumes do not begin to come off for a few minutes, so that one operator can start a number of pots. After lighting the pots, observe that they are all burning; then close the door of exit and paste up its cracks.

When the sulphur has been burning half an hour, search for sulphur fumes escaping from any openings that may have been overlooked and close them.

Leave the apartment or room closed for 12 hours, and then open doors, windows, etc., and allow the remaining sulphur fumes to blow out. It is well to have the windows so they can be opened from the outside, otherwise entrance to the rooms may be impossible for an hour or so. The rooms can usually be occupied in two or three hours after opening the doors and windows.

Liquid Sulphur Dioxide—The technic of disinfection with liquid sulphur dioxide differs from the pot method only in the manner of production, therefore that is the only phase of the subject that will be described here, the reader being referred to the description already given for further details.

The method has the advantage of liberating a large quantity of sulphur dioxide in a short time, but it is a far more expensive method than burning sulphur by the pot method, the relative cost being about 10 to 1. The method of using liquid sulphur dioxide, however, is very simple and it is free from any danger of fire. The liquid is prepared commercially and is usually obtained in metal cans or casks, which for use only require the simultaneous cutting of the leaden pipes on the tops of the necessary number of cans and the inversion of the latter in a metal or earthen vessel, when volatilization rapidly takes place.

To obtain the 5 per cent of sulphur dioxide required for disinfection, it is necessary to use 10 pounds of liquid sulphur dioxide for every 1000 cubic feet of air space. Therefore, the space should be estimated and the required quantity of liquid dioxide obtained. Of course, with this method the same preparations and precautions with regard to injury of certain articles should be carried out as with the pot method. If a number of adjoining rooms are to be disinfected, it is best to begin opening and inverting the cans in the most

distant rooms and work toward the door of exit. It is necessary to have everything in readiness and to work quickly as the gas is given off rapidly. If the container of the liquid dioxide is provided with a siphon or tube the liquid can be introduced by means of a tube through the keyhole into a suitable receptacle inside the room.

The time of exposure should be 12 hours.

One striking disadvantage of this method as compared with the pot method is that it produces no moisture, which is necessary to obtain the maximum disinfecting power of sulphur dioxide.

Sulphur Candles—As sulphur candles are applicable only for killing insects and not for disinfection purposes the method of using them will be described under sulphur as an insecticide.

Chlorine—Owing to its poisonous and destructive properties, chlorine is very seldom used as a disinfectant. Moisture is necessary for its action as a disinfectant, and in the presence of moisture it is also a powerful bleaching agent for all the organic pigments. Carpets, curtains, and fabrics generally are injured by its action. It is destructive to both animal and plant life. According to Rosenau the most convenient method of generating the gas is by decomposing 1½ pounds of chlorinated lime with 6 ounces of strong sulphuric acid. This produces sufficient gas for the disinfection of 1000 cubic feet of air space. Another method of generating chlorine gas is by adding four parts of strong hydrochloric acid to one part of manganese dioxide. For practical purposes of disinfection, according to Munson, free chlorine is much inferior to sulphur dioxide, since it is more difficult to control, more dangerous to manipulate, and more destructive in its effects.

Chemical Solutions

Bichloride of Mercury—This substance is also known as corrosive sublimate, bichloride, mercuric chloride, and corrosive mercuric chloride. In the pure state it is a white, crystalline substance and fairly soluble in water, thus differing from calomel (mercurous chloride), which is a white, amorphous powder and insoluble in water.

The "antiseptic tablets" or "bichloride tablets" sold on the market are usually composed of bichloride of mercury. These tablets are generally artificially colored (blue) in order to lessen the chances of accidental poisoning with them, as bichloride of mercury dissolved in water makes a perfectly clear solution (see poison tablets of corrosive mercuric chloride, page 500).

Bichloride of mercury is one of the most powerful germicides available. It has the disadvantages, however, of corroding metals, forming inert compounds with albuminous matter and of being very poisonous. It is therefore inadvisable to use it for disinfecting sputum, excreta, or under any condition in which it comes in contact with much albuminous or organic matter, since it forms inert compounds with these substances.

One part of bichloride of mercury will dissolve in 16 parts of cold water and in three parts of boiling water. The bichloride should be pulverized before attempting to dissolve it. Even then it dissolves with some difficulty. The solubility is increased by using sea water for the solution or by adding two parts per 1000 of sodium chloride (common salt) to the water employed. The water used should be free from organic matter and for dissolving the bichloride it is preferable that the water be hot.

The strength of solution used in disinfecting for the infectious diseases is usually 1 part of bichloride to 1000 parts of water, *viz*, a strength of 1 to

1000. This solution is made by dissolving 1 ounce of bichloride in 1000 ounces of water—approximately 8 gallons; a 1 to 500 solution is made by dissolving 1 ounce in 500 ounces of water, and so on for any other strength desired. The solutions are best made in an earthen or wooden vessel, a wash-tub or barrel being very suitable. The addition of a little indigo or other coloring matter will avoid the possibility of the solution being drunk by mistake.

To disinfect soiled clothing, bed linen, etc., they should be placed in a tub containing a 1 to 1000 solution and left for an hour. They can then safely be taken out and rinsed in water and laundered. Bichloride of mercury, however, is a mordant, and clothing containing stains, such as blood, etc., will be permanently stained if placed in bichloride solution. Eating utensils should not be placed in bichloride of mercury on account of the danger from poisoning. Infected floors, tables, wooden beds, chairs, walls, etc., can be washed with a 1 to 1000 solution of bichloride of mercury. For applying it, a floor mop may be used. Saturate the floors and other surfaces with the solution and allow them to dry. The hands and body, except the face, can be bathed in a 1 to 1000 solution without injury.

As already stated, feces, urine, sputum, and products containing albuminous matter should not be disinfected with bichloride solution unless no other disinfectant is available, in which case a 1 to 500 solution should be used.

Surgical instruments are corroded by bichloride solution and it should not be used for rendering them sterile.

"Antiseptic tablets" are usually very soluble in water, and the method of obtaining the desired strengths is stated on the label of the container. They are very useful when only a small quantity of bichloride solution is required. A 1 to 1000 solution is easily prepared from them and is very useful for washing the hands after handling the sick or any possible infected material. The hands should be bathed in the solution for two or five minutes after cleansing them with soap and water.

Solution of Formaldehyde—Solution of formaldehyde has already been considered under gaseous disinfection but it is also a valuable disinfectant solution. It has an advantage over bichloride of mercury in that its action is not retarded by albuminous matter; it is not corrosive; articles are usually not injured by it; it is a good deodorant; and it is not so highly poisonous as is bichloride of mercury.

Solution of formaldehyde is well adapted to the disinfection of urine, feces, sputum, and other discharges of like character, for in addition to disinfecting them, it also deodorizes them. For this purpose, according to Anderson, a 5 per cent solution of formaldehyde and one hour's exposure is required. They should be thoroughly mixed. Allowance must be made for the dilution caused by mixing the formaldehyde solution with the material to be disinfected. For instance, if 1 pint of feces is to be disinfected it should be mixed with 1 pint of a 10 per cent solution of formaldehyde, or a half pint of a 20 per cent solution, which in each case gives the 5 per cent strength required.

Solution of formaldehyde can not be used in the sickroom, as the liberated gas is irritating; nor is it adapted to the washing of floors, walls, etc., for the same reason.

Soiled linen and bedclothing can be disinfected by one hour's immersion in a 5 per cent solution of formaldehyde.

Disinfection with formaldehyde solution should be done out of doors, to avoid the irritating effects of the gas given off.

A few drops either of pure or diluted formaldehyde solution poured into water-closet bowls, urinals, sinks, etc., destroys offensive odors.

Phenol, Popularly Known as Carbolic Acid—This is a very useful disinfectant. It has a penetrating odor, a strong burning taste, and it is a corrosive poison. Pure phenol crystallizes and becomes solid at ordinary temperature, but it can be liquefied either by heat or by the addition of a small quantity of water, about 5 per cent.

Phenol is soluble in about 15 parts of cold water; that is, 1 ounce of phenol dissolves in 1 pint of water (16 ounces), which is about a 6 per cent solution.

Phenol dissolves in water with some difficulty. Therefore, to insure its solubility, hot water should be used and the mixture well agitated.

For disinfection purposes phenol is commonly used in solutions of 3 to 5 per cent. A 3 per cent solution is made by adding 3 volumes of phenol to 97 volumes of water; a 5 per cent solution is made by adding 5 volumes to 95 volumes of water, etc.

In these strengths phenol is not destructive to fabrics, colors, metals, etc. Therefore, it has a wide range of usefulness in disinfection. As it does not actively coagulate albuminous matter, it is useful for the disinfection of urine, feces, sputum, etc. For this purpose a 5 per cent solution is added to an equal volume of the excretions, the mass then thoroughly mixed and allowed to stand one hour before final disposal.

Soiled linen, bedclothes, etc., are best disinfected by immersion for one hour in a 3 per cent solution, and the same strength solution should be used for mopping floors, walls, etc. After handling the sick or any objects possibly infected, such as bedpans, sputum cups, etc., the hands may be disinfected by washing them for two to five minutes in a 2½ per cent (1 to 40) solution of phenol. The hands should then be washed or saturated with alcohol in order to avoid the benumbing effect of the phenol. As phenol does not kill spores it should not be used to destroy the infection of tetanus, anthrax, or malignant edema.

"Crude Carbolic Acid", or *"Tar Acid"* as sold upon the market, is a black, tarry liquid of very varying composition. It contains cresols and other compounds, but although some of these products have greater germicidal powers than pure phenol (carbolic acid), their solubility in water is so slight that the use of pure crude carbolic acid as a disinfectant is greatly limited. It is available, however, in soap solution in which form it is miscible in all proportions in water. It is official as the compound solution of cresol (see page 814) and is sold under various trade names such as *lysol*, *creolin*, etc., see page 815. Its uses are similar to phenol.

Potassium Permanganate—This is a germicide of undoubted power, but of very limited application in general practice on account of the readiness with which it is reduced and rendered inert by organic matter. Except in surgical practice its uses are largely limited to the disinfection of water tanks, cisterns, etc. For this purpose they are emptied of water and the interior thoroughly scrubbed with a 1 per cent aqueous solution of permanganate. After standing an hour or two they are washed out with water until the water comes away perfectly clear. Provided scrubbing of the tanks, etc., is impracticable, they may be filled with water and then enough of a strong solution of permanganate, made with boiling water, added to produce a dark rich purple color. After standing four hours, clean water should be added until the water in the tanks etc., comes away clear. The tanks are then ready for use. Potassium permanganate is soluble in 16 parts of cold and 2 parts of boiling water. Stains produced by permanganate can be removed by washing in a solution of oxalic acid, lime juice, or vinegar.

Lime—This substance is also known as *quicklime* and calcium oxide. It is cheap and when used properly is an efficient disinfectant. Lime may be used for the disinfection of feces, urine, sputum, and other dejecta; it is useful for the disinfection of privies and for any condition under which the soil is suspected of being infected, as in cellars, mucky back yards, etc., and it is also useful, when applied as whitewash, for the disinfection and sweetening of cisterns, cellars, barracks, barns, stables, poultry houses, etc.

It is necessary that the lime be obtained fresh and kept in the unslaked condition. As unslaked lime is often in large, stony masses, it should be sufficiently slaked by the addition of a little water to enable its being distributed for disinfection purposes. In then applying it there should be present only enough moisture to cause the slaking to be completed. This necessary moisture is present in urine, feces, sputum, etc., and is usually present in damp cellars, cisterns, privies, dairies, and back yards, it being required only that these localities be liberally sprinkled with the lime. For disinfecting feces, sputum, etc., they should be well mixed with an equal quantity of lime and allowed to stand for an hour or so before final disposal.

Air-slaked lime is practically inert as a disinfectant; therefore, care should be exercised to keep the lime from the air as much as possible before using it.

Milk of lime is a better disinfectant than lime. It is made by mixing, in a tub or bucket, fresh lime with four times its volume of water, the resulting mixture being ready for use. It is useful for disinfecting excreta, etc., to which it should be added in equal volume and allowed to stand for two hours before final disposal. Milk of lime is most powerful when first prepared. It therefore should be made and used fresh, unless it can be bottled or in some way protected from the air after it is prepared.

Chlorinated Lime—Chlorinated lime, or bleaching powder, popularly miscalled "chloride of lime", according to Rosenau, ranks with unslaked lime in power and value as a germicide, and has about the same uses in practical disinfection. It is a much better deodorant than lime.

As chlorinated lime deteriorates on exposure to the air, through the liberation of its chlorine, it should be kept in air-tight containers and preferably stored in a cool, dry place.

For disinfection purposes it may be used either as a powder or in solution. As a powder, it is applied in very much the same manner as lime. Cellars, privies, etc., are simply sprinkled with it, but not so liberally as when lime is used. It should be well mixed with urine, feces, sputum, etc., in sufficient quantity to form about 4 per cent of the entire mass.

Small quantities of chlorinated lime sprinkled in sinks, urinals, water-closet bowls, etc., will destroy foul odors.

By mixing 1 pound of good chlorinated lime with 4 gallons of water a *solution of chlorinated lime* is obtained which is very useful for disinfection purposes. With this solution floors may be mopped and the hands disinfected by washing them in it for a few minutes. Excreta and sputum are disinfected by thoroughly mixing them with equal volumes of this solution and allowing to stand for one hour.

Chlorinated lime corrodes metals, but the injury to agate ware, such as bedpans, is only slight. It bleaches and otherwise injures fabrics. The disagreeable odor resulting from the use of chlorinated lime in the sickroom may be removed by hanging about in the room towels saturated with a strong solution of baking soda (see also page 568).

The Hypochlorites—As the active disinfection agent found in solutions of chlorinated lime is principally calcium hypochlorite, the uses of the hypochlorites are practically the same as the solution of chlorinated lime.

Labarraque's solution is an aqueous solution of several chlorine compounds of sodium, chiefly sodium hypochlorite and sodium chloride.

It may be diluted with twice its volume of water and used for the same purposes and in the same manner as the solution of chlorinated lime.

Other hypochlorites and chlorine compounds were largely developed during the World War for the disinfection of wounds and also for destroying bacteria in drinking water. These are discussed on pages 546 and 570.

The Practical Application and Use of Disinfectants and Insecticides in the Eradication and Prevention of Communicable Diseases

There are already a large number of diseases known to be communicable, and the list is still increasing as time goes on and new discoveries are made.

As communicable diseases are preventable, this, then, is the day of preventive medicine, and a large share of the responsibility naturally falls upon the medical profession, particularly the health authorities. Their work, however, would be very much handicapped and often go for naught without the aid of the general public; therefore it must do its part, and its part is no small one.

A knowledge of medicine is not always necessary in order to conform to the simple rules of hygiene and intelligently to apply the use of disinfectants in the prevention of communicable diseases. "Communicable", "infectious", and "contagious" are terms that have become more or less synonymous in their meaning, and are often used interchangeably to convey the same idea in referring to the transmission of disease.

A thorough understanding—which at present is lacking—as to the exact nature of the cause and methods of transmission of some of the communicable diseases might make it possible to inaugurate for their prevention more effective and probably simpler methods than those at present in use.

In the case of many of the communicable diseases, however, the specific organism is known and its modes of transmission are understood; with others the specific germ is known, but its modes of transmission are not at all or only poorly understood; with others the organism has not been identified, but its modes of transmission are at least fairly well understood; while with still others the specific organism or cause is still unknown and its ways of transmission are only vaguely understood. Furthermore, some of the communicable diseases are transmitted through the agency of insects acting as simple carriers of the infection; others through insects as intermediate hosts; and others through food, drink, contamination of the air, contact, and various other ways.

It is evident that the uses and application of disinfectants and insecticides in the prevention of all the communicable diseases is a large subject, and to take up each disease in detail would reach far beyond the limits of this article. Therefore, as some diseases call for the same general hygienic management and preventive measures, the one most typical of the class will be described, and the remaining ones of that class described only in so far as they may differ from the one described as typical. For instance, the prophylactic measures that should be carried out against typhoid fever are very much like those that should be used against cholera, dysentery, etc., and, therefore, typhoid will be taken as typical of the class; likewise smallpox will be described

as typical of the exanthemata, others of which are scarlet fever, measles, chicken pox, etc.

It should be borne in mind that, after all, disinfection is a more or less relative process and that it can but seldom be made absolute, particularly in so far as the infection of the communicable diseases is concerned. Patients suffering with some of the communicable diseases are constantly eliminating the infection from their systems and to disinfect all the infection thus eliminated is well nigh impossible. Nevertheless, most of it can be destroyed by the intelligent use of disinfectants, thus reducing to a minimum the danger of the infection being spread.

Typhoid Fever—Typhoid fever is a communicable disease caused by the *Bacillus typhosus*, a germ so small that it can not be seen except with a microscope.

The germs are contained in enormous numbers in the feces, usually in the urine, and often in the sputum of typhoid patients. Typhoid fever is always contracted by taking these germs into the body, through the mouth, either with the food, drink, or otherwise.

A small particle of typhoid excreta, even what will adhere to the legs of a fly, may contain the typhoid organism in large numbers. It is easy then to understand how flies and other insects may spread typhoid infection. They light upon the feces, urine, sputum, or even the lips of the patient; they then may infect food and drink by lighting upon it, or they may carry the infection direct to healthy persons.

The fly, therefore, should be rigidly excluded from the sickroom and from the whole house, if possible, by screening; fly paper or fly poison should be exposed in the sickroom to kill any that may by chance gain entrance thereto. During certain seasons of the year the fly may not be present, but under no condition should excreta of typhoid patients be exposed to flies, at least until it has been thoroughly disinfected. The disinfection should, therefore, be done in a fly-proof inclosure.

The sickroom should have a bare floor, so that it may be washed with a disinfectant from time to time and whenever it may be soiled with the patient's excretions; unnecessary furniture should be excluded from the room; a basin containing a 1 to 40 solution of phenol or a 1 to 1000 solution of mercuric chloride should be in readiness for the doctor's and nurse's hands. A cup or glass containing a 1 to 40 solution of phenol for the thermometer should be on hand, and the thermometer should be kept entirely submerged in the solution when not in use; one or more bedpans should be available, and there should be on hand a supply of disinfectants, as well as some buckets or vessels in which to prepare the disinfectant solutions.

Special gowns for those attending the patient may be used, but they are not necessary, provided intelligent care is exercised. The nurse, however, should wear a rubber apron when bathing the patient, and it should be frequently washed in 3 per cent phenol solution. Visitors and others not required in the sickroom should be excluded.

Disinfection and Disposal of Excreta—Feces, urine, sputum, and all discharges from a typhoid-fever patient should be disinfected as soon as they leave the patient.

This is economically and efficiently accomplished by having a jar, bucket, or pan large enough to hold several times the volume of the excretions voided in 24 hours. It is placed convenient to, but not in the sickroom, and not accessible to flies. The urine, feces, etc., are placed in it when they are

voided, and a volume, equal to, or greater than the volume of excretions, added to it of one of the following solutions:

Solution of chlorinated soda (page 569).
Milk of lime (page 672).
Solution of phenol, 5 per cent.
Solution of formaldehyde, 10 per cent.

The bedpan is rinsed with the disinfectant solution and it then should be immersed for 10 minutes in one of the above solutions, contained in a suitable vessel, as it must be remembered that the outside of the bedpan may be infected by coming in contact with the patient. Bedpans may also be disinfected by sprinkling them with a strong solution of formaldehyde and then simply covering them with a heavy cloth for 15 to 20 minutes. On account of the formaldehyde gas given off this will have to be done out of doors.

In the above manner the entire excretions of a patient for a day can be disinfected and disposed of in sewers, water-closets, privies, etc., without danger of spreading the infection.

Chlorinated lime (powdered form), if used for disinfecting excreta, should be thoroughly mixed with the excretions in sufficient quantity to form 4 or 5 per cent of the entire mass. Likewise, lime used for the same purpose should be added in volume equal to that of the excretions.

When it is impracticable to disinfect the excretions for 24 hours, as stated above, bear in mind that excretions from typhoid patients should not be finally disposed of until they have been exposed to the action of the disinfectant for at least one hour, and under no condition should the excretions be disposed of without disinfection.

The typhoid germ is rather easily killed by heat; therefore in rural districts when disinfectants are not available or only in very small quantities, typhoid excreta can be disinfected with boiling water. In this case the excretions may be sufficiently disinfected to render them safe by filling the bedpan containing the excretions with actually boiling water and allowing it to stand until cool; the contents of the pan are then disposed of, preferably by burying, and the pan rinsed (scalded) with boiling water. Of course the excretions may be disinfected by boiling them in a vessel located in the back yard or some other suitable place. The bedpan though, after it is emptied, should be placed in boiling water for a few minutes.

The preventive measures outlined above should be kept in force, with regard to the urine and feces of typhoid patients, for two or three weeks after recovery, as these excretions may contain the typhoid organism for a considerable time after convalescence. Typhoid excretions should *never* be disposed of where they may get into the water supply, even though they have been disinfected.

Disinfection of the Hands—After handling the patient, bedpan, soiled linen, or any possibly infected material, the hands should be washed for at least two minutes in one of the following solutions:

Bichloride of mercury	1 to 1000
Phenol (carbolic acid)	1 to 40
Compound solution of cresol, or lysol	1 to 100

After washing the hands in any one of the last two solutions they should be rinsed in alcohol to avoid the benumbing effect of these solutions. Persons engaged in handling and managing typhoid-fever patients should avoid, as far as possible, placing their hands about their own faces, and they should

invariably wash their hands in one of the above disinfectant solutions before eating their meals.

Disinfection of Soiled Linen, Bedclothing, Eating Utensils, etc.—Soiled linen, towels, bedclothes, etc., are best disinfected by boiling them for a few minutes. They may also be disinfected by one hour's immersion in a 3 per cent solution of phenol or a 1 per cent solution of cresol, etc.

Eating and drinking utensils, after being used by the patient, should be washed in boiling water. They should not be used by others, at least until they have been sterilized by boiling.

Disinfection of the Bath Water—The water used in bathing the patient may undoubtedly be infected by the patient's excretions. The ordinary bath of 50 gallons of water may be disinfected by mixing in it half a pound of chlorinated lime and allowing it to stand for half an hour before disposing of it.

Terminal Disinfection—Gaseous disinfection of the room after convalescence, death, or removal of the patient is not always necessary, but it is advised as a measure of safety against any possible infection that otherwise might escape disinfection. It is therefore recommended that formaldehyde gas be used, as described on page 1866.

The floor, walls, tables, bed, chairs, etc., should be washed with a disinfectant solution, particularly if gaseous disinfection is omitted. The bedclothing, pillows, linen, etc., should be treated as already described. Without the use of a steam chamber the disinfection of mattresses is a difficult and uncertain problem. Therefore, it is far better that they be burned.

It may be well to state here that during the prevalence of typhoid fever in a house or community it is well to drink only boiled water, and either to avoid drinking milk or drink it only after it has been heated to the boiling point.

Bear in mind, then, that the watchword in typhoid-fever prevention is to *disinfect the excretions as they leave the patient, and to avoid taking living typhoid germs into the body in the food, drink, or otherwise, for without taking these germs into the body through the mouth there will be no typhoid fever.*

Cholera—Cholera is a communicable disease due to the *Vibrio choleræ asiaticæ* or, as it is often called, the "comma bacillus". The disease is sometimes called Asiatic cholera, on account of its home in India, and to distinguish it from *cholera nostras, cholera morbus,* and other forms of non-communicable affections with choleraic symptoms.

The feces always, and the vomit frequently, of those having the disease contain the germ in great numbers. They, however, are not found in the urine.

The germs are conveyed from sick to healthy persons and the disease thus contracted in almost the identical way as is typhoid fever. The reader is therefore referred to the description of typhoid fever given above for the details of disinfection and other preventive measures to be carried out against cholera.

Dysentery—Dysentery is a communicable disease occurring in epidemic form, especially in the tropics or during the hot season of the year. It is sometimes called "epidemic dysentery" to distinguish it from "amebic dysentery". Dysentery is caused by the *Bacillus dysenteriæ*, a minute bacterial organism, while amebic dysentery is believed to be due to the *Entamœba histolytica*, an organism belonging to the animal kingdom and rather resembling in appearance a white blood cell. The former, then, is due to a bacterium, the latter to a protozoön. The two diseases, however, are contracted in very much the same manner, namely, by taking the organisms into the body through the mouth, usually with the food and drink.

The feces of patients having either one of these diseases contains the specific organism in large numbers. Therefore what has been stated with regard to the prevention of typhoid fever applies also to the prevention of both dysentery and amebic dysentery.

Smallpox—Smallpox is highly communicable, but the cause of the disease has not been discovered. The disease is often referred to as "contagious" because it is readily conveyed by contact between the sick and the well. The exact manner in which the virus of infection of smallpox is given off from the body of the patient is not definitely known, but it is thought to be thrown off from the body of the patient into the surrounding air, perhaps with the exhaled breath and certainly from the eruption, whether fluid or dried in the crusts.

The infection of smallpox is thought to enter the body through the respiratory tract.

The preventive measures to be carried out against smallpox are, briefly stated, *vaccination, isolation,* and *disinfection.*

Vaccination—All persons should be vaccinated at least by the time they are a year old. If the vaccination does not "take" it should be repeated until it does "take". They should be vaccinated again about every five years or whenever they are exposed to smallpox. Persons continuously exposed to smallpox should be vaccinated at least once a year.

Isolation—Whenever possible, smallpox should be treated in an isolation hospital provided for contagious diseases. Where this is not practicable, a room should be used that is isolated as much as possible from the remainder of the building. The room, before being occupied by the patient, should be divested of all unnecessary furniture, hangings, draperies, carpets, etc. It should be capable of being darkened and freely ventilated. An adjoining room should be available for the use of the doctor and nurses, as well as for disinfection and other obvious purposes. There should be no communication with the patient except on the part of the necessary attendants, nurses, and the physician.

Disinfection—Body clothing worn by the patient before taking to bed should be boiled or burned. All linen, garments, towels, etc., soiled or used by the patient should, as soon as they leave the patient, be immersed at least one hour in one of the following solutions:

Phenol (carbolic acid)	5 per cent.
Compound solution of cresol, or lysol	1 to 2 per cent.
Chlorinated lime	4 ounces to 1 gallon of water.

As a further measure of safety they should then be boiled, after which they may be laundered and again used, if desired.

Handkerchiefs or clothes soiled by secretions from the patient's nose and mouth had better be burned, though they may be disinfected, as stated above.

The urine and feces of smallpox patients are not supposed to contain the virus of smallpox, but since they may become infected either during or after they are passed by the patient they should be disinfected before disposing of them. They may be disinfected in any one of the ways described for the disinfection of typhoid excreta.

Eating utensils, medicine glasses, etc., used by the patient should be immersed in actually boiling water. Food that has been in the sickroom, but not consumed, should either be burned or placed in boiling water. All disinfection should, so far as possible, be done in a room adjoining the sickroom

or, if that is not available, in the sickroom. The doctor or others temporarily entering the sickroom should wear gowns provided for the purpose.

The nurse should wear dresses of material not injured by disinfectants, for these garments, as well as the doctor's gowns, should be disinfected.

The physician, nurses, etc., after being with the patient, should change their clothing before mingling with other persons. After handling the patient or any possibly infected material, the hands of the operator should be washed for a few minutes in phenol solution 1 to 40, bichloride of mercury 1 to 1000, or some other disinfectant solution. The floor of the sickroom should occasionally be dampened with one of these solutions.

In cleaning the sickroom the raising of dust should be guarded against by using a damp cloth or mop for the purpose, or by dampening the floor before sweeping it.

By applying a bland oil, such as petrolatum, to the surface of the skin of the patient during the stage of desquamation, the dissemination of the exfoliated particles of skin, crusts, etc., may be largely prevented.

Remember that smallpox is infective during the entire period of desquamation and that the patient should be treated accordingly. When the patient is able to be up and desquamation is fairly well along, the body of the patient may be sponged daily with a 1 to 2000 solution of bichloride of mercury. The patient should then occupy another room, at least until the original sickroom can be disinfected. To do this, everything in the room should be left *in situ* and formaldehyde gas applied by one of the methods already described, preferably by the formaldehyde-permanganate method. In rural districts, if formaldehyde is not available, sulphur dioxide (pot method) may be used as described on page 1871. Sulphur dioxide, however, is rather difficult to confine to one room.

After the gaseous disinfection is completed the floor, tables, chairs, etc., should be washed with a 3 per cent solution of phenol or some other disinfectant solution. The mattress should be burned and the bed linen, garments, and other articles in the room disinfected, as has already been stated.

Any room that may be occupied by the patient during the stage of desquamation should, when vacated, be disinfected in accordance with the rules that have been outlined above.

When the stage of desquamation is entirely over—that is, when the skin is smooth and scales or particles of skin are no longer being given off, even from the pocks of the scalp—the entire house should be disinfected with formaldehyde gas.

After the disinfection is over the room last occupied by the patient should be further treated, as has been stated.

Of course, if the patient dies or is sent to a hospital, the room and entire house from which the patient is removed should be thoroughly disinfected in accordance with the rules outlined to be carried out after the patient's recovery.

Scarlet Fever—Scarlet fever is a highly communicable disease, but the nature of the specific organism or cause is not yet known. The infection is likely contained in the secretions of the nose and mouth, and certainly in the exfoliated particles of skin. Desquamation is often so extensive in this disease that it amounts almost to a complete peeling of the outer layers of the skin. The infection seems to live more or less indefinitely in the exfoliated particles of skin, and the disease is often in this way conveyed from the sick to healthy persons.

Scarlet fever is very analogous to smallpox from the standpoint of con-

veyance, prophylaxis, etc. Therefore, omitting the subject of vaccination, what has been outlined with regard to preventive measures, management, disinfection, etc., for smallpox applies almost equally well to scarlet fever. The reader is consequently referred to the subject of smallpox for many of the details omitted here.

The patient should be isolated in a similar manner and the same precautions taken as have been stated for smallpox. All soiled linen, towels, bedclothes, etc., eating utensils, urine, feces, sputum, and nasal secretions should be disinfected; and the same care of the hands and of the floor, the same precautions as to the doctor's gowns and the nurse's wearing apparel should be taken as have been already outlined above for smallpox.

Remember that it is during the desquamatory or peeling stage of scarlet fever that the disease is most dangerously communicable, and that this condition exists until the stage of desquamation is entirely completed. During this stage the body of the patient should be daily sponged with a 1 to 100 phenol or a 1 to 2000 bichloride solution. In children, however, the use of phenol solution is not entirely free from danger.

Disinfection of the room, bedding, etc., during the stage of desquamation, and disinfection of the entire building, room, and bedding, etc., after desquamation is over should be carried out as in the case of smallpox.

The floor of the sickroom should not be swept in a manner that will raise the dust, as the infection may thus be spread. Either dampen the floor or use a damp mop or cloth for cleaning it.

Measles—Measles is a communicable disease the cause of which is unknown. It usually occurs in epidemic form. The infection is present in the secretions and in the skin, and there seems to be no doubt but that it is present in the secretions of the nose and mouth very early in the disease.

Direct contagion is common, but dried particles of skin, sputum and nasal secretion containing the infection may be conveyed in dust, clothing, etc., and thus spread the disease. Measles is, therefore, spread in very much the same manner as smallpox and scarlet fever. Consequently the disinfection for measles is the same as that described for smallpox, to which the reader is referred.

Attention is called to the fact that measles being a very common disease, it is not often deemed necessary to take the precautions of isolation and disinfection for measles that are taken for smallpox and scarlet fever; but it should be borne in mind that in the United States measles caused more than twice the number of deaths caused by smallpox in the same length of time.

Chicken Pox—The cause of chicken pox is unknown, but it is undoubtedly due to a specific infection.

The disease is highly "contagious" in the same sense that smallpox is, *viz.*, by contact between the sick and the well. The disease is spread in much the same way and through about the same channels that smallpox spreads, and therefore the same disinfection measures that apply to smallpox apply also to chicken pox.

Erysipelas—Erysipelas is communicable and is caused by the *Streptococcus erysipelatis*. The organism is contained in the pus and secretions from the seat of the inflammation, and also in the desquamating skin of those suffering with erysipelas.

It is not definitely known how the infection enters the system, but probably it is through the abraded skin or mucous membranes; at least, persons with wounds or abrasions of the skin are very susceptible to infection with erysipelas.

Patients suffering with erysipelas should be isolated and the disinfection

measures for erysipelas carried out along the same general lines as have already been prescribed for scarlet fever.

Diphtheria—Diphtheria is a communicable disease caused by the *Bacillus diphtheriæ*. The germ is found in the secretions of the mouth, nose, and throat, and in the membrane from the site of the lesion in diphtheria. It may sometimes be found in the throats of persons showing no signs of the disease. It is not found in the air unless particles of secretions, membranes, etc., after drying, are blown about with the dust. The infection may be directly communicated from mouth to mouth by kissing, coughing, etc., or indirectly by objects that have become contaminated with the germs of the disease. It may also be spread by food, especially milk.

The uses of antitoxin in the prophylaxis and treatment of diphtheria will not be discussed.

Isolation—Isolation of diphtheria should be carried out as prescribed for smallpox.

Disinfection—The germ being contained in the secretions of the nose, mouth, and throat, it is obvious that these secretions should be disinfected as soon as eliminated, and that cloths, handkerchiefs, etc., used to receive them should be disinfected or burned. Bed and body linen of the patient, when removed or soiled, should be immersed for one hour in one of the following solutions: Phenol, 5 per cent; formaldehyde, 5 per cent; and compound solution of cresol or lysol, 2 per cent. The immersion in the formaldehyde solution can not be done in the sickroom. Eating utensils, medicine glasses, etc., used by the patient should be disinfected in boiling water. The thermometer, except when in use, should be kept in a 3 per cent solution of phenol. Brushes, swabs, etc., used about the patient's mouth should, when not in use, be kept in a weak (1 per cent) phenol solution, and when no longer required they should be burned.

Before disposing of feces or urine, they should have added to them, and allowed to stand for at least an hour, an equal volume of one of the following: A 5 per cent solution of phenol, or a solution of chlorinated lime, 4 ounces to the gallon of water.

The hands of attendants, after handling the patient or any material connected therewith, should be washed in a 1 to 40 solution of phenol or a 1 to 1000 solution of bichloride of mercury.

Upon convalescence of the patient the entire house should be disinfected with formaldehyde gas, preferably by the formaldehyde-permanganate method. The room in which the patient was sick should then be washed with a disinfectant solution, the mattress burned, and the bedding, etc., either disinfected as described above or boiled or burned.

The *Bacillus diphtheriæ* often exists in the throat for some time after convalescence; therefore, the patient should be kept isolated until bacteriological examinations no longer show the presence of the diphtheria organisms in the throat.

Epidemic Cerebrospinal Meningitis—This is a communicable disease caused by the *Diplococcus intracellularis meningitidis*. The organism is found in the cerebrospinal fluid and in the nasal secretions. It is possible that it is sometimes contained in the sputum, urine, and feces.

The methods of conveyance of epidemic cerebrospinal meningitis are not yet definitely settled, but it seems very likely that it and diphtheria are communicated in very much the same way. The measures of isolation, disinfection, etc., prescribed above for diphtheria apply and should be enforced against meningitis.

Acute Anterior Poliomyelitis—This disease is also known as "epidemic poliomyelitis" and "infantile paralysis". The cause of the disease is unknown, and it has been definitely proven to be a communicable disease. It may occur in epidemic form. The infection is undoubtedly contained in the nasal secretion and probably in the sputum, urine, and feces of those having the disease.

The way in which the infection is communicated from sick to healthy persons is not well established, but it probably takes place in much the same manner as in the case of diphtheria and epidemic cerebrospinal meningitis; and therefore the same preventive measures should be rigidly carried out against it that have been prescribed for the two latter named diseases.

Influenza—Influenza is a highly communicable disease, occurring in widespread epidemics and caused by the *Bacillus influenzæ*. The organism is found in great numbers in the secretions of the nose and mouth of those suffering with the disease. The preventive measures for influenza should be carried out along the same lines as those prescribed for diphtheria.

Pneumonia—Pneumonia, croupous or lobar pneumonia, is a communicable disease. It is caused by the *Diplococcus pneumoniæ*. The organism is widespread and is often found in the sputum of healthy persons. The sputum and nasal secretions of those suffering with the disease contain the organism in enormous numbers. It is therefore obvious that the disease may be communicated in very much the same way that diphtheria is communicated, and that, from a prophylactic standpoint, it should be handled accordingly.

Tuberculosis—Tuberculosis is a communicable disease prevalent in all parts of the world.

It is caused by the *Bacillus tuberculosis*, a very minute organism or bacterium. Tuberculosis may affect any part of the human body, although the lungs and respiratory tract are the parts most frequently affected, in which case the disease is often called "pulmonary tuberculosis", "consumption", etc. This is the variety of the disease that is the most dangerously communicable and therefore the one that will be especially considered here.

The bacillus of tuberculosis is usually contained in the sputum of consumptives in large numbers. It is very often contained in the nasal secretion and feces and sometimes in the urine. The germs of tuberculosis outside the body are long-lived and resistant to destruction. It is obvious, then, that the germs may be scattered far and wide by the constant coughing and spitting attending consumption. The dried secretions containing the organisms may mix with the air and dust and thus be inhaled into the lungs of healthy persons.

The germs may also be communicated in many other ways, as, for instance, in the common use by healthy persons and consumptives of drinking cups or glasses, towels, tableware, soap, eating utensils, beds, berths, etc.; from mouth to mouth by kissing or coughing; through the food, especially milk and meat from tuberculous animals; and by the association or living of healthy persons with consumptives. It is largely by means of the sputum in the moist condition that a consumptive infects another person.

Isolation—A consumptive should be isolated, though not necessarily in the strict meaning of the term as applied to smallpox or scarlet fever. The patient should sleep alone, whether it be in a room, a tent, or in the open. If a room is used, it should be one that is isolated as much as possible from the remainder of the building. It should preferably be on the sunny side of the house and well ventilated. Consumptives that are able to be up and around should spend their time, as far as possible, in the open air, but when indoors

they should occupy their own rooms. The consumptive's room should be frequented only by those having duties to perform therein.

Disinfection—Be careful to *destroy all the sputum of consumptives.*

The germ of tuberculosis is easily killed by heat, but it is rather difficult to kill it with chemical disinfectants, especially when it is incorporated with sputum. Therefore the sputum from a consumptive should, as far as possible, either be burned or boiled.

Portable spit cups that are destructible and cheap should be used by consumptives, and after a cup has been in use a few hours it should be burned. If indestructible cups are used, they should contain, while in use, a small quantity of a 5 per cent solution of phenol or a solution of chlorinated lime, and they should be disinfected each day by boiling them and their contents in water. The same measures should be carried out with regard to spittoons, whether they are used by the consumptive or by the public. The spitting in public spittoons by consumptives should be prohibited, but as a matter of fact it often occurs. Consumptives should expectorate only into their own private cups or into the fire. During the act of coughing consumptives should hold a handkerchief before the mouth in order to catch the particles of sputum expelled.

Napkins, handkerchiefs, clothes, etc., used by consumptives should be disinfected in boiling water. Eating utensils, drinking cups, medicine glasses, etc., should also be disinfected in actually boiling water, and under no conditions should they be used by healthy persons until they have been disinfected. Consumptives should never use public drinking cups.

Bed and body linen removed or soiled by the consumptive should be placed directly into a kettle of water and boiled; if this is not practicable at the time of removal they should be placed in a 5 per cent solution of phenol or a 2 per cent compound solution of cresol or lysol until such time as they can be boiled.

As the feces of consumptives usually contain the germs of tuberculosis in large numbers, the fecal discharges of consumptives should be disinfected in accordance with the same general rules as have been prescribed for the stools in typhoid fever.

The floor of a consumptive's room should occasionally be mopped with a disinfectant solution. The floor should *never* be swept without guarding against the raising of dust; either dampen the floor before it is swept or use damp mops or cloths for cleaning it.

Consumptives, when not confined to the bed, should occasionally wash their hands in a disinfectant solution, such as 2.5 per cent phenol or 1 per cent compound solution of cresol or lysol. After handling a consumptive or any infected material the hands of the attendant should be washed in one of the solutions just mentioned.

Upon the permanent vacation of the quarters occupied by a consumptive, whether through death, removal, or recovery, the room, and preferably the entire building, should be disinfected with formaldehyde gas, as described on page 1866. The ingredients for producing the gas not being available, sulphur dioxide (pot method) should be used. The treatment of the room, bedding, etc., following the gaseous disinfection should be as has been prescribed for smallpox.

Leprosy—Leprosy is a communicable disease caused by the *Bacillus lepræ.* It is not as highly communicable as tuberculosis, but in many other ways the two diseases are very analogous. The germs of leprosy are contained in the lesions of leprosy in enormous numbers, and therefore they are

being continually thrown off with the scales, discharges, etc., from the lesions of those suffering with the disease. The nasal secretions of lepers usually contain the germs in large numbers, and consequently many of them are eliminated from the body in these secretions.

The way in which the disease is communicated from the leper to the non-leper is not well understood, but it has been observed that a non-leper sometimes contracts the disease after having lived or associated with a leper.

There is no doubt that lepers should be segregated, but ample provision should be made for their maintenance and comfort. The same thing, said of tuberculosis, would undoubtedly hold true were it possible of accomplishment, but the segregation of all those suffering with tuberculosis is, from an economic standpoint, impossible.

The principles of disinfection for leprosy should be carried out along the same lines as for tuberculosis, which it so closely resembles, particular attention being paid to the nasal secretions. The Leprosy Investigation Station has found a nasal spray of value in freeing the nasal discharges from the bacilli. The nasal cavity is sprayed three times a day with acetozone inhalant (acetone 1 per cent, chlorotone 0.5 per cent in liquid petrolatum).

Plague—Plague, also called bubonic plague, black death, etc., is a communicable disease caused by the *Bacillus pestis*. Patients suffering with plague may give off the germs of the disease in all the discharges from the body, but especially in the sputum and feces. Plague is communicated largely through the agency of insects, particularly fleas, bedbugs, lice, etc. Rats, mice, squirrels, guinea pigs, monkeys, cats, etc., are susceptible to the disease; and among rats, mice, and squirrels it may occur in fatal epidemic form.

Fleas become infected by feeding on the blood of plague-sick animals, after which they may carry the infection either to other animals or to human beings. Fleas are largely responsible for the transmission of plague, but it may also be transmitted by bedbugs, lice, flies, etc. Although an unsettled question, it is possible that plague infection may be communicated to man through food that has been contaminated by plague-infected rats or insects.

The principal disseminators of plague infections, then, are *rats*, indirectly by having the disease and harboring fleas, which carry the infection from rat to rat; and, second, *fleas* directly by becoming infected from plague-sick rats or humans and carrying the infection to healthy persons.

Isolation—Plague should be isolated in the same manner as has been prescribed above for the isolation of smallpox.

Disinfection—Disinfection in plague prevention is directed largely toward the destruction of rats, mice, fleas, bedbugs, flies, and other animals and insects that may transmit the infection. Rats, mice, squirrels, etc., in a plague-infected territory should be exterminated as completely as possible. Use sulphur dioxide, traps, poison, etc., and as soon as the animals are killed they should be burned. The floor of the sickroom of a plague patient should be sprinkled occasionally with pyrethrum powder in order either to kill the fleas and other insects or to keep them away from the patient. Sweepings from the room should be burned. Sputum, feces, urine, and other discharges from the patient should be disinfected with one of the following solutions: Five per cent phenol, 5 per cent formaldehyde, 2 per cent compound solution of cresol, or lysol, chlorinated lime, etc. Soiled bed linen, towels, handkerchiefs, and other objects that have come in contact with the patient should be disinfected by immersion in one of the disinfectant solutions just mentioned

or by boiling. The hands of the nurse should be washed in a solution of phenol or bichloride of mercury.

Upon the termination of the disease the room should be liberally sprinkled with pyrethrum and then fumigated with sulphur dioxide. Following this fumigation, the mattress should be burned, the bedclothes, etc., burned or boiled, and if any lice or bedbugs are present they should be killed, either with boiling water, gasoline, or in some other way.

Typhus Fever—Typhus fever, also known as spotted fever, jail fever, ship fever, *tabardillo*, etc., is a communicable disease, the cause of which is unknown. The disease is conveyed by the body louse, *Pediculus vestimenti*. The louse, by biting a patient suffering with typhus fever, becomes infected, and it may then transfer the infection to healthy persons by biting them.

Patients suffering with typhus fever should be isolated lest healthy persons entering the sickroom become infested with infected lice.

Disinfection—The preventive measures should be rigidly carried out toward the destruction of the louse. When a case of typhus fever is discovered the patient's clothing should be removed and immediately boiled or placed in a 1 to 500 bichloride of mercury solution in order to kill the lice and their eggs. Another bed should be provided for the patient and the framework of the one just vacated should be scalded with boiling water or the lice killed in some other way. The mattress should be burned, and the bedclothing boiled or placed in a 1 to 500 bichloride solution. Parts of the room likely to harbor lice should be scalded with boiling water. The patient's hair should be clipped and the clippings burned. The patient should then be given a thorough sponging with a 1 to 1000 solution of bichloride of mercury. The discharges from the patient are not thought to contain the infection of typhus fever; therefore their disinfection is thought to be unnecessary.

Following the removal of the patient from the room, the mattress, bedclothing, etc., should be treated as above stated, and then the room should be given a thorough fumigation with sulphur dioxide, as has been prescribed for the destruction of lice. Following the fumigation, the framework of the bed, the floor, walls, etc., of the room should be soaked with boiling water or saturated with petroleum, gasoline, or some other method of killing lice enforced. The use of petroleum, and particularly of gasoline, is of course attended with danger from fire.

Yellow Fever—Yellow fever is a communicable disease, the cause of which has not yet been discovered. The disease is transmitted by the bite of a mosquito, the *Stegomyia calopus*. In order for this mosquito to transmit the disease it is necessary that it be infected by biting a human case of yellow fever. About 14 days after thus becoming infected, it may transmit the disease to non-immune persons by biting them; this it may do during the remainder of its life. It is only in the manner just stated that yellow fever is transmitted from sick to healthy persons.

Yellow fever patients should be isolated on account of the possibility of their quarters harboring infected mosquitoes.

The preventive measures against yellow fever consist of screening the patient and the destruction of the mosquito. The patient, therefore, should be kept in a well-screened room and, as a further precaution, in a bed covered with mosquito netting.

Following the removal of the patient, the room, and preferably the entire building, should be fumigated with sulphur dioxide, as described for the destruction of mosquitoes on page 1836. Pyrethrum may be used, but it is not nearly so efficient for killing mosquitoes as is sulphur dioxide.

Malaria—Malaria is a communicable disease caused by the *Plasmodium* of malaria. It is transmitted only by the bite of a mosquito of the group known as *Anopheles*. The mosquito becomes infected and transmits the disease in a manner very similar to that described for yellow fever.

Administering quinine, screening the patient, and destroying the mosquito are the preventive measures to be carried out against malaria. However, effective screening of the patient becomes a difficult problem when consideration is given to the widespread prevalence of malaria and to the fact that the mosquito may become infected by biting a case of malaria long after the patient has apparently recovered from the disease.

Dengue—Dengue is a communicable disease, the cause of which is unknown, but is transmitted by the bite of a mosquito, the *Culex fatigans*. This mosquito may transmit the disease to non-immune persons by biting them almost immediately after the mosquito has fed on the blood of a patient suffering with dengue.

As to how long the mosquito after becoming infected is capable of infecting non-immune persons is not known.

The measures for preventing dengue should be carried out in the same manner as they are carried out in the case of yellow fever.

PART XIV

BIOLOGICAL PRODUCTS

CHAPTER CXVIII

THE SCIENTIFIC BASIS AND CLASSIFICATION OF BIOLOGICALS

THIS section deals with a group of medicinal and diagnostic agents commonly designated as "Biological Products". The term "biological", serves to distinguish these products from the pharmaceutical preparations and chemical substances, including the vegetable drugs, galenicals, and the organic and inorganic chemicals. The word "biological" also carries the thought of complex products resulting from the *life* activities of animal, plant, or bacterial organisms, as distinguished from those resulting from the simpler chemical and physical processes with which chemists deal. As commonly used, it is a general term or group designation, which includes antitoxins, serums vaccines, tuberculins, pollen extracts and the like.

The production of biological products involves the exercise of the skill of expert laboratory technicians and the practical application of the principles of the science of Bacteriology and related branches of knowledge. Their preparation requires (*a*) the growing and handling of mass cultures of bacteria, (*b*) their treatment by technical processes so that they can be made into vaccines, (*c*) the separation and refinement of the toxins or poisonous products elaborated, (*d*) the production of serums, antitoxins, and antibody solutions, (*e*) the preparation of attenuated viruses, and (*f*) the preparation of protein extracts, etc., by scientific methods. These will be outlined below under the description of each product.

The use of biological products in medicine rests entirely upon the science of *immunology*—the science which treats of the defensive and offensive reactions of the body to infectious or parasitic microörganisms and to foreign proteins. It is therefore necessary to understand something of the processes of immunity before one can appreciate why the so-called biological products have attained such an important place in the prevention and treatment of disease.

IMMUNITY

Immunity is an altered or acquired condition, as a result of which the body adapts itself to the presence of foreign protein, resists the invasive powers of pathogenic microörganisms and protects itself against the deleterious action of their toxic products.

Invading pathogenic organisms irritate or destroy body tissues or blood cells. The injury may be effected either by the toxins which they form or by the poisonous effect of the bacteria themselves. The normal individual will respond to such irritation or invasion by an increased production of white blood corpuscles (leucocytes) and of specific *antibodies*—formless but complex physicochemical substances which appear in the blood and lymph and are capable of neutralizing toxins or antagonizing the bacteria and their products. Since the effects of bacteria are of two kinds, it is not surprising to learn that

there are two distinct types of immunity, namely, *antitoxic immunity* or ability to neutralize toxins, and *antibacterial immunity*, or the ability to destroy the bacteria themselves. The more important distinctions may be readily visualized by the following tabulation[1]:

- Reactions to Infection
  - Increase in white corpuscles
  - Production of antibodies
    - against toxins (antitoxin)
    - against bacteria
      - acting alone
        - dissolving bacteria (lysins)
        - clumping bacteria (agglutinins and precipitins)
      - acting with white corpuscles
        - digesting bacteria (opsonins)

The defensive reactions of the body which give rise to immunity are thus seen to be quite varied. In most diseases probably several of these reactions are going on at one and the same time, but usually one is much more important than the others and is commonly emphasized as the sole protective reaction in a given disease.

There is another conception of immunity which it is important to grasp before one can understand the different kinds of biological products and their uses. We refer to the distinction between two general types of immunity commonly spoken of as "passive" immunity and "active" immunity.

Fig. 783

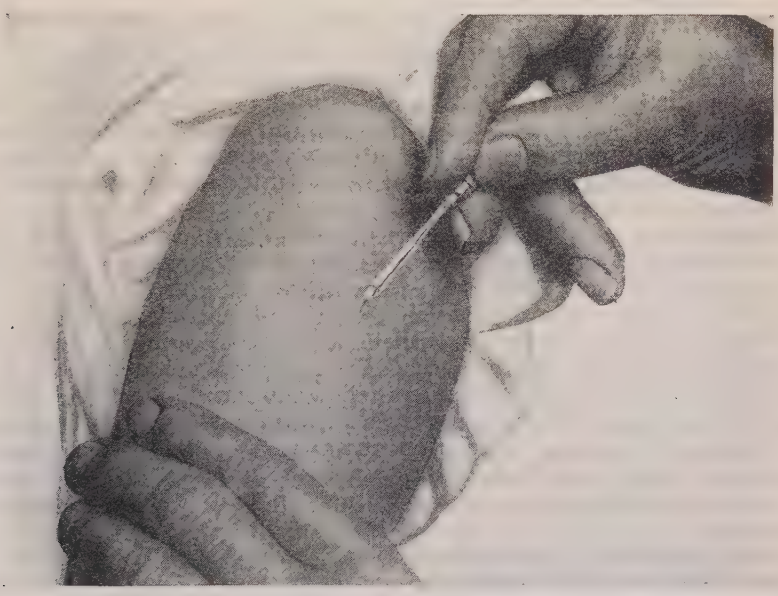
Horse used for the production of Diphtheria Antitoxin

Passive Immunity—Passive immunity is that conferred on a patient by the injection of antitoxins or antibacterial serums. It involves no active response on the part of the patient but gives him the benefit of an excess supply of specific antibodies previously produced in another animal, usually the

[1] Modified from Broadhurst.

horse. The organism concerned is injected into the horse, which reacts by the formation of antibodies. These soon appear in abundance in the blood, and are transferred in the serum to the patient. The latter is merely a passive recipient of protective substances which were produced through the activity of the tissues of the animal whose serum was transferred. Passive immunization is employed in the treatment of acute infections and as a means of supplementing the activity of the patient's own tissues in their efforts to develop sufficient antibodies to destroy the invading organisms and counteract their poisons. Passive immunity is of short duration. The injected antibodies are rather quickly eliminated and their protective influence is gradually lost, so that at the end of two or three weeks, it has practically disappeared.

FIG. 784



The modern method of vaccination against smallpox. Single linear scratch (⅛ inch) through outer layer of skin, upon which droplet of vaccine is expelled from capillary tube and rubbed in gently, with aseptic precautions

Active Immunity—Active immunity is that produced when the cells and tissues of the individual, by their own activities, react to an infection or to an injected antigen, and overcome it by producing and accumulating an excess supply of specific antibodies in the blood and lymph. This type of immunity results only from an active struggle between the body cells and the invading or injected agent. In the words of Kolmer, this battle may be of any degree of severity, ranging from an attack of a disease itself, which may threaten life, down to the most transitory and trivial reaction due to the injection of a minute dose of a mild vaccine. Active immunity may be induced in one or more of three ways. (*a*) By accidental infection, that is, by an actual attack of an infectious disease, such as diphtheria, scarlet fever, measles, etc. (*b*) By artificial inoculation. Before the modern methods of vaccination (see Fig. 784) for smallpox were perfected, this was the common practice in the control of smallpox. Healthy persons were inoculated with the virus from a mild case and thus actually contracted the disease, preferring rather a mild attack while

in health, than to fall a victim to a virulent attack during an epidemic or during ill health. Ex-Senator Beveridge, in his "Life of John Marshall", has made famous the story of how the first Chief Justice of the Supreme Court, as a young man, journeyed on foot from Richmond to Philadelphia to be made proof against the disfiguring malady. (*c*) By vaccination. Vaccination means the injection of an antigenic substance, that is, one which will stimulate the body cells and tissues to the formation of antibodies. The antigens used in vaccination may be living, but modified and attenuated viruses, as in smallpox and rabies vaccination, or killed microparasites and their products, as in bacterial vaccines, or toxins produced by bacteria, as the Scarlet Fever Toxin for immunizing to scarlet fever.

If one inject a guinea pig at weekly intervals with gradually increasing doses of diphtheria toxin, beginning with an exceedingly small dose which will not kill the animal, within five or six weeks a dose can be given that will contain several times the amount of diphtheria toxin which would have killed the animal before the injections began. Repeated injections of small doses of the toxin result in the development of a resistance on the part of the animal, so that it can soon withstand many times the minimum fatal dose. Such an experiment illustrates the development of active immunity of a kind which is spoken of as antitoxic. *Antitoxic immunity* is that induced by either accidental or purposeful injections of toxins.

Monkeys have been vaccinated with pneumococcus vaccines and, after a suitable interval, were experimentally infected with a virulent strain of the pneumococcus. It was found that they were completely protected. The monkeys did not contract pneumonia even when the living virulent pneumococci were introduced directly into the lungs. This experiment illustrates an antibacterial immunity, as distinguished from antitoxic immunity. Practically everyone knows of the immunity which follows an attack of typhoid fever and that which can be produced by anti-typhoid vaccination. These are examples of *antibacterial immunity*—a form of resistance to the infecting organisms themselves, which is generally dependent upon the production and presence of various antibodies (lysins, opsonins, agglutinins, etc.) in the circulating body fluids.

Active immunity of the antitoxic type is of considerable duration, often persisting for years, as in diphtheria and scarlet fever. The duration of antibacterial active immunity is variable. In some cases it is quite short, as that following a common cold, while anti-typhoid vaccination may protect for a period of perhaps two years, and smallpox vaccination for a period of seven years or longer.

Antigens—Antigens have been defined as substances which stimulate the production of protective substances or antibodies. It happens that not only will living bacteria and viruses act as antigens, but also their soluble products (toxins) and other protein substances. In general, any complex protein substance, whether "organized", as in the case of bacteria or red blood cells, or "unorganized", as the white of egg, serum proteins, etc., may, in some degree act as an antigen. In an infectious disease, therefore, the invading organism acts as an antigen because it stimulates the body to the production of protective substances. Likewise, dead microörganisms in the form of bacterial vaccines, or their soluble products in the form of toxins act as antigens. Soluble proteins, when injected parenterally, that is, by any route other than the intestinal tract, also act as antigens and cause the production of specific antibodies.

Protein Sensitization—This brings us to the difficult and complex subject of protein sensitization, which requires consideration in any discussion of

immunity. A few fundamental facts will help explain the use in medicine of such biological products as the pollen, and other protein, extracts. Protein substances such as white of egg, and muscle-substance protein (meat), when taken into the alimentary canal, are broken down by digestion into simpler, harmless substances before they are absorbed through the wall of the intestine into the blood. If these proteins, instead of being taken by mouth, were injected directly into the blood stream, an unusual condition would be set up because the blood does not contain enzymes or ferments necessary to effect their digestion; hence the term "foreign proteins". Foreign proteins act as antigens and the cells of the body are stimulated to dispose of them in some way or to become adapted to their presence.

Protein sensitization manifests itself in many different ways—most dramatically in the phenomenon known as *anaphylaxis*. This abnormal sensitiveness may be demonstrated experimentally as follows. An initial dose of some foreign protein, horse serum, for example, is injected into a guinea pig or rabbit. If, after an incubation period of ten to twelve days, a second fairly large dose is injected, symptoms of a more or less violent character appear. The reaction is manifested chiefly by the contractions of the involuntary or smooth muscles. In the guinea pig this affects particularly the smooth muscle fibers of the bronchi, producing marked respiratory distress and perhaps resulting fatally. In the rabbit, the reaction apparently selects the smooth muscle fibers in the walls of the arterial system of the lungs, with the effect that circulation through the lungs is stopped and the animal dies through oxygen starvation of the remainder of the body. Other animals react in other ways. The animal is said to be "sensitized" by the first injection, with the result that a second dose of the same protein in a sub-lethal quantity for a normal control, and given after a suitable interval, will cause the death of the animal.

Although easily produced in animals, anaphylaxis is fortunately rather rarely observed in the human subject.

There are, however, many other manifestations of protein sensitization of a less severe type. Hay fever, urticaria, serum sickness, asthma, eczema, etc., are examples. A long list of proteins—food, animal, epidermal, bacterial, and pollen—have been incriminated as the inciting agents. One authority estimates that about one per cent of the population of the United States suffers from hay fever. It is the most prevalent form of sensitization. The main factors in this disorder are the wind-borne pollens. When present in inspired air they impinge upon the mucous membranes of the nasal passages and some of their soluble substances are absorbed. This sets up a train of symptoms in pollen-sensitive individuals, marked by congestion and irritation of the respiratory mucous membranes and by catarrh, paroxysmal sneezing, itching, etc. Some are sensitive to one or more of the tree pollens, such as the willow, oak, walnut, maple, and others which pollinate in the early spring. Other patients are sensitive to one or more of the grass pollens, especially timothy, and suffer from hay fever during the pollinating period of this plant in the latter part of May and June. A still larger group is sensitive to some one or more of the numerous wind-borne pollens of late summer and autumn, particularly the ragweeds in Eastern United States and the wormwoods and sagebrush in the western half. There are certain localities, as for example, in the Southwest, where climatic conditions permit plant growth throughout the year, with a succession of pollinating periods, so that sensitive individuals are in discomfort practically the year round. This is the so-called perennial hay fever. Many of the common weeds which pollinate in the late summer and early fall are

factors in hay fever of a mixed type. While some hay fever sufferers are sensitive to but one pollen, the majority are sensitive to two or more, but these are usually closely related botanically.

Asthma, in some of its forms, constitutes another example of protein sensitization. A large number of inciting factors have been identified in this disease. Some patients, for example, are found to be sensitive to house dust or mill dust. Others are sensitive to horse dander and cannot enter a stable without developing an attack. Some asthmatics suffer acute attacks if they have to sleep on a feather pillow. Others are sensitive to sheep wool, and in some, the asthmatic symptoms are caused by pollens.

Serum sickness is a manifestation of protein sensitization with which the physician is frequently concerned. The ordinary form of serum sickness appears usually from eight to thirteen days after the injection of the serum, and is characterized by a rash and skin eruption together with some edema or swelling and joint pains and sometimes a slight fever. Sometimes it manifests itself by an immediate stormy reaction resembling shock. Such immediate reactions occur usually after the first dose of the serum and develop only in those individuals who are naturally sensitive to horse serum. Natural sensitiveness to horse serum is fortunately rare—about one patient in twenty thousand according to one authority. Most individuals are normal with respect to sensitivity to horse serum and can be given a dose of antitoxin or serum without any immediate or severe reactions. These patients are more likely to show more pronounced symptoms of serum sickness following a second dose of serum than after the first.

The mild, delayed form of serum sickness is not serious and excites no alarm. The immediate or shock reaction, however, must be avoided as far as possible. Physicians should take the precaution to determine, before giving the first injection of a serum, whether the patient is sensitive to horse serum. This is particularly important if the patient gives a history of asthma, for it may be that the asthma is a symptom of sensitiveness to horse protein. In any case, sensitiveness can be readily determined by making a preliminary skin test. This is done by injecting a very small amount, $\frac{1}{20}$ to $\frac{1}{10}$ of a cc., between the layers of the skin. If the patient is sensitive, a noticeable reaction will appear within twenty minutes to one-half hour, in the nature of an area of redness with development of a wheal around the site of injection. One who is not sensitive to horse serum develops no reaction and may safely be given ordinary therapeutic doses of serum.

Serum treatment of those who show a positive reaction must be carried out very carefully, usually beginning with a very small dose, a fraction of a cc., and gradually increasing this at hourly intervals, until 1 cc. can be given without causing a reaction. Doses may then be more rapidly increased, until the required therapeutic dose has been administered.

Treatment of the many forms of protein sensitization may be carried out along different lines. The simplest method, of course, is to avoid or remove the specific cause of illness. If this cannot be done, specific protein treatment is the method of choice. Specific protein treatment means the partial or complete relief of the symptoms by subcutaneous injections of a suitable preparation of the specific protein, found by test to be the causative factor. It is necessary to begin the injections with very small sub-toxic doses. These can be increased very gradually. Usually they must be continued over a considerable period of time. The doses may be given at short intervals, with the object of increasing the patient's tolerance as rapidly as possible. The duration of the immunity or tolerance gained by this method of treatment varies greatly. In hay fever, for

example, one authority states that one cannot rely upon the duration of tolerance lasting more than six to eight weeks. For this reason hay fever sufferers usually have to repeat the treatment preceding the onset of symptoms each season.

In the treatment of other forms of protein sensitization there are marked irregularities in the results, which may be accounted for by difficulties in making accurate specific diagnosis, by differences in the degree of the sensitiveness of the patient and by differences in the intensity of exposure. Developments in this branch of Immunology are appearing rapidly and the pharmacist who makes some effort to keep in touch with them will be in the best position to render service on biological products.

CLASSIFICATION OF BIOLOGICAL PRODUCTS

The subject of immunity to infectious diseases and of tolerance to foreign proteins has been discussed briefly, in order to provide a sufficient background for understanding the different kinds of biological products which the pharmacist is called upon to handle and the different uses to which they are put in the treatment and prevention of disease. The biological products generally used in medicine today fall into distinct groups, which may be outlined as follows:

CLASSIFICATION OF BIOLOGICAL PRODUCTS

Antitoxins *Serums* *Antibody Solutions*	*For Passive Immunization*—in treatment of acute diseases and for temporary prophylaxis.
Toxins and *Toxoids* *Toxin-Antitoxin Mixture* *Tuberculins* *Bacterial Vaccines (Bacterins)* *Sensitized Bacterial Vaccines (Serobacterins)* *Viruses*	*For Active Immunization*—in treatment of chronic diseases and for prophylaxis. Bacterial vaccines, both plain and sensitized, sometimes used in acute diseases.
Proteins—Foreign Protein Therapy—specific and non-specific.	
Diagnostic Reagents	Include many products under the above groups, especially the *toxins*, *tuberculins*, and *proteins*, used in the specific diagnosis of disease.

The groups are more clearly defined and the individual preparations are described in the following pages.

Dating, Preservation and Dispensing—There are some practical points which apply to all biological products and are of great importance to the pharmacist, both in his professional capacity and as a means of preventing unnecessary losses.

The potency of biological products in general tends to decrease or fall off more or less rapidly with the lapse of time. Their period of potency is greatly prolonged by preserving them at low temperatures. This is nowhere more clearly shown than in the data which was first worked out by Dr. W. F. Elgin for smallpox vaccine. It was found that the potency of vaccine virus was lost within three or four days by exposure to temperatures of 98° F. (37° C.); it was greatly weakened or lost by one to three weeks' exposure at 70° F. (21° C.); at ordinary refrigerator temperatures of 50° F. (10° C.), the virus was still active after three or six months; at 10° F. (−12° C.) it remained active for four years.

Cold storage is just as important for the pharmacist as for the manufacturer, and physicians will usually give preference, in purchasing biologicals, to the pharmacist who is equipped to keep the products continually at a low temperature while in his possession.

NOTE—In spite of the importance of refrigeration in preserving biological products, *freezing should be avoided*. This precaution is particularly important in the case of Diphtheria Toxin-Antitoxin Mixture. Some unfortunate experiences have shown beyond a doubt that freezing was responsible for some change in the Toxin-Antitoxin Mixture by which the toxin was left under-neutralized. Its use subcutaneously was followed by severe constitutional reactions and painful local inflammations. Freezing probably has some injurious effect on some other biological products.

Not only the temperature of the storage space but the time that the package remains on the shelf is a very important consideration. Some loss of potency occurs even at the lower temperatures. Because of the effects of temperature and age, United States Federal laws require that packages of most biological products be marked with an "expiration date", beyond which the contents cannot be expected, beyond a reasonable doubt, to yield specific results. The regulations may be briefly summarized as follows:

Dating of Biological Products—Official antitoxins and those subject to official potency tests, with

20 per cent excess potency, 1 year
30 per cent excess potency, 2 years
40 per cent excess potency, 3 years
50 per cent excess potency, 4 years

Anti-Anthrax, Antidysenteric, Antipneumococcic, Antistreptococcic Serum, 1 year from date of manufacture or issue.

Other immune serums, 6 months.

Normal serums, 3 years.

Vaccine Virus, 3 months, "if kept below 5° C. (41° F.)", and 2 months, when issued between May 1st and September 15th.

Rabies Vaccine, killed virus, 6 months.

Rabies Vaccine, living virus, in less than 50 per cent glycerin, 21 days after emulsification; in an emulsion containing at least 50 per cent glycerin, 1 month.

Tuberculins, concentrates, 5 years; dilutions, 1 year.

Bacterial Vaccines, 18 months.

Sensitized Vaccines (Serobacterins), 18 months.

Modified bacterial derivatives, 18 months.

Diphtheria Toxin-Antitoxin Mixture, 6 months.

Diphtheria Toxin for Schick Test, 6 months, "if kept between zero and 8° C. (32 to 46.4° F.)". In the absence of such proviso, 1 month.

Pollen extracts, animal, vegetable and bacterial protein extracts, 1 year.

The fixing of an expiration date does not necessarily mean that the products lose all their potency when the period has expired, but simply that past experience has shown that there is more or less loss within that period, so that after the expiration date, the full therapeutic effects cannot be expected. Most biological products are subject to a return privilege for credit or exchange. While this is necessary, in view of the nature of the products, abuse of the privilege is to be avoided by carefully anticipating current local needs and stocking only enough biological products to meet demands likely to arise over a limited period of time.

In dispensing biological products the pharmacist is dealing with preparations, most of which are intended for use by injection, either subcutaneously, intramuscularly or directly into the vein. It is therefore of paramount importance that the sterile condition of the preparations be maintained up to the time they are actually injected. Sterility is assured by the processes used in the manufacturing establishments, and no product is released until repeated tests have shown the product to be safe in this respect. The pharmacist contributes his part to the maintenance of sterility of the product and safety to the patient by observing the requirements of the U. S. P. X, for the official antitoxins, *viz.*, that *they must be dispensed in the unopened glass containers in which they were placed by the manufacturing establishments.*

CHAPTER CXIX

BIOLOGICAL PRODUCTS USED FOR PASSIVE IMMUNIZATION

ANTITOXINS

Antitoxins are antitoxic serums, usually more or less concentrated and purified by the removal of some of the non-essential serum constituents. They confer passive antitoxic immunity and are used in the specific treatment of the acute manifestations of disease.

Official Products—Two antitoxins are recognized by the U. S. P. X, namely, Diphtheria Antitoxin and Tetanus Antitoxin. The former is now official only in the refined or concentrated form, while Tetanus Antitoxin is official in two forms—the concentrated and the crude.

Legal Control—The official antitoxins must be prepared in an establishment licensed by the Secretary of the Treasury of the United States. The requirements for labeling are that the outside label must bear the name of the antitoxin and the minimum number of units in the package, the lot number of the antitoxin, the name, address and license number of the manufacturer, and a statement of the date beyond which the minimum potency may not be maintained. This date is one year from date of issue from the manufacturing establishment if an excess of 20 per cent over the minimum potency has been placed in the container, two years for a 30 per cent excess, three years for a 40 per cent excess, or four years for a 50 per cent excess.

The strength shall be expressed in units of antitoxic power, and the unit shall be that of the standard antitoxin distributed by the Hygienic Laboratory of the United States Public Health Service.

ANTITOXINUM DIPHTHERICUM. U.S. Diphtheria Antitoxin

[**Antitox. Diph.**—Serum Antidiphthericum Purifactum U. S. P. IX, Purified Antidiphtheric Serum, Concentrated Diphtheria Antitoxin, Refined Diphtheria Antitoxin, Antidiphtheric Globulins]

Diphtheria Antitoxin is an aqueous solution of certain antitoxic substances obtained from the blood serum or plasma of an animal of the genus *Equus*, which has been properly immunized against diphtheria toxin. After the serum or plasma from the immunized animal has been collected, the antitoxin-bearing globulins are separated from the other constituents of the serum or plasma and dissolved in water. Sodium chloride and a preservative are then added and the solution is filtered through a bacteria-excluding filter. It has a potency of not less than 350 antitoxin units per cc.

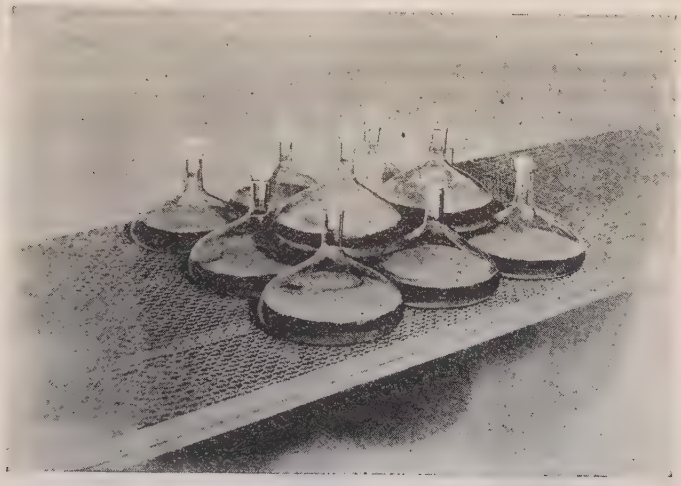
Description and Physical Properties—A transparent or slightly opalescent liquid, with sometimes a slight granular deposit, of a faint brownish, yellowish or greenish color, nearly odorless, or having an odor due to the presence of the antiseptic used as a preservative. Diphtheria Antitoxin must come from healthy animals, must be sterile, free from toxins, and must not contain an excessive amount of preservative (not more than 0.5 per cent of phenol or 0.4 per cent of cresol, when either of these is used) and the total solids must not exceed 20 per cent.

Uses—Diphtheria Antitoxin is the specific curative agent in the treatment of diphtheria. Its administration accomplishes two things, provided it is given in adequate dosage and sufficiently early in the course of the disease. (1) It neutralizes diphtheria toxin in the blood and body fluids and possibly the toxin which is in contact with, or united to, the tissue cells. (2) Adequate dosage supplies the patient with an excess of antitoxin, which serves to neutralize any

further toxin production as long as virulent diphtheria bacilli remain. The antitoxin also influences the destruction and removal of the bacilli which produce the toxin.

Benefit from the use of Diphtheria Antitoxin depends largely on the method and time of administration and the size of the dose. All authorities emphasize the importance of introducing the Diphtheria Antitoxin into the circulation as soon as possible after infection has occurred. In view of the importance

FIG. 785



Flasks on shelf in incubator showing growth of Diphtheria Bacilli in the production of Diphtheria Toxin

of the time factor it is generally recommended that antitoxin be given to every patient upon the mere suspicion of diphtheria, making bacteriological diagnosis afterward.

With reference to the methods of administration, the subcutaneous route is used only in the treatment of mild cases. Any part of the body where there is an abundance of subcutaneous cellular tissue may be selected. The intrascapular region is usually preferred. In moderate cases intramuscular injections are recommended. The gluteal region or the anterior part of the thigh offer suitable sites. Absorption is three to four times more rapid than from subcutaneous injections. Intramuscular injections, if properly carried out, are no more painful than subcutaneous injections, and because of the more rapid absorption are recommended for routine use. In severe and malignant cases and in all cases seen late in the disease it is important to introduce the antitoxin into the circulation at the earliest possible moment. Intravenous injection is therefore the method of choice.

Diphtheria Antitoxin is also used for prophylactic or protective purposes. To those who have been exposed to diphtheria by contact with cases and have not themselves developed the symptoms, immediate though temporary protection is conferred by the injection of 1000 units Diphtheria Antitoxin. This gives a temporary, passive immunity which protects the individual against infection for a short time. This protection lasts little more than two weeks, and is therefore limited to prophylaxis in persons actually exposed to the disease and finds its chief value in the presence of epidemics. A more or less permanent

active immunity to diphtheria is conferred by the use of Diphtheria Toxin-Antitoxin Mixture, see page 1916.

Dose—The Pharmacopœia states the average dose as, curative, 10,000 units, protective, 1000 units. In practice, physicians gauge the curative dosage by the severity of the symptoms and the stage of development of the disease. In very mild cases, treated early, 3000 to 5000 units is often sufficient. An average dose of 10,000 units should be regarded as a minimum initial dose in severe cases and in those seen late. The dosage may be repeated at short intervals, if indicated. There is apparently no danger of an overdose. It is the practice to reduce the dosage by one-half for infants under twenty pounds, and a one-third reduction is recommended for children under fifty pounds. Otherwise, the dosage given applies to all age groups. The protective or preventive dose of 1000 units is standard practice.

Dosage Forms Available—Commonly supplied in 1000 unit, 3000 unit, 5000 unit, 10,000 unit and 20,000 unit containers.

Manufacturers—1, 2, 6, 8, 14, 17, 45, 52, 56, 63, 64, and 65.[1]

FIG. 786

Relative difference in volume between unconcentrated antitoxic serum (A), antitoxin of the usual concentration (B), and super-concentrated antitoxin (C) of the same strength (10,000 units)

Unofficial Diphtheria Antitoxin

DIPHTHERIA ANTITOXIN SUPER-CONCENTRATED

In the words of the N. N. R., this product resembles Diphtheria Antitoxin, U. S. P., but differs in that the volume per thousand units is smaller and the protein content is claimed to be lower.

Preparation—The method of preparation is the same as that for Diphtheria Antitoxin, U. S. P., except that certain refinements and improvements in the method of concentration are applied by which antitoxin-bearing globulins of higher potency are obtained.

Uses—Has the same indications as Diphtheria Antitoxin, U. S. P., with the claim that its use causes less pain to the patient and is more quickly absorbed because of its smaller volume. The dosage, in terms of unit strength, is the same as that of the official preparation.

Dosage Forms Available—Supplied in 1000 unit, 3000 unit, 5000 unit, 10,000 unit and 20,000 unit syringe packages.

Manufacturer—2.

[1] The numbers refer to the licenses issued by the United States Public Health Service to manufacturers of Biological Products. A key will be found at the end of Chapter CXXII, page 1936.

ANTITOXINUM TETANICUM. U.S. Tetanus Antitoxin

[**Antitox. Tet.**—Serum Antitetanicum Purificatum U. S. P. IX, Purified Antitetanic Serum, Concentrated Tetanus Antitoxin, Refined Tetanus Antitoxin, Antitetanic Globulins]

Tetanus Antitoxin is an aqueous solution of certain antitoxin-bearing substances obtained from the blood serum or plasma of an animal of the genus *Equus*, which has been properly immunized against tetanus toxin. After the serum or plasma from the immunized animal has been collected, the antitoxin-bearing globulins are separated from the other constituents of the serum or plasma and dissolved in water. Sodium chloride and a preservative are then added and the solution is filtered through a bacteria-excluding filter. It has a potency of not less than 300 units per cc.

Description and Physical Properties—A transparent or slightly opalescent liquid, with sometimes a slight granular deposit, of a faint brownish, yellowish or greenish color, nearly odorless, or having an odor due to the presence of the antiseptic used as a preservative. Tetanus Antitoxin must come from healthy animals, must be sterile, free from toxins, and must not contain an excessive amount of preservative (not more than 0.5 per cent of phenol or 0.4 per cent of cresol, when either of these is used) and the total solids must not exceed 20 per cent.

Uses—Tetanus Antitoxin must be considered rather as a preventative than as a curative agent, as best results are obtained when the antitoxin is routinely administered before the tetanus toxins have invaded the motor nerve cells. Conditions favoring the growth of tetanus bacilli are found in contused, lacerated wounds, in which destruction of tissue and blood has occurred.

"It should be the universal rule to give a prophylactic dose of 1500 units of antitoxin to all patients who have received lacerated or penetrating wounds. If the wounds contain necrotic tissue or a suspected foreign body, the dose should be repeated in ten days and subsequently if operation on the wound is contemplated[2]." Deeply seated wounds which heal on the surface are especially dangerous, as also puncture wounds from nails and Fourth of July accidents. Statistics of its use in armies have fully demonstrated the protective value of tetanus antitoxin in wounds occurring in warfare. Wounds occurring in or about stables or on the farm, where manure, one of the best carriers of tetanus bacilli, is present, should be treated as soon as possible, and the injection of an immunity dose of Tetanus Antitoxin should be regarded as standard routine practice.

Treatment of tetanus is not as satisfactory as the protective use of the serum. Tetanus toxin has a special affinity for nerve tissues, and eventually fixes itself to the nerve cells of the spinal cord. Since this fixation of the toxin in the nerve cell cannot be reversed, the object of treatment is to administer large quantities of *antitoxin* at the earliest possible moment in an attempt to neutralize the toxin before fixation has had time to proceed to a dangerous extent. Therefore, if the symptoms of the disease have appeared, an attempt should be made at once to saturate the patient with antitoxin by the quickest possible method. For this reason authorities recommend either intravenous or intraspinal injections or both.

Dose—The curative dose stated by the Pharmacopœia is 10,000 units. This is usually greatly exceeded. Therapeutic doses of from 30,000 to 40,000 units, repeated daily, are often given, and occasionally even larger doses have been used.

The protective or immunity dose is 1500 units. This dose should be repeated

[2] Stone, W. J., *J. A. M. A.*, *78*, 1943, June 24, 1922.

every eight to ten days, as long as the condition of the wound indicates the possibility of the continued presence therein of tetanus bacilli or its spores.

Dosage Forms Available—Commonly supplied in 1500 unit, 5000 unit and 10,000 unit containers.

Manufacturers—1, 2, 6, 8, 14, 17, 45, 52, 56, 63, and 65.

ANTITOXINUM TETANICUM CRUDUM. U. S. Crude Tetanus Antitoxin

[**Antitox. Tet. Crud.**—Serum Antitetanicum U. S. P. IX, Antitetanic Serum, Crude Antitetanic Serum, Unconcentrated Tetanus Antitoxin, Unrefined Tetanus Antitoxin]

Crude Tetanus Antitoxin is a fluid, having a potency of not less than 150 units per cc., separated from the coagulated blood of an animal of the genus *Equus*, which has been properly immunized against tetanus toxin.

Description and Physical Properties—A yellowish or yellowish-brown, transparent, or slightly turbid liquid with sometimes a slight granular deposit, having the faint odor of horse serum or having an odor due to the presence of the antiseptic used as a preservative. Crude Tetanus Antitoxin must come from healthy animals, must be sterile, free from toxins, and must not contain an excessive amount of preservative (not more than 0.5 per cent of phenol or 0.4 per cent of cresol, when either of these is used) and the total solids must not exceed 20 per cent.

Uses—Crude Tetanus Antitoxin can be used in the same way as the refined or concentrated product, but in considerably larger volume of liquid for the same number of antitoxic units. In this country the crude product finds practically no use in human medicine. The manufacturers referred to under the refined antitoxin are, of course, equipped to supply it, but none list it. Most of the lower unit Tetanus Antitoxin finds its way into veterinary practice.

Unofficial Antitoxins

SCARLET FEVER STREPTOCOCCUS ANTITOXIN (CONCENTRATED)

(Scarlet Fever Antitoxin. Scarlatinal Antitoxin)

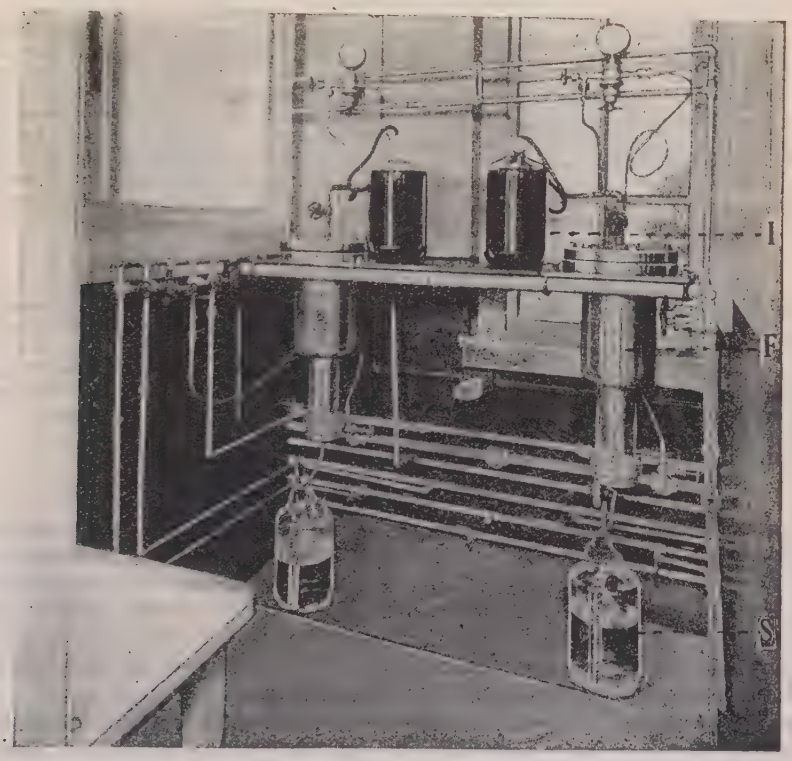
The approved product is the result of research work carried out by Drs. G. H. and G. F. Dick at the McCormick Memorial Institute for Infectious Diseases in Chicago. The method of preparation and the standards are protected by a patent now administered by a Scarlet Fever Committee. It is manufactured under license granted by the Scarlet Fever Committee.

Preparation—Normal, full-grown horses are used, after a ten-day period of observation in quarantine has shown them to be free from disease. The horses are injected subcutaneously with toxin from broth cultures of the scarlet fever streptococcus. The injections are increased gradually up to the limit of tolerance. When potency reaches a satisfactory stage the horses are bled regularly until large amounts of serum have been collected. The serum or plasma is then purified and concentrated by the method used for the concentration of Diphtheria and Tetanus Antitoxin. A preservative (phenol to make 0.35 per cent) is added and sterility effected by passing the antitoxin through germ-removing filters (see Fig. 787). Sterility and potency tests are carried out by the manufacturers, who must then submit samples of each lot to both the U. S. Public Health Service and to the Scarlet Fever Committee, Inc. The antitoxin is released for distribution only upon passing check tests in the laboratories of these two organizations.

Description and Physical Properties—A transparent or slightly opalescent liquid, having much the same appearance as Diphtheria Antitoxin or Tetanus Antitoxin. Possesses a faint amber-yellow or greenish color. Potency is expressed in terms of the number of "skin test doses" which it will neutralize. A "skin test dose" is the amount of scarlet fever toxin which will produce a mild reaction consisting of an area of redness at the point where the toxin has been injected between the layers of, not under, the skin. One thousand times this amount of toxin, that is, 1000 "skin test doses", if injected into one who is not immune to scarlet fever, will produce transient symptoms of the disease. The present potency requirement for the antitoxin is that sufficient to neutralize fifteen times this quantity of toxin. In other words, it must contain enough antitoxin per cc. to neutralize at least 15,000 skin test doses.

Uses—Used in the treatment of scarlet fever. When administered early and in adequate dosage, it has a remarkable curative action, usually bringing about a reduction of the temperature and relief of most of the symptoms within twenty-four hours. Its early use also apparently reduces the incidence of the serious complications and sequellæ which otherwise often follow. Used late in the disease its value is less marked and it has little or no effect in the control of complications and sequellæ once they have developed. It is also used as a prophylactic or preventative. A prophylactic immunity dose is administered to contacts and susceptible individuals who have been directly exposed to scarlet fever infection. Like the prophylactic use of Diphtheria Antitoxin, it gives an immediate passive immunity which will protect the recipient from scarlet fever for a period of two weeks or a little more, and is

FIG. 787



Filtering crude serum to remove broken cells, shreds of fibrin, etc. (I) Immune serum, (F) filter, containing porcelain or clay "candle" through which the serum is forced under pressure, (S) sterile serum ready for finishing process and filling into containers

therefore useful only for the protection of contacts in the home where a case has already developed and for the quick control of an epidemic. An active immunity, presumably more or less permanent, can be developed through the use of Scarlet Fever Streptococcus Toxin—Immunizing, see page 1916.

Dose—Approved Scarlet Fever Antitoxin, manufactured under license from the Scarlet Fever Committee, Inc., is supplied in two dosage forms only, one known as the "therapeutic dose", supplied in syringes containing not more than 14 cc. of antitoxin; the other, known as the "prophylactic dose" syringe, contains one-half the contents of the therapeutic dose. In treatment, one therapeutic dose is usually sufficient in cases treated early and in mild attacks. Sometimes two, rarely three or four "therapeutic doses" are required.

Dosage Forms Available—Commonly supplied in syringe packages of two sizes—therapeutic dose and prophylactic dose.

Manufacturers—2, 52.

SCARLET FEVER STREPTOCOCCUS ANTITOXIN (Dochez Method)

The United States Public Health Service has also issued a license to manufacture Scarlet Fever Antitoxin by the Dochez method, and the product is described in the N. N. R. By the method of Dr. A. R. Dochez, horses are immunized against the specific scarlet fever organism by the localization of living streptococci in a subcutaneous agar nodule, in which they grow and stimulate the production of antitoxic and antibacterial substances. The standard established by the U. S. Hygienic Laboratory is that 1 cc. of the final product must neutralize and hold in neutralization for forty-eight hours not less than 1000 skin test doses of control toxin supplied by the U. S. Hygienic Laboratory. The product actually supplied is in concentrated form and is claimed to neutralize 20,000 skin test doses.

Manufacturer—56.

BOTULINUS ANTITOXIN

Outbreaks of botulism—a type of food poisoning—often occur and sometimes assume epidemic proportions. The symptoms are caused by the toxins of the Bacillus Botulinus; and usually appear only after a definite incubation period of from eighteen to thirty-six hours. It has been found that there are two distinct toxins, and that they have an affinity for the central nerve system. A very small amount of toxin-containing food is enough to cause symptoms and death. When cases appear the need for antitoxin is urgent. As in the case of tetanus, Botulinus Antitoxin must be given early if it is to be effective. The antitoxin is available commercially through only one source. At the present time only one license has been issued by the United States Public Health Service—to the Agricultural Experiment Station, College of Agriculture, University of Illinois, License No. 81.

PERFRINGENS ANTITOXIN (ANTI-GAS-GANGRENE SERUM)

The Bacillus Perfringens is one of the causative factors of gas gangrene. A hemolytic poison or toxin is produced by its growth in muscles. Antitoxic serums have been produced and best results seem to have followed their prophylactic use. Intramuscular injection in the vicinity of the wound together with intravenous administration is advised. The Hygienic Laboratory has established standards for Perfringens Antitoxin and license has been issued for its manufacture.

Dosage Form Available—Supplied in 100 cc. bottles.

Manufacturer—2.

ANTIBACTERIAL SERUMS

Antibacterial serums are antagonistic to bacteria. They attack the germs themselves and for this reason are to be clearly distinguished from the antitoxic serums or antitoxins. As noted in the preceding section, antitoxic serums neutralize the toxin or poison produced by certain germs. Antibacterial serums, on the other hand, contain antibodies which act in a very different way. They contain one or more of several kinds of antibodies, of which the better known are briefly defined as follows:

Bacteriolysins—Bactericidal Antibodies which kill by actually dissolving or disintegrating the bacterial cells. They act only in the presence of complement—a substance which is present in fresh blood.

Bacteriotropins—These antibodies do not destroy bacteria by direct action, but promote phagocytosis, that is, they in some way affect the invading bacteria so that they are rendered defenseless and taken up easily by the phagocytes or white blood corpuscles. Bacteriotropins are not injured by moderate heat.

Opsonins—Antibodies similar in function to the bacteriotropins but different in that they are easily destroyed by moderate heat.

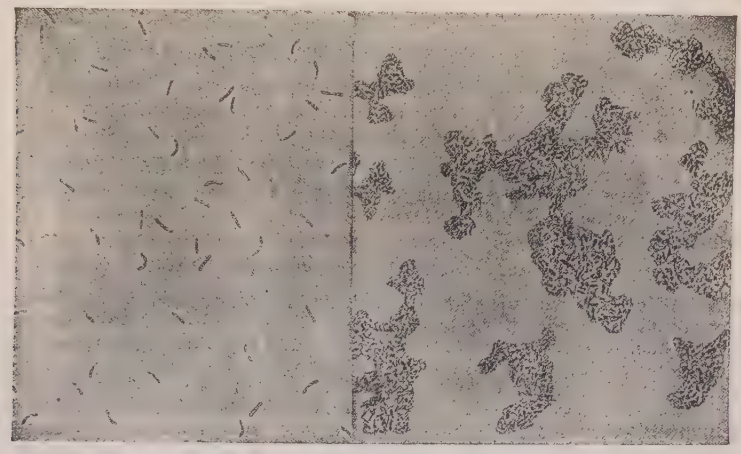
Agglutinins—Agglutinins are antibodies which act directly on the bacteria without complement, causing them to come together in clumps.

Precipitins—Precipitins act on solutions of bacterial substances, causing them to precipitate. Many regard precipitins and agglutinins as identical.

It will be seen, from the number of different kinds of antibodies, that the action of antibacterial serums is much more complicated than that of the

antitoxins. The production of potent antibacterial serums is correspondingly difficult. Their therapeutic value is not so clearly defined nor as well established as that of the antitoxins. There are several reasons for this. One is found in the fact that antibacterial antibodies are associated with a different serum globulin, and, up to this time, it has not been found practical to concentrate them successfully. The antibacterial substances cannot, therefore, be prepared in the degree of purity and concentration which characterizes the antitoxins. The antibacterial serums are unconcentrated and, comparatively

FIG. 788



Showing action of an agglutinating serum. Left: Appearance under microscope of a suspension of free swimming typhoid bacteria. Right: Same after addition of serum containing typhoid agglutinins. Typhoid organisms are massed together in clumps. From Thomas and Ivy, Applied Immunology. J. B. Lippincott Co.

speaking, low in antibody content. Specificity of the antibodies must be taken into account in preparing and using antibacterial serums. This is nowhere more clearly seen than in the case of meningococcus and antimeningococcic serum. Four distinct types of the meningococcus have been found and it has been shown that serum containing antibodies effective against one of these types is not effective against the other three. So with antipneumococcic serum. Type I antipneumococcic serum is not effective against Type II or Type III organisms. In other words antibacterial serums are effective, as a rule, only against the particular strains or types of the organism used in producing the serum.

Unofficial Antibacterial Serums

ANTI-ANTHRAX SERUM

Serum Antianthracicum—A serum prepared by immunizing horses or other animals with anthrax bacilli and their spores.

Uses—Anti-Anthrax Serum is specific in the treatment of anthrax. Results reported are generally favorable to the curative value of the serum in both human beings and in animals. Localized anthrax of the skin (malignant pustule) occurs more or less frequently in human beings, especially among workers in hair, wool and hides. Infected shaving brushes, hairbrushes, or other articles made of hair are sometimes concerned in carrying the infection.

The pustule of cutaneous anthrax frequently heals spontaneously if not subjected to any interference. On the other hand, anthrax septicemia is practically always fatal. The object, therefore, in treating cutaneous anthrax, is first to prevent development of septicemia. It is recommended that, immediately upon diagnosis, the patient should be given an injection of anti-anthrax serum. If the lesion is small an intramuscular injection of 40 to 50 cc. of the

serum is given, while if the lesion is large, together with marked symptoms, it is better to give 50 to 100 cc. intravenously. Excision is the only surgical remedy countenanced. Incision or other manipulations of the lesion are to be avoided as they may start infection of the blood stream. An additional safeguard against septicemia may be derived from the local injections of anti-anthrax serum around the base of the pustule for the purpose of walling off the lesion. Injections of from 2 to 3 cc. each are given at several points so as to circumscribe the lesion. These are repeated two or three times in twenty-four hours, depending on the severity of the case. The local injection method is advised, particularly when excision is refused or cannot be done.

Treatment of internal anthrax or anthrax septicemia must be carried out very vigorously because the cases are so much more severe and highly fatal.

Dose—In malignant pustule or cutaneous anthrax, 40 to 50 cc., intramuscularly, in mild cases; 50 to 100 cc., intravenously, in the more severe, supplemented by excision of the lesion or by walling off the lesion by means of local serum injections, or both. The serum treatment of anthrax bacteriemia calls for intravenous administration of the serum in 100 to 200 cc. doses, frequently repeated until the condition of the patient indicates improvement. The serum has been given in 200 cc. doses at four hour intervals, or a total of 800 cc. of serum given within the first sixteen hours of treatment. This is the highest dosage that has come to the attention of the writers. Even this may safely be exceeded in the treatment of urgent cases.

Dosage Forms Available—Anti-Anthrax Serum is commonly supplied in 50 cc. double-end vials, with or without apparatus for facilitating intravenous injection. Ten cc. and 20 cc. syringes are also supplied.

Manufacturers—1, 2, 8, 17.

ANTIDYSENTERIC SERUM

Serum Antidysentericum—The N. N. R. defines this as the serum (polyvalent) of horses immunized against the Shiga bacillus, its products of growth, and other types of the dysentery bacillus. The strains or types commonly used include not only Shiga bacillus but other types known among bacteriologists as the Flexner, Y Hiss, and Strong types, so named for the investigator who first isolated and studied them. It is an antibacterial serum, but also contains antitoxin against the poisons elaborated by the Shiga strain of *B. dysenteriæ*.

Preparation—Cultures of the different strains of the dysentery bacillus are mixed in certain proportions, usually with the Shiga strain predominating. These mixed strains are killed and further prepared for injection into horses. Injections, first with the killed mixed cultures and finally with living organisms, are carried out on a gradually increasing scale until tests show that the titer of the serum has reached the required level. The horses are then bled at intervals. The serum is collected, sterilized by filtering, and preservative added. It is finally filled into market containers, after satisfactory sterility and potency tests.

Uses—Used in the treatment of bacillary dysentery. Cases in the early acute stages are especially suitable for serum treatment. Chronic cases and recurrent forms do not, as a rule, respond so favorably. According to Kolmer, most observers agree that a potent serum will reduce mortality of acute cases at least from 30 to 50 per cent. Its curative effect is manifest in the reduction of the number of stools, disappearance of blood and pus from the discharges, relief of pain and tenesmus, and in return of temperature to normal. The polyvalent serum is recommended for use in all cases, with a realization of the fact that infections due to certain of the strains, principally the Shiga bacillus, respond more favorably than do others. Statistics show that this serum is of value as a preventive. Its prophylactic use is justified as a means of controlling local outbreaks as in schools, institutions, camps, etc., even though the passive immunization is of short duration.

Dose—In light cases, 20 to 40 cc. are usually sufficient for prompt relief. If symptoms persist, the dosage is repeated within twenty-four hours. In severe cases, 50 to 100 cc. should be given as the initial dose and a similar amount given within twenty-four hours. Injections in milder cases are usually given subcutaneously. Better results would doubtless attend the intravenous use of the serum in the treatment of severe infections. The prophylactic or preventive use, and temporary passive immunity of perhaps two weeks duration, may be attempted by administering 10 cc. of the serum subcutaneously.

Dosage Forms Available—Commonly supplied in 10 cc. or 20 cc. syringes and in 50 cc. vials.

Manufacturers—1, 2, 17.

ANTIMENINGOCOCCIC SERUM

Serum Antimeningococcicum—A polyvalent serum containing antibodies for the various types or strains of meningococci associated with cerebrospinal meningitis.

Preparation—Cultures of a number of strains representing the four different types of the meningococcus are mixed in one emulsion. Horses are given regularly graduated doses of

this suspension at fixed intervals, until trial bleedings show that the serum of the horse is equal in agglutinin content to that of a standard control serum prepared by the U. S. Hygienic Laboratory. Then regular bleedings are made and the serum is recovered, sterilized, tested and filled into market containers in the usual way. Since the antigens used in immunizing the horses contain representative strains from each of the four principal types of meningococcus, the resulting serum contains antibodies specific for the four types and the serum is therefore described as polyvalent.

Uses—Specific in the treatment of meningococcus meningitis. In the first or carrier stage the germs are found in the mucous membranes of the nose and tonsils and in the sinuses. Treatment in this, the initial stage, is almost entirely local.

In the second stage of the disease, that is, in septic cases, there is a blood stream infection. This occurs before the meninges are affected. Sterilization of the blood stream is attempted at once by giving large doses of Antimeningococcic Serum, preferably by vein. Intravenous use is also advisable when the meningococci persist or reappear in the blood during the third stage, that is, after the localization of the infection in the membranes of the brain and spinal cord, but the precaution must be taken to desensitize the patient before giving the first intravenous injection after intraspinal injection has been done. Treatment of the third stage requires the introduction of the serum into the spinal canal. This is done by lumbar puncture. Directions for making lumbar puncture and introducing the serum intraspinally usually accompany packages of Antimeningitis Serum. In infants, if the fontanel is not closed, it is often practical and advisable to introduce the serum by intraventricular injection.

Dose—In acute meningitis it should be the rule to inject the serum into the spinal canal as quickly as possible and to maintain concentration of the serum within the canal by repeated injections. On the basis of clinical experience intraspinal dosage has been outlined according to the age of the patient, as follows: one to five years, 5 to 15 cc.; five to ten years, 10 to 20 cc.; ten to twenty years, 20 to 30 cc.; twenty years and over, 30 cc. This is a rather arbitrary statement, not to be followed blindly. The dosage varies with different patients of the same age and "the volume of serum introduced should never be greater or as great as the amount of cerebrospinal fluid withdrawn". In the presence of the milder symptoms intraspinal injections at twenty-four hour intervals for three or four days will usually bring the infection under control. In the more severe cases injections are given at eight to twelve hour intervals until the appearance of the spinal fluid and a decrease in the number of organisms found in it indicate that the infection is under control.

Dosage Forms Available—Commonly supplied in vials of 15 and 30 cc., with or without attachments for intraspinal administration.

Manufacturers—1, 2, 17, 52, 63.

ANTIPNEUMOCOCCIC SERUM

Serum Antipneumococcicum—The serum obtained from horses immunized by the injection of virulent pneumococci. There are three fixed types or strains of the pneumococcus and a fourth group of miscellaneous forms.

Anti-serums can be produced against each of the three fixed types. Moreover, they may be produced in the same horse. In this way polyvalent serums are prepared. The Type I anti-serum has been best worked out and is the one which is generally recognized. Type II serums have been produced but it is admittedly difficult to obtain a satisfactory Type III anti-serum. While some manufacturers have produced and supplied a polyvalent serum with the idea that Type II and Type III pneumonias should be given whatever benefit may be derived from such a source, yet the Type I serum only has received recognition in the N. N. R. The following applies only to the Type I serum.

Preparation—From cultures of the Type I pneumococcus standard suspensions are prepared and horses are injected with gradually increasing doses. When the blood shows satisfactory antibody content large quantities are collected and the serum is separated and treated in the usual way. It is standardized for potency by a so-called protection test, that is, by demonstrating its power to protect white mice against living cultures of virulent pneumococci.

Uses—Used in the treatment of pneumonia due to the Type I pneumococcus. Approximately one-third of pneumonia cases are Type I pneumonias, and therefore suitable for the use of Antipneumococcic Serum, Type I. The serum is highly specific and is without beneficial effect in Type II and Type III or in the group IV infections. Best results are attained by giving the serum as early as possible, and by vein. If intravenous injection is not practicable, as in very young children or in obese patients, intramuscular injection is the next procedure. Subcutaneous injection is not recommended.

Dose—An initial dose of 50 to 100 cc. of the serum, intravenously, as soon as possible after diagnosis, and a repetition of this dose every eight hours until fall of temperature and relief of symptoms indicate the control of the infection.

Dosage Forms Available—Commonly supplied in 50 cc. and 100 cc. vials.

Manufacturers—1, 2, 17, 52, 63.

ANTISTREPTOCOCCIC SERUM

Serum Antistreptococcicum—A polyvalent serum obtained by immunizing horses to several virulent strains of hemolytic streptococci, beginning first with the injection of killed cultures, followed by living streptococci. The agglutinin content of the serum offers a ready means of standardization. A potent serum also contains protective antibodies and some antitoxic substances.

Uses—Has been used in the treatment of streptococcus infections of the blood stream (septicemia). Of value in surgical septicemia and postabortal septicemia and that following streptococcus infections of wounds and minor injuries; also used to some extent in the treatment of puerperal sepsis due to the streptococcus. Erysipelas is another disease of streptococcus origin in which Antistreptococcic Serum Polyvalent has been used with some benefit in a certain percentage of cases. Recent research work, however, indicates that the streptococci of erysipelas constitute a rather distinct strain and points to the possibility of the development of a more specific serum or antitoxin.

Dose—The importance of early administration is emphasized and the use of large doses given intramuscularly or preferably by intravenous injection. The initial intravenous dose is 30 to 100 cc. of the serum for adults. If no improvement results, or if acute symptoms again appear after temporary improvement, the second and subsequent doses should be given intravenously at six to twenty-four hour intervals. If improvement follows the first dose, subsequent doses may be given intramuscularly or subcutaneously.

Dosage Forms Available—Commonly supplied in 10 cc. and 20 cc. syringes, and in 20 cc., 30 cc., 50 cc., and 100 cc. vials.

Manufacturers—1, 2, 8, 17, 52, 56, 63.

ANTIGONOCOCCIC SERUM

License has been issued by the U. S. Public Health Service for the preparation of Antigonococcic Serum. The evidence of its therapeutic value has not yet been considered sufficient to admit it to the N. N. R. It is prepared from serum of horses immunized to different strains of gonococci, and has been used to some extent in the treatment of acute gonorrheal complications, *e.g.*, gonorrheal epididymitis and gonorrheal arthritis.

Dosage Forms Available—Commonly supplied in 2 cc., 10 cc., 12 cc., 50 cc., and 100 cc. containers.

Manufacturers—1, 2, 17, 52.

NORMAL HORSE SERUM

Serum Equinum—Although not a specific immunizing product, Normal Horse Serum may conveniently be placed in the general group of the serums. Normal Horse Serum is that separated from the freshly drawn blood of normal horses and sterilized by filtration. It is called normal serum because it contains no antibodies or antitoxins produced artificially by the injection of antigens into the horse. It is therefore to be distinguished from the curative serums which contain antitoxins, or antibacterial bodies, or both.

Uses—Its principal use is to increase the coagulability of the blood and is employed in the treatment of hemophilia and other hemorrhagic conditions, for example, hemorrhages following wounds and fractures and during or following surgical operations. It has also been used in non-specific protein therapy. Like other foreign proteins, injected hypodermically, sufficient doses of Normal Horse Serum are followed by a shock reaction, which has been considered of benefit in the treatment of many conditions.

Dose—May be applied locally to any bleeding surface by means of sterile cotton saturated with the serum. It is recommended for use subcutaneously in doses of 20 to 30 cc., or intravenously in doses of 10 to 20 cc., as a means of increasing coagulability of the blood and of preventing hemorrhage.

Dosage Forms Available—Commonly supplied in 10 cc. syringes or ampuls, in 20 cc. syringes or vials, in 25 cc., 50 cc., and 100 cc. ampuls, in 30 cc. and 50 cc. vials, and in 50 cc. and 100 cc. bottles.

Manufacturers—1, 2, 6, 8, 14, 17, 52, 56, 63, 65.

Antibody Solutions

Under this heading is placed a therapeutic agent of comparatively recent development. Separate classification, to distinguish it from either antitoxins or antibacterial serums, is given because it is practically free from serum proteins. The method of preparation and the nature of the resulting product make it clear that it is not a serum nor an antitoxin, but in fact a solution of antibodies.

PNEUMOCOCCUS ANTIBODY SOLUTION

An aqueous solution of the protective antibodies specific for the pneumococcus, Types I, II, and III, practically free from chemically demonstrable proteins of horse serum.

Preparation—Since the time of Ehrlich and Morganroth (1899), it has been known that bacteria absorb their specific antibodies from an immune serum. The bacteria in turn can be washed free from the serum, yet they will carry with them quantities of the absorbed immune antibodies. The preparation of Pneumococcus Antibody Solution depends upon these facts and upon the further discovery that it is possible to separate or dissociate the protective antibodies from the pneumococcus. Suspensions of pneumococci of the three fixed types are treated with potent antipneumococcic serum. The bacteria are then washed free from the serum, and the pneumococci treated so that the protective antibodies are separated from the bacterial cells and obtained in relatively pure state in isotonic salt solution. It is sterilized by filtration and the finished product is a perfectly clear colorless solution.

Uses—There is evidence that this antibody solution is a specific agent of value in the treatment of lobar pneumonia. Records show that it is of particular benefit in the Type I cases. In Type II cases, given early and in large doses, it checks the pneumonia and prevents the septicemia to which Type II is particularly prone. It is only occasionally effective in Type III pneumonias. Since group IV cases are not caused by the fixed types, beneficial effects are not often noted. Since 95 per cent of the cases of lobar pneumonia are pneumococcus pneumonias, and since Type III cases constitute less than 10 per cent of the total, it has been recommended that Antibody Solution be given immediately upon diagnosis of lobar pneumonia. It should not be withheld to await a laboratory report on the type of the causative organism. This recommendation is also based upon observations that Antibody Solution, like serums and antitoxins, gives the best results when administered early in the disease. Time is a very important factor in the specific treatment of pneumonia and the use of Antibody Solution, if instituted during the first, second, or third days of the disease, has given much better results than when first administered during the fourth day or later.

Dose—Pneumococcus Antibody Solution is administered preferably by the intravenous route, in doses of from 25 to 100 cc., repeated at intervals of six to twelve hours if necessary. Sometimes a "thermal reaction", *i.e.*, a chill and further rise of temperature of one or two degrees, may follow shortly after intravenous administration. This reaction passes over within a very short time and is usually followed by rapid lowering of the temperature and prompt improvement in other symptoms. Reactions are not considered dangerous except in the presence of kidney or heart lesions, and are regarded by some as of value in treatment. However, progress has been made in eliminating the thermal reactions without reducing the therapeutic efficiency of the preparation for the fixed types. Subcutaneous administration, although apparently of benefit in some instances, is not recommended. Published statistics indicate that, given by this method, the solution is of little benefit. On the other hand, it has been shown that, when Pneumococcus Antibody Solution is given intravenously, protective antibodies can be demonstrated in the circulating blood immediately and have been found to persist there for a variable period of two weeks or longer.

Dosage Forms Available—Supplied in 50 cc. vials.

Manufacturer—2.

CHAPTER CXX

BIOLOGICAL PRODUCTS USED FOR ACTIVE IMMUNIZATION

Following recovery from many of the acute infections, such as scarlet fever, typhoid fever, and others, a more or less well-developed and lasting immunity appears. This is a matter of common knowledge. The condition represents an acquired active immunity resulting from the stimulation of the body cells by the infecting agent and the excess production of specific antibodies. But in this chapter we are interested in the possibility of *protection without infection*, that is, the artificial production of an active immunity without subjecting the individual to the disease itself. Such use for biological products follows from the early observations on vaccination against smallpox and against rabies. Jenner's observations and experiments proving (1798) that cowpox virus or vaccinia, inoculated into the human subject, gave immunity to smallpox, was followed some eighty years later by the accidental discovery by Pasteur that a disease virus or germ could be so modified or attenuated that its inoculation into the human subject did not cause the actual disease, yet it would stimulate the body cells to produce specific antibodies and thus give rise to active immunity. Upon this fundamental observation the whole theory and practice of prophylactic immunization has been built. Pasteur himself early devised a method of attenuating the virus of rabies or hydrophobia and a method of immunizing against this disease.

The historical importance of smallpox vaccine and of rabies vaccine and the effective immunity induced by them gives them first place in the discussion of biological products used for active immunization.

The Viruses in Living Attenuated Form and Killed Viruses

VACCINUM VARIOLÆ. U. S. Smallpox Vaccine

[**Vaccin. Var.**—Virus Vaccinicum U. S. P. IX, Glycerinated Vaccine Virus, Jennerian Vaccine]

Smallpox Vaccine consists of a glycerinated suspension of the vesicles of vaccinia or cowpox which have been obtained from healthy vaccinated animals of the bovine species (see Fig. 789). The vesicles must be removed and the vaccine must be prepared under aseptic conditions.

The vesicles (see Fig. 790) must be removed from the animal at the time of maximum potency, thoroughly triturated and made into a smooth suspension with an aqueous solution of glycerin. This solution shall not be acid to bromcresol purple T.S. or distinctly alkaline to phenol red T.S.

The following regulations established by the Pharmacopœia conform to those issued by the U. S. Public Health Service. Smallpox Vaccine must be prepared in an establishment licensed by the Secretary of the Treasury of the United States. The following precautions must be observed in licensed establishments:

No vaccine shall be used from any animal having a communicable disease, other than vaccinia. Animals used for propagating Smallpox Vaccine must have been previously subjected to a tuberculin test and must have been held at least seven days in quarantine under daily veterinary inspection prior to vaccination. After the vaccine pulp is removed from each animal, a necropsy shall be performed, permanent records of which shall be kept. Each lot of

Smallpox Vaccine shall be examined to determine its freedom from undue bacterial content and a special examination shall be made of each lot to determine the absence of tetanus organisms and other pathogenic anaërobes.

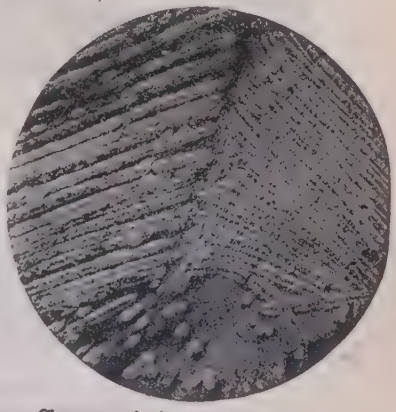
FIG. 789

Vaccinating calf. Light scarifications are made on a shaved and thoroughly cleansed area of the skin of the abdomen. Seed vaccine is then applied. Note precautions taken by operator to prevent contamination.

Permanent records must be kept of these examinations. The finished product must be placed in sterile containers that comply with the requirements of the law and of the regulations established by the United States Public Health Service.

Smallpox Vaccine loses potency rapidly, even at moderate temperatures. It must, therefore, be kept at the lowest possible temperature, preferably below 0° C., and never above 5° C.

FIG. 790



Close-up of the vaccine vesicles which develop on skin of the calf. Pulp or lymph from these vesicles is removed by a curette, with precautions against contamination

Uses—Smallpox vaccine has amply demonstrated its efficacy in producing an effective immunity against smallpox. Human beings of both sexes and of all ages and races are very susceptible to smallpox, and it has been chiefly through the widespread use of vaccination that the deaths from the disease have been reduced as much as they have, and that the epidemics of olden times, which used to assume the nature of a plague, have ceased to appear. The statistical evidence from human experience is supported by the experiments conducted with great care both in England and in America, in which it was shown that smallpox vaccine will produce an immunity in monkeys which will protect them against subsequent infection with a virulent smallpox

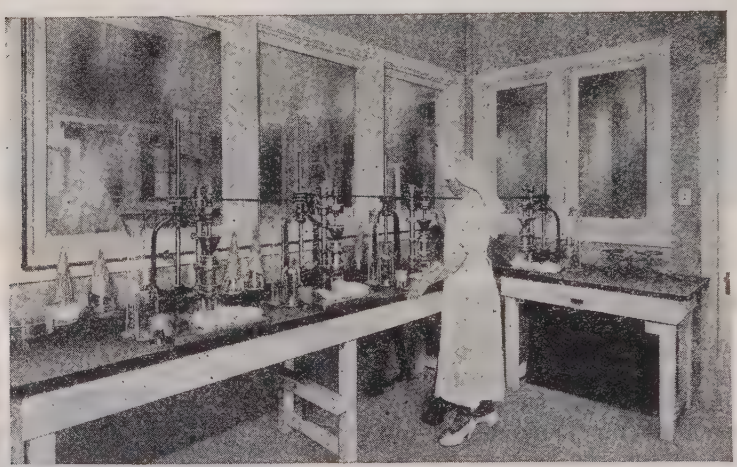
virus. The extremely rigid scientific control over every step in the modern methods of producing smallpox vaccine, and the precautions which are taken to make sure that the finished product is free from pathogenic or harmful germs, has contributed greatly to the safety of the practice, so that untoward results following vaccination have, in recent years, been conspicuous by their absence.

The dosage requires no discussion since the process of vaccination consists of applying a tiny quantity of the vaccine to a light scarification, abrasion, or shallow puncture of the skin. For the technic of vaccination and interpretation of the results, readers are referred to the publications of the U. S. Public Health Service, to standard textbooks, and to direction circulars which accompany the trade packages.

Dosage Forms Available—Supplied in hermetically sealed capillary tubes and in combination capillary tube and scarifying point (Tube-Point). May be obtained in packages of 1, 2, 3, 5, and 10 vaccinations.

Manufacturers—1, 2, 6, 8, 14, 17, 52, 56, 63 and 64.

FIG. 791



Pulp, removed from vesicles shown in Fig. 790, is being ground in glycerin to produce a smooth homogeneous suspension

Unofficial Viruses

SMALLPOX VACCINE—DRIED

Many attempts have been made to prepare a smallpox vaccine which would withstand the effects of higher temperatures and one that would be suitable for shipment to, and use in, tropical and sub-tropical countries. A dried smallpox vaccine for such use has been supplied for some time by two or more European laboratories. Dried Smallpox Vaccine was successfully produced on a manufacturing scale in the United States as early as 1922, and has found a considerable field of usefulness in torrid countries. License for its regular production was issued by the U. S. Public Health Service in 1925, but it is supplied chiefly in export trade to those regions of the world where the temperature conditions or lack of refrigeration facilities render the use of the glycerinized vaccine virus impractical.

Manufacturer—2.

RABIES VACCINE

[Vaccinum Rabies—ANTIRABIC VACCINE]

Rabies is an acute infectious disease caused by a filterable virus It is one of the diseases most dreaded by the laity. The virus or causative agent is contained in the saliva of the rabid animal. Infection takes place through abrasions or punctures of the skin following bites or scratches. The virus shows a special affinity for the nervous system and makes its way along the nerve tracts to the central nervous system, the involvement of which causes the distressing symptoms. Fortunately, the incubation period is a long one, varying from

fourteen to ninety days, and it is possible to develop a protective immunity before the symptoms of the disease appear. Pasteur was the first to demonstrate the protective value of Rabies Vaccine. The method which he devised is still in common use with some modifications.

Preparation—Rabies Vaccine is attenuated or rendered practically non-virulent for man by repeated passage through rabbits, and is treated in various ways to decrease or destroy infectivity. The method of preparing Rabies Vaccine by the Pasteur method, as modified by the U. S. Hygienic Laboratory, is outlined briefly in the N. N. R. as follows: The spinal cords of infected rabbits are dried over caustic potash at constant temperature for from one to eight days, then cut into 0.5 cm. pieces and preserved in glycerin. For use, one of these pieces is emulsified in physiological solution of sodium chloride and injected into the subcutaneous tissue of the anterior abdominal wall. Injections are continued daily for twenty-one days.

There are other methods of treating the virus before inoculation. These are (a) the dilution method—Högyes, (b) low temperature method—Harris, (c) dialyzing method—Cummings, (d) phenol treated or killed virus—Semple and Fermi.

In the dilution method of Högyes, the brains of rabbits dead from rabies are preserved in glycerin. Emulsions of the brain substance are prepared, beginning with a 1 in 20,000 dilution and increasing the strength until a 1 in 100 dilution is given. The Harris low-temperature method involves freezing the emulsion of the brains and spinal cords and desiccation in vacuum. The result is a dried powder which is standardized, and emulsions in graded doses are prepared for injection. The method of dialysis, or Cummings' method, is applied by dialyzing a 1 per cent suspension of brain tissues against running distilled water until the active virulent virus is destroyed.

The phenol killed virus, Semple and Fermi, calls for a preparation of an emulsion or standard suspension of the brain and cord substance killed by treatment with phenol.

Uses—Rabies Vaccine is used to establish an immunity to rabies or hydrophobia by treating the individual after the bite of a rabid animal, but before the incubation period is completed. The injection of attenuated, or modified, or killed virus during the period of incubation stimulates the production of antibodies, so that the infecting virus of the wound is neutralized or destroyed. The efficacy of rabies vaccine is demonstrated by the statistics which indicate the reduction in the death rate from 16 to 20 per cent to less than one-half of 1 per cent (0.5 per cent). The immunizing treatment, to be effective, must be instituted as soon as possible after the bite has been inflicted. The treatment is without effect after the symptoms of rabies have appeared. The resulting immunity is not regarded as very durable and the recommendation is that if the person is bitten a second time by a rabid animal one or more years after an immunizing treatment, a complete series of prophylactic injections should be repeated.

Dose—Dosage recommendations vary considerably, according to the method of preparation and the amount and condition of the virus in the suspension injected. Rabies Vaccine, Pasteur, as prepared in accordance with the general method of the U. S. Public Health Service, consists of 21 to 25 doses. The doses are graded so that the first contains virus of the greatest attenuation, while the last dose in the series represents the highest. Doses are injected at 24 hour intervals. Rabies Vaccine prepared by the dilution method (Högyes) is supplied in a treatment of 18 doses, each dose varying in quantity from 3 to 5 cc., the first one consisting of a 1 in 20,000 dilution and the last a 1 in 100 dilution. Rabies Vaccine (Harris) is given in daily doses over a period of 10 days or more, the dosage increasing gradually up to a maximum at the tenth day, which may be supplemented if desired. Rabies Vaccine (Cumming's method) is available in 14 or 21 dose treatments. The 21 dose is recommended for the more severe cases, the 14 dose in the less severe. A 2 cc. dose is given each day. Rabies Vaccine, phenol killed, is available in 14-dose treatment packages. It possesses better keeping qualities than the attenuated living virus, and therefore can be stocked by pharmacists, and the entire treatment can be put up and dispensed in one package. The doses are the same size and strength, which avoids the necessity of following out a fixed schedule of increasing doses.

Manufacturers—*Rabies Vaccine, Pasteur* (U. S. modification), 2, 8, 14, 17, 49, 52 and 63.
Rabies Vaccine (Högyes), 50, 54.
Rabies Vaccine (Harris), 56, 66.
Rabies Vaccine (Cummings), 1.
Rabies Vaccine, phenol killed, 2, 84, 85.

TOXINS; TOXIN-ANTITOXIN MIXTURES; TOXOIDS

Under this heading we include the Scarlet Fever Streptococcus Toxin, Diphtheria Toxin-Antitoxin Mixture and Diphtheria Toxoid. It will be noted that these are preparations of the soluble exotoxins, or a modified form thereof. The organisms which produce these toxins are not used for immunizing purposes.

DIPHTHERIA TOXIN-ANTITOXIN MIXTURE

The toxin produced by the diphtheria bacillus is exceedingly powerful and very small amounts will produce symptoms of poisoning and even death. It is not practical, therefore, to use this toxin for the production of active immunity. Early in the history of the production of Diphtheria Antitoxin, it was found that the horses could be more quickly immunized, and with greater safety if they were given injections of a mixture of toxin and antitoxin. The presence of antitoxin in the injected material protected the animal against untoward effects, yet active immunity developed promptly. This is explained on the assumption that the toxin was gradually separated or dissociated from the mixture and acted as an immunity stimulant on the body cells. The early observation on animals naturally led to the suggestion that the same method could be used to produce immunity in man. Von Behring and others demonstrated the safety of the method for human beings and thus paved the way for the general adoption of the method. A great deal of evidence has accumulated which demonstrates, beyond a doubt, that injections of toxin-antitoxin mixture are effective in developing an active immunity to diphtheria in persons susceptible to diphtheria. One of the most important contributions to the subject is that of Dr. William H. Park and his co-workers of the New York State Department of Health, who have greatly increased the safety of the procedure. They experimented with toxin-antitoxin mixtures of different strengths and found that what is known as the "1/10 L plus dose" was effective, although containing only 1/30 as much toxin as some of the older preparations in use. As a result, the older preparations of 3 L plus or 5 L plus doses have been discontinued. Practically the only preparations available commercially are of the 1/10 L plus strength.

Preparation—The well-ripened toxin of known strength is thoroughly mixed with a carefully determined amount of concentrated antitoxin. The measurement of the quantity used requires extreme care, and the resulting mixture must be subjected to elaborate tests on guinea pigs, not only to insure sterility but to determine its toxicity, that is, whether a sufficient degree of neutralization has been effected. The 1 cc. dose employed in human immunization is so low in toxicity that it will not kill a guinea pig.

Uses—Toxin-Antitoxin Mixture is effective in stimulating immunity to diphtheria. Since susceptibility to this disease is greatest between the ages of two and ten years, the greatest field of usefulness is in the immunization of children, especially inmates of children's homes and asylums, and in the protection of children of pre-school age, and especially against the dangers of infection during the school years.

Dose—Doses of 1 cc., given subcutaneously and repeated at weekly intervals until three doses have been given. In children of one year the volume is reduced one-half with each injection. From 5 to 8 per cent are so highly susceptible to diphtheria that three injections are not sufficient to produce the desired degree of immunity. Such individuals require additional doses of the mixture in order to render them immune. The reactions to the injections in young children are practically negligible. In children of school age there may be some soreness and slight temperature. Adults and older children may develop considerable local reaction. Immunity develops rather slowly and does not reach its height until three to six months following the injections. According to the records it is evident that immunity persists for several years and possibly for life.

Dosage Forms Available—Commonly marketed in vials, ampuls, or syringes of 1 cc. each, three doses to the package; or, for convenience in hospital and institutional work, it may be obtained in ampuls or vials of 10 cc., 20 cc., and 30 cc.

Manufacturers—1, 2, 8, 14, 17, 52, 56, 63, 64, 65.

DIPHTHERIA TOXOID

Diphtheria Toxoid is a diphtheria toxin, so modified that it has lost most, if not all, its toxicity for guinea pigs, yet its antigenic or immunity-stimulating properties remain. A strong toxin is obtained from a culture of the diphtheria bacillus and is then treated with formaldehyde until five doses of the size ordinarily used on the human being will cause no symptoms of acute poisoning, when injected subcutaneously in guinea pigs. Some evidence has accumulated which shows that such a modified toxin is of considerable utility as an immunizing agent. It has the advantage over Toxin-Antitoxin Mixture of being less toxic, and containing no horse serum, but considerable work remains to be done in perfecting methods of preparing a uniformly potent preparation and in the accumulation of evidence of its immunizing power. At this writing the U. S. Public Health Service has issued tentative specifications for Diphtheria Toxoid, and has under consideration the releasing of the product for the market.

SCARLET FEVER STREPTOCOCCUS TOXIN

An approved product, now made generally available for the development of active immunity to scarlet fever. It was developed by Drs. G. F. and G. H. Dick, and is now issued under license from the U. S Public Health Service and the Scarlet Fever Committee, Inc. This toxin is prepared from cultures of scarlet fever streptococci, and standardized by comparison with an official toxin distributed by the U. S. Public Health Service. It is used as an immunizing agent to develop an active immunity to scarlet fever and is of value in immunizing susceptible individuals.

Dose—The dosage recommended consists of five injections of 1 cc. each. Doses are of graded strength, beginning with 500 skin test doses per cc. and increasing up to 20,000 skin test doses. The injections are given subcutaneously at weekly intervals, and the resulting immunity reaches its height within three weeks after the last dose.

Dosage Forms Available—Marketed in packages of five doses in 1 cc. containers, and in larger packages for hospital and Board of Health use.

Manufacturers—2, 52.

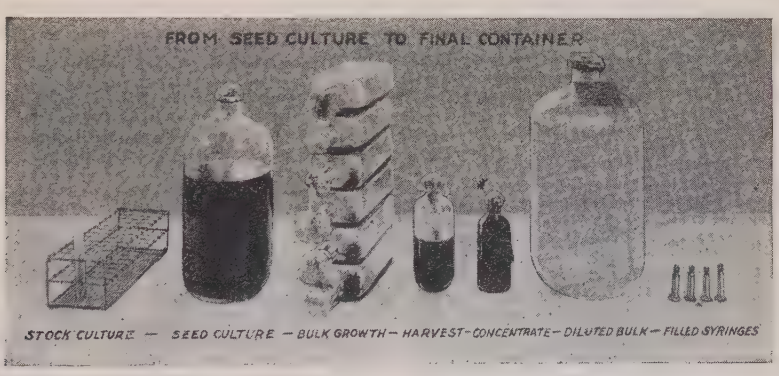
BACTERIAL VACCINES

Bacterial vaccines, or bacterins, are sterile standardized suspensions of bacteria in physiological salt solution. Ordinarily, some preservative is added, such as tricresol, phenol or glycerin. When injected into the body, the bacterial substance tends to stimulate the tissues to the production of antibodies.

Preparation—The preparation of bacterial vaccines demands careful technic and the experience of trained bacteriologists. The first step is to procure the infecting agent or causative organism in pure culture. These may be isolated from pus collected from an abscess or sinus, or they may be taken from nasal secretion, or from sputum, or from urine, or blood, or direct from an infected lung, etc.

When this is done, the isolated strains may then be maintained as "stock cultures". In the preparation of a vaccine, the stock culture is used as the source or "seed". The organisms are planted in suitable media and grown under optimum conditions. After a suitable interval at controlled temperature the growth is collected and emulsified. Purity tests are made to determine

FIG. 792


FROM SEED CULTURE TO FINAL CONTAINER
STOCK CULTURE — SEED CULTURE — BULK GROWTH — HARVEST-CONCENTRATE — DILUTED BULK — FILLED SYRINGES

Illustrating steps in the process of making bacterial vaccine

that the suspension contains none but the desired organism. If this test is satisfactory the suspension is killed by exposure to heat or by other means. The killing temperature is carefully controlled, the degree and time of exposure varying for different types of vaccines. A preservative is then added and the vaccines standardized by bacterial count and dilution to the required strength, placed in the final containers and released for distribution only after satisfactory tests show the product to be sterile.

Uses—As antigens capable of producing active immunity, some of the bacterial vaccines have proved of great value in prophylaxis. The preventive use of typhoid bacillus vaccine is the outstanding example. Pneumonia, plague, cholera and pertussis vaccines have also been so used.

Their employment in the treatment of disease has been extensive, not only in chronic infectious diseases, but even in the acute stages. No general statement can be made of their value in this connection, except that subacute and chronic cases seem to be more amenable to treatment. Some have apparently given much more favorable results than others. Specific indications are mentioned under the individual products following.

Dose—For prophylactic (preventive) immunization, three to five gradually increasing doses are given at intervals of three to seven days.

For treatment of acute conditions, no scheme of dosage can be stated definitely, for the reason that no two individuals react alike to the same dose of a given bacterin, and because reactions produced by different bacterins are not the same, owing to inherent differences in the germs themselves. The initial dose is arbitrarily selected, the physician being guided by the thought that, in general, the severer the disease the smaller the first dose. Subsequent doses are controlled as to amount and interval by the results obtained from preceding doses. The clinical symptoms which physicians look for in controlling dosage of bacterial vaccines have been summarized as follows:

A *sub-minimal* dose has no perceptible effect.

A *minimal* dose is rapidly followed by a feeling of well-being on the part of the patient, and a transient fall in temperature, if in a febrile case.

A *medium* dose may induce some local reaction at the site of injection and a slight reaction at the focus of infection, and possibly a slight general reaction which may show itself by a rise of temperature of not more than 1° C, accompanied by a slight malaise and some increase in pulse rate. This is followed, in twenty-four hours, by a fall in temperature and a general improvement in the condition.

A *large* dose is followed by a local reaction and by a severe reaction at the focus of infection, and symptoms of a general reaction (malaise, rise of temperature, etc.) may persist for some time without evidence of improvement.[1]

ACNE BACILLUS VACCINE—Acne Bacterin. Prepared from the acne bacillus. Used in cases of acne vulgaris, especially in the cystic form and in acne indurata. Even when other therapeutic measures are regarded as more important, Acne Vaccine may still be given as a supplementary treatment to improve the patient's immunity to the acne bacillus.

Dose—Five to fifty million killed acne bacilli, as initial injection.

Dosage Forms Available—Commonly supplied in packages of four vials or syringes, and in graded doses; and in bulk packages of 5 cc., 10 cc., and 20 cc. vials.

Manufacturers—1, 2, 8, 17, 30, 43, 45, 52, 56, 63, 65, 86.

CHOLERA VACCINE, CHOLERA BACTERIN—Prepared from killed cholera vibrios.

Indications—Preventive immunization against Asiatic cholera.

Dose—Three injections at ten-day intervals.

Dosage Forms Available—In packages of three syringes each, the first of 500 million and the second and third each containing 1000 million killed cholera vibrios; and in packages of two 1 cc. vials, containing respectively, 4000 and 8000 million killed cholera vibrios; also in packages of two 10 cc. vials, containing respectively, 4000 and 8000 million cholera vibrios per cc.

Manufacturers—2, 17.

COLON BACILLUS VACCINE—Coli Bacterin. Prepared from killed Bacillus Coli. Used in infections caused by this organism, such as cystitis, catarrhal jaundice, etc. Initial dose, 10 to 50 million B. coli.

Dosage Forms Available—Packages of four syringes or four ampuls of graded doses, and in 5 cc., 10 cc., and 20 cc. vials.

Manufacturers—1, 2, 6, 8, 17, 30, 43, 45, 51, 52, 56, 58, 65, 67, 79, 86.

MENINGOCOCCUS VACCINE—Meningococcus Bacterin. Prepared from various strains of the meningococcus. Used in preventive immunization against cerebrospinal meningitis.

Dose—Three injections of 1000, 2000 and 2000, or 500, 1000 and 1000, million killed meningococci.

Dosage Forms Available—Packages of four syringes, four ampuls, three syringes or three ampuls of graded doses, and in 5 cc., 10 cc., 12½ cc., and 20 cc. vials.

Manufacturers—1, 2, 17, 30, 52, 56.

GONOCOCCUS VACCINE—Neisser Bacterin. Prepared from strains of the gonococcus. Used in gonorrhea and in gonorrheal rheumatism, etc. Initial dose, 10 to 50 million killed gonococci.

Dosage Forms Available—Packages of four syringes, four ampuls, or four vials of graded doses, and in 5 cc., 10 cc., 12½ cc. and 20 cc. vials.

Manufacturers—1, 2, 6, 8, 14, 17, 30, 45, 51, 52, 56, 58, 63, 65, 79, 86.

---

[1] After Fleming and Clemenger, "Nelson's Loose Leaf Medicine".

PERTUSSIS VACCINE—Pertussis Bacterin. Prepared from strains of the pertussis bacilli isolated from cases of whooping cough. Used in the treatment and preventive immunization of whooping cough (pertussis). Initial dose, 250 million killed pertussis bacilli. For children more than one year old, the initial dose should be 500 million. Increased doses should be given every second day as follows: 500, 1000, 2000, 4000 and, if necessary, as much as 10,000 million. For immunity three doses are given of 500, 1000 and 2000 million organisms at three day intervals.

Dosage Forms Available—Packages of four syringes, four ampuls, four bulbs or four vials, and in packages of three syringes, three ampuls or three vials of graded dosage, and in 5 cc., 10 cc., 12½ cc. and 20 cc. vials.

Manufacturers—1, 2, 8, 14, 17, 30, 43, 45, 52, 56, 58, 63, 65.

PLAGUE VACCINE, PLAGUE BACTERIN—Prepared from the bacillus pestis. Used in prevention of bubonic plague. Initial dose, 1000 million to 5000 million killed plague bacilli.

Dosage Forms Available—In single vaccination, double vaccination, and triple vaccination packages, and in 1 cc. vials and 20 cc. vials.

Manufacturers—2, 17, 56.

PNEUMOCOCCUS ANTIGEN—MODIFIED—A vaccine or "antigen" prepared by digesting a suspension of pneumococci of the three fixed types and Group IV strains until about 95 per cent of the organisms become Gram-negative and preparation is relatively non-toxic to guinea pigs. It is not intended for prophylactic use, but there is some evidence that it is of value in the treatment of lobar pneumonia.

Dosage Forms Available—Marketed in 5 cc. vials, 20 million partially autolyzed pneumococci per cc.

Manufacturer—56.

PNEUMOCOCCUS VACCINE—Pneumococcus Bacterin. Prepared from killed pneumococci of the various types is of considerable value as a prophylactic for the prevention of pneumonia, but of doubtful value in treatment.

Dosage Forms Available—Packages of four syringes, four ampuls, and four bulbs and three syringes or three vials of graded doses, and in 5 cc., 10 cc., and 20 cc. vials.

Manufacturers—1, 2, 8, 14, 17, 30, 43, 45, 51, 52, 56, 58, 63, 65, 67, 79, 86.

FIG. 793

Large incubator room where constant temperature of 37° C. is maintained to promote growth of quantities of bacterial organisms for the production of bacterial vaccines

STAPHYLOCOCCUS VACCINE—Staphylococcus Bacterin. Usually consists of a suspension containing both the *aureus* and *albus* strains of the staphylococcus. Some contain also the *citreus* strain.

Uses—Used in the treatment of boils, carbuncles, in certain cases of acne and in sycosis.

Dose—Initial dose, 50 to 250 million killed staphylococci.

Dosage Forms Available—Packages of four syringes, four ampuls or four vials in graded doses, and in 5 cc., 10 cc., and 20 cc. vials.

Manufacturers—1, 2, 6, 8, 14, 17, 30, 43, 45, 51, 52, 56, 58, 63, 65, 67, 79, 86.

STREPTOCOCCUS VACCINE—Streptococcus Bacterin. Prepared from various strains of the streptococcus. Used in abscesses and cystitis. Has been suggested for preventive use in puerperal fever, acute rheumatism, etc. Initial dose, 10 to 50 million killed streptococci.

Dosage Forms Available—Packages of four syringes, four vials, or four bulbs of graded doses, and in 5 cc., 10 cc., 12½ cc. and 20 cc. vials.

Manufacturers—1, 2, 6, 8, 14, 17, 30, 43, 45, 51, 52, 56, 63, 65, 67, 79, 86.

TYPHOID VACCINE—Typhoid Bacterin. Prepared from the bacillus typhosus. Of recognized utility in the prevention of typhoid fever, immunity persisting in most cases for a period of two years or longer.

Dose—Initial preventive dose, 500 million killed bacteria, second and third doses containing 1000 million killed bacteria, given at intervals of seven to ten days.

Dosage Forms Available—Three-dose immunizing packages in syringes, vials or bulbs, also in four syringe and four ampul packages of graded doses, and in larger packages for hospital use. Bulk packages of five 5 cc., 10 cc. and 20 cc. vials.

Manufacturers—1, 2, 6, 8, 14, 17, 30, 43, 45, 51, 52, 56, 58, 63, 64, 65, 86.

MIXED BACTERIAL VACCINES

Mixed bacterial vaccines are made by mixing or combining suspensions of two or more species of bacteria. The formulas of the so-called mixed vaccines vary and their number is large, so that space will not permit detailed information concerning each one. Formerly, a considerable number were admitted and described in the N. N. R., but of recent years many of them have been dropped from the book on the grounds that there was not sufficient acceptable clinical evidence to warrant retaining them.

In one instance, however, a mixed vaccine has proven of very great value, and has practically supplanted the use of the single vaccine. This is the Typhoid-Paratyphoid Vaccine, or Typhoid Bacterins, Mixed.

TYPHOID VACCINE, MIXED—Typhoid Bacterin, Mixed. Triple Vaccine (TAB). This is a suspension containing the true Bacillus typhosus and the two strains of the Bacillus paratyphosus "A" and "B". The triple vaccine is now used very generally and gives protection against both the typhoid and the paratyphoid fevers.

Dose—Three injections at seven to ten day intervals.

Dosage Forms Available—Packages of three syringes, three vials, or three bulbs in graded doses, sufficient for one complete immunization; also in packages of thirty vials, sufficient for ten immunizations, and in 5 cc. and 20 cc. vials.

Manufacturers—1, 2, 6, 8, 14, 17, 30, 45, 51, 52, 56, 63, 65, 86.

OTHER MIXED VACCINES—It will be sufficient here to merely mention other mixed vaccines by name and refer the reader to the price lists of the manufacturers for information concerning the formulas. These include Acne Vaccine Combined or Mixed, Catarrhal or Respiratory Vaccines Mixed, Combined Coli Vaccine (Van Cott), Coley's Mixed (Erysipelas and Prodigiosus) Vaccine, Gonococcus Mixed Vaccine or Neisser Bacterin Mixed, Influenza-Pneumonia Vaccines, Pertussis Mixed Vaccine, Combined Streptococcus and Staphylococcus Vaccine, and Staphylococcus-Acne Vaccine.

Manufacturers—1, 2, 8, 17, 30, 52, 56, 63, and others.

SENSITIZED BACTERIAL VACCINES—SEROBACTERINS

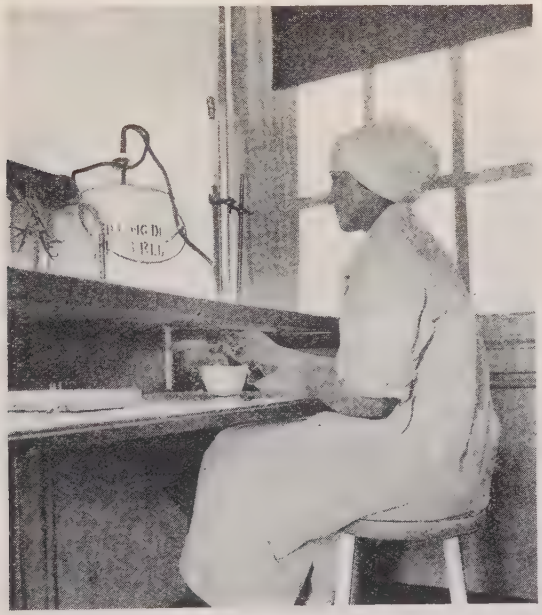
(Antigen-Antibody Combinations)

In a previous chapter, in discussing the preparation of Pneumococcus Antibody Solution, the fact was mentioned that a suspension of bacteria, treated with a specific immune serum, will absorb a considerable quantity of Antibodies. The serum can then be removed by washing, leaving the bacteria (antigens) in combination with their specific antibodies. They are then resuspended in salt solution and standardized by bacterial count. Bacteria, so treated and prepared in combination with antibodies, were first introduced by Besredka of the Pasteur Institute, Paris, and he and his followers are responsible for much of the early clinical evidence upon which the use of serobacterins is based. The descriptive term "sensitized" was also applied by Besredka, but our present conception of them is probably better conveyed by the term "antigen-antibody combinations". There is evidence that when a sensitized vaccine or serobacterin is injected into the body, a portion of the antibodies carried by the bacteria are set free in the blood stream and thus confer a certain amount of immediate protection in the nature of a passive immunity, and that this is followed in due course by the development of an active immunity in the same way as in the case of plain or unsensitized bacterial vaccines. Active immunity following injection of plain vaccines does not

begin to appear until about seven to ten days after injection. It is claimed that the sensitized vaccine gives an immediate protection which is of some value during this preliminary period before the active immunity begins to develop. Sensitized vaccines are also claimed to be less toxic and to give less uncomfortable reactions following injection.

Sensitized vaccines correspond to the plain bacterins in indications and uses, except in one point, namely, that serobacterins may be used with greater confidence during an epidemic and after exposure to infection, for the reason that they give some immediate protection. Dosage with serobacterins is considerably higher than with the plain bacterins. The process of sensitizing

FIG. 794



Filling bacterial vaccine into containers. The bacterial vaccine is passed through sterile tubing and filled into vials or syringes under a bell-glass as a precaution against accidental contamination from bacteria in the air

detoxicates the bacterial suspensions so that it is possible to administer sensitized vaccines in larger doses (two to six times the corresponding unsensitized vaccine), and to give them at shorter intervals. The following is a list of the serobacterins licensed by the U. S. Public Health Service: *Acne Serobacterin, Cholera Serobacterin, Coli Serobacterin, Meningococcus Serobacterin, Neisser Serobacterin, Pertussis Serobacterin, Pneumococcus Serobacterin, Staphylococcus Serobacterin, Streptococcus Serobacterin*, and *Typhoid Serobacterin.*

Dosage Forms Available—Practically all of the above are marketed in packages of four syringes, and in 5 cc. and 20 cc. vials. Typhoid Serobacterin Cholera and Meningococcus Serobacterin are also supplied in a three syringe immunizing package.

Mixed serobacterins are also supplied. The principal one of these is Typhoid Serobacterin Mixed, containing the typhosus and B. paratyphosus "A" and "B". Others include Acne Serobacterin Mixed, Catarrhal Sero-

bacterin Mixed, Influenza Serobacterin Mixed, Neisser Serobacterin Mixed, Pertussis Serobacterin Mixed and Pneumococcus Serobacterin Mixed, Staphylococcus Serobacterin Mixed and Staphylo-Streptococcus Serobacterin Mixed. These are marketed in packages similar to the individual serobacterins.

Manufacturer—2.

AUTOGENOUS VACCINES

In protective immunization in general, stock vaccines are used, and in most instances, notably in the case of Typhoid Vaccine, results are entirely satisfactory. In the treatment of acute infections stock vaccines are required so that time shall not be lost from treatment while awaiting the isolation and identification of the infective agent. On the other hand, in some chronic infections of long standing, it sometimes happens that after a slight initial improvement following the use of stock vaccine, the condition will remain

FIG. 795

Laboratory animals used in testing bacterial vaccines and serums to determine their freedom from contaminating pathogenic bacteria and absence of toxic property

practically stationary, in spite of repeated injections. Substitution of an autogenous vaccine is then indicated.

Autogenous vaccines are those prepared from bacteria isolated from the patient. Their use has the advantage of bringing to the patient an antigen calculated to stimulate antibodies specific for the infecting organism. Their use is indicated particularly in chronic conditions where vaccine therapy is plainly indicated and where stock vaccines have failed to bring about the desired improvement.

Manufacturers—Some of the manufacturers of bacterial vaccines are equipped to supply autogenous vaccines, and supply collecting outfits in which infectious material may be taken from the patient and mailed to the laboratory for isolation and growth of the organism and the preparation of the autogenous vaccine. (1, 2, 52.)

TUBERCULINS

Tuberculins are extracts or suspensions of the tubercle bacillus substances. A large number of preparations have been advanced from time to time, for each of which, special advantages or properties have been claimed. Only those

which have been accepted and described in New and Non-official Remedies will be mentioned here. These are often designated by symbols, as follows: "O.T."—Koch's Old Tuberculin; "T.R."—Tuberculin Residue, Tuberculin Rückstand, Koch's New Tuberculin; "B.E."—Bacillen Emulsion; "B.F."—Tuberculin Denys or Bouillon Filtrate.

Preparation—*Tuberculin O.T.* is essentially a glycerin bouillon extract of tubercle bacilli. The culture is grown in glycerin bouillon and this is sterilized by heating with steam, and reduced by evaporation to one-tenth the original volume. The bacilli themselves are removed by filtration. The filtrate is a brownish colored liquid and keeps indefinitely.

Tuberculin T.R. or *Tuberculin Residue* is made from living dried tubercle bacilli which are thoroughly ground and extracted in water. By centrifuge, extractives contained in the supernatant fluid are separated. The sediment is reground, extracted, and centrifuged as before, the process being repeated until practically no sediment remains. Fluid portions are combined and diluted with glycerin until the solution contains the residue of 10 mg. of dried tubercle bacilli per cc. It is a colorless liquid.

Tuberculin B.E. or *Bacillen Emulsion* is a suspension of dried, pulverized tubercle bacilli in equal parts of water and glycerin. Sediment is removed and the emulsion standardized to represent 5 mg. of tubercle bacilli per cc.

Tuberculin B.F., Bouillon Filtrate, or *Tuberculin Denys,* is a culture of tubercle bacilli from which the bacilli are removed by filtration. It contains all the soluble products of the growth of the *tubercle bacillus,* but differs from Tuberculin O.T. in that no heat is applied during the course of preparation.

Action and Uses—The tuberculins are not toxins, like the Diphtheria Toxin or Scarlet Fever Streptococcus Toxin. This is proved by the fact that relatively large amounts may be injected into a healthy non-tuberculous subject, without any ill effect. On the other hand very small amounts will produce a reaction in tuberculous subjects. Tuberculins have little or no antigenic power and are of negligible immunizing value. Nevertheless, they have, in the opinion of those who have used them, a definite place in the treatment of selected cases of tuberculosis, especially in those of a chronic and localized character. The benefit derived from their use must be ascribed to the tuberculin reaction.

FIG. 796

Growing tubercle bacilli in mass cultures for the production of Tuberculins. The tubercle bacilli appear as spongy white growth on the surface of the medium in the bottles.

So small an amount as 0.00,000,01 of a cc. of tuberculin may cause symptoms of illness in a tuberculous subject. The tuberculin reaction is accompanied by local reactions and also a focal reaction, that is, a reaction at the site of the lesions. The local reaction is employed as a means of diagnosis.

Recovery from tuberculosis is commonly regarded as resulting from the formation of fibrous tissue around the foci of infection, or tubercles, thus forming a dense capsule within which the tubercle bacilli are imprisoned. There is some evidence that the administration of tuberculins in suitable dosage sets up a slight inflammation and chronic local congestion at the site of the lesions, and that this congestion favors the formation of fibrous tissue, thus promoting the walling-off of the lesion. Tuberculin therapy is therefore considered most promising in chronic tuberculosis with localized lesions. The use of tuberculins in treatment requires special knowledge and experience, the great danger being in the administration of too large doses. Doses that are

too large produce severe reactions with ill effects on the patient. Physicians applying tuberculin therapy realize that the susceptibility to tuberculins in different patients varies considerably, and they take every precaution not to exceed the patient's tolerance.

The diagnostic uses of tuberculins are discussed in Chapter CXXII.

Dose—In treatment, an initial dose may consist of 0.00,000,001 to 0.00,000,1 cc. Not more than two doses per week should be given. No fixed dosage schedule can be given because different patients vary greatly in their sensitiveness to tuberculin. Subsequent doses are gradually increased but always keeping them low enough to prevent any marked constitutional disturbances. Tuberculin therapy should be accompanied by the usual measures of rest, diet and proper hygiene.

Different kinds of tuberculins vary in strength and even different lots of the same tuberculin may vary somewhat. It is a wise precaution, therefore, during a course of treatment, when a package of tuberculin bearing a new laboratory number is first used, to reduce the dosage one-half, in order to guard against possible change in strength.

Dosage Forms Available—*Tuberculin O.T.* Marketed in 0.5 cc., 1 cc., and 3 cc. vials, and in various serial dilutions.
Manufacturers—1, 2, 8, 14, 17, 56, 63.

TUBERCULIN T.R.—Marketed in 1 cc. vials and in serial dilutions.
Manufacturers—1, 2, 56.

TUBERCULIN T.R. DRIED—In vials containing ten tablets, five concentrations, (1) 0.0001 mg., (2) 0.001 mg., (3) 0.01 mg., (4) 0.1 mg., and (5) 1 mg. Tuberculin T.R. per tablet.
Manufacturer—1.

TUBERCULIN B.E.—Marketed in 1 cc. and 3 cc. vials, and in serial dilutions.
Manufacturers—1, 2, 17, 63.

TUBERCULIN B.E. DRIED—In vials containing ten tablets, five concentrations, (1) 0.0001 mg., (2) 0.001 mg., (3) 0.01 mg., (4) 0.1 mg., and (5) 1 mg. Tuberculin B.E. per tablet.
Manufacturer—1.

TUBERCULIN B.F.—Marketed in 1 cc. and 3 cc. vials, and in serial dilutions.
Manufacturers—1, 2, 8, 17, 56, 63.

CHAPTER CXXI

PROTEINS AND PROTEIN THERAPY

PROTEINS, ATOPENS, ALLERGENS, AND ANTIGENS

In Chapter CXVIII, some of the manifestations of protein sensitization were briefly discussed. Mention was made of the widespread occurrence of hay fever, of the relation of various proteins to asthma, and of a few facts concerning serum sickness. But there are many other manifestations of protein sensitization with which the physician has to familiarize himself, as cases of this sort are met with every day. One authority has stated that protein sensitiveness is a type of illness which affects, in slight or marked degree, about fifteen per cent of individuals. It is not only a common cause of annoying minor conditions but a rather frequent cause of severe illness.

Protein sensitization is a condition of hypersensitiveness to foreign proteins. A certain percentage of individuals inherit a constitution which easily becomes sensitive, and once sensitive, severe symptoms may appear whenever the patient comes into intimate contact with the foreign protein in question. This condition of sensitiveness has been given various names. Frequently the name "*allergy*" is applied, which conveys the idea of an altered or change reaction to the presence of foreign proteins. Another term proposed is the word "*atopy*", literally meaning a strange disease. It is used, like "*allergy*", to cover a broad group of illnesses due to proteins. Similarly, the agents which cause this type of illness, and the remedies which are used in their treatment, have been given different names, including "*allergic proteins*", "*allergens*", "*atopens*", and "*antigens*". For practical purposes the pharmacist can regard these terms as synonymous.

The Products Which Cause Hypersensitiveness—The allergic or atopic agents responsible for the many symptoms of protein sensitization comprise a very extensive list, and include almost every protein-containing substance which is ingested with food, inhaled in the air or which comes in contact with the body surface. Patients may exhibit sensitiveness to pollens or plants, emanations from animal hair or feathers, to dust, smoke, inhaled with the air, and to animal and vegetable foods and to other substances, such as bacterial proteins, insects, etc. Duke has recently pointed out that some human beings are also apparently sensitized by non-antigenic substances and may exhibit symptoms even by contact with inorganic matter or in response to a physical agent, such as light, cold, etc.[1] Duke has well stated that "relatively little is positively known concerning the physical or chemical make-up which characterizes agents which can sensitize human beings. More is known concerning their location.

"It is not difficult in many cases to trace the source of an illness to contact with substances, such as milk, egg, pollen, animal hair, feathers, cottonseed, orris, or flax, or to constituents of these which can be extracted with salt solution or glycerin, or even to relatively well purified constituents, such as ovomucoid, egg-white, or lactalbumin. It is very difficult, however, to identify and place the blame on the chemical body actually responsible. It is difficult even to classify it as protein or non-protein, organic or inorganic. The mere fact that an individual reacts to a certain protein cannot be looked upon as

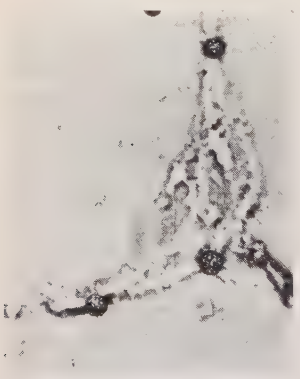
[1] Duke, W. W., Asthma, Hay Fever, Urticaria, 1925

conclusive evidence that the suspected protein is actually the cause of reaction for it is perfectly possible that the offending agent simply accompanies certain proteins, just as diphtheria antitoxin accompanies certain globulins of the serum."

Present knowledge does, however, warrant the definite statement that, in sensitive individuals, "*atopens*" or the substances which produce sensitization, may act as violent poisons in almost infinitesimal doses. Even so small a dose as 1/10 cc. of a 1 in 10,000 solution of a pollen may cause a severe reaction in a sensitive hay fever subject. Another observation based on clinical experience is the fact that some substances sensitize patients more easily than others.

The Symptoms of Specific Hypersensitiveness—Protein sensitization is a common cause of illness, of which the symptoms and manifestations are varied. In fact, almost any tissue or organ in the body may be involved. The more common symptoms are those which involve the mucous surfaces, especially the membranes of the nose, throat, bronchial tubes, the conjunctiva, and the membranes lining the gastro-intestinal tract. Symptoms involving the skin and subcutaneous tissues are less common, and are usually a part of a general reaction following the absorption of an offending protein.

FIG. 797



Showing ragweed pollen grains in nasal secretion from hay fever patient. After Scheppegrell.

The more important symptoms have been conveniently summarized as follows[2]:

1. Nasal—Sneezing, pallor and swelling of mucous membrane, usually with excessive watery or clear mucous secretions (see Fig. 797).
2. Pharyngeal—Itching of the soft palate and pharynx, spasmodic cough.
3. Bronchial—Bronchial obstruction with inspiratory and expiratory wheezing, and often with the expectoration of clear mucoid sputum. In milder cases cough and shortness of breath on exertion.
4. Ocular—Edema of the conjunctiva, puffiness, itching, swelling and redness of the lids. Excessive lacrimal secretions.
5. Cutaneous—Urticaria (an itching eruption), angioneurotic edema (swelling due to injury to the nerves which control the circulation), eczema, erythema, and pruritis, either local or general.
6. Gastro-intestinal—Abdominal pain (either steady or griping, local or general; mild or severe), nausea, vomiting, bloating, diarrhea, mucous colitis, etc.
7. Neurological—Asthenia (weakness), and a sensation described as nervousness.
8. Arthritis—Joint pain and swelling is a very definite and interesting manifestation of allergy.
9. Blood Pressure—Often reduced to from 90 to 110 mm.
10. Headache.
11. Bladder—Frequent painful micturition.

Diagnosis and Treatment—The diagnosis of protein sensitization is made, in the majority of cases, through the information gained by the history, by physical examination, and from cutaneous or clinical tests. The cutaneous

[2] From Duke, Ann. of Clin. Med., Vol. I, Nov., 1922

tests are usually indispensable. A brief description of the cutaneous tests and a discussion of the products used therein will be found in the next chapter.

Treatment of these conditions may be approached in four ways: (1) by the removal of the cause, (2) by specific protein treatment, (3) by non-specific protein treatment, and (4) by symptomatic treatment. Removal of the cause is the simpler method in many instances. Where this cannot be effected, specific protein treatment is the method of choice. Treatment consists in giving subcutaneously a series of injections with an extract of the offending protein. Infinitesimal doses are given first, which are then increased as rapidly as the patient's tolerance will permit, and is continued until the patient acquires enough resistance or tolerance to withstand the amount with which his habits and environment bring him into contact. Clinical investigation with different methods of specific protein treatment have gradually led to an appreciation of what Duke calls the "short interval method". This method, as applied in the treatment of hay fever, consists of an infinitesimal initial dose, subsequent doses being given twice a day or more usually once a day during the first part of the treatment, the dose being doubled at each inoculation, or as rapidly as the tolerance of the patient will permit. As the higher doses are reached, it is frequently necessary to space out the time intervals to two or even three day intervals. The time intervals and the rate of increase in dosage will vary, and are adjusted to suit the case. The immunity or tolerance developed is often of short duration. In hay fever, for example, it persists little more than six or eight weeks. It is not necessary to discuss here any of the special points in the technic of treatment, enough having been said to explain the nature and the contents of many of the packages of protein substances which the pharmacist is called upon to distribute.

Dose—It is regarded important to start with a dose which will not cause an intense local reaction. The initial dose, therefore, is chosen very carefully and is usually based upon the information gained from the cutaneous tests. If the skin reaction has been a vigorous one, indicating a high degree of sensitivity, then the initial treatment dose must be correspondingly small, little larger than the test dose, in fact. The commercial houses supply protein extracts in dilutions which lend themselves to a suitable scale of dosage for average cases. Some of the products are labeled to show their strength in terms of the degree of dilution, others by chemical analysis of the protein content.

Simple Protein Preparations

POLLEN EXTRACTS, POLLEN ATOPENS, POLLEN ALLERGENS, AND POLLEN ANTIGENS

Liquids obtained by extracting the dried pollen of plants and used for the diagnosis, prophylaxis or relief of hay fever or pollinosis.

Preparation—There are several methods of extraction in common use. Most of them involve a preliminary grinding of the dried pollen in order to break the cell membranes. The subsequent procedures include the following:

(a) Extraction with water containing phenol 0.5 per cent. The resulting extract is standardized by determining the protein content. (2)[1]

(b) Extraction is done with 1 per cent sodium chloride solution and the extract is diluted with glycerin and 1 per cent sodium chloride solution until the final volume contains 60 per cent glycerin. (52)

(c) Extraction is done with physiological sodium chloride, and alcohol added to make 12 per cent. After twenty-four hours, the mixture is centrifuged and the supernatant fluid drawn off. The resulting extract is a 12 per cent alcoholic solution. From this, sterile dilutions are prepared for administration. (67)

[1] Numbers in parenthesis are license numbers of manufacturers.

(d) Extraction is done with sodium chloride, followed by clarification by filtration, and standardized on the basis of the amount of pollen extracted. (1)

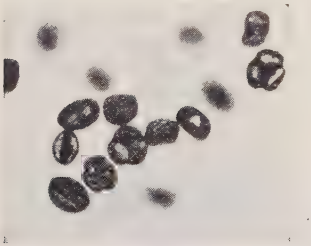
(e) Extraction is done in a solution containing 67 per cent glycerin and 33 per cent saturated sodium chloride solution, and the total volume adjusted so that 1 cc. is equivalent to about 14,000 pollen units, the pollen unit having been arbitrarily chosen as the equivalent of 0.001 mg. of pollen. The solution is standardized by complement fixation tests. (17)

(f) Extraction is done in glycerin-sodium chloride solution, and sufficient of the solution is added so that each cc. represents about 10,000 pollen units. (58)

In all the methods the final steps involve the sterilization of the pollen extracts by filtration and filling them into sterile market containers. Tests for sterility are made after dilution and after filling.

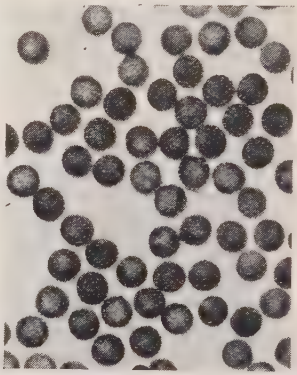
A pollen extract prepared from the pollen of one plant is not intended for use in hay fever caused by the pollen from other plants. Yet hay fever sufferers are frequently sensi-

Fig. 798



Pollen grains of the Absinth Wormwood (greatly magnified). A primary cause of fall hay fever in certain parts of the country. After Scheppegrell.

Fig. 799



Pollen grains of the Marsh Elder, *Iva ciliata* (greatly magnified). One of the causes of hay fever. After Scheppegrell.

tive to more than one pollen, and very often these are closely related botanically. Some authorities have held the opinion that the extract of a given pollen will produce a certain amount of tolerance, on the part of the patient, to pollens of botanically related plants. For example, Timothy extract is said to give some protection against pollens of closely related grasses. Following is a list of pollen extracts arranged alphabetically by the English common name of the plants. Certain ones among them are the principal factors of hay fever and therefore the extracts are the ones most often called for. Timothy, Orchard Grass, and June Grass are by far the most important of the grasses and are responsible for hay fever symptoms in the late spring and early summer. They have a very wide distribution. In certain sections of the country, Bermuda Grass and Johnson Grass are primary causes, as in the Southwest. In the fall the common ragweeds are responsible for perhaps 90 per cent of the hay fever cases in the eastern part of the United States, while the most important factors in the West are the various sagebrushes and wormwoods. Local importance of other pollens has been brought out in the literature from time to time. Russian Thistle, for example, has been identified as a primary cause in the State of Washington, and Mountain Cedar, in portions of Texas.

A List of Hay Fever Pollen Extracts Supplied for the Prophylaxis and Treatment of Hay Fever

Annual Salt Bush	Birch	Cedar
Amaranth, Spiny	Box Elder	Cherry
Arizona Cottonwood	Brome Grass	Clover
Ash, Arizona	Burr Ragweed	Cocklebur
Ash, White	Burroweed	Corn
Aster	Canary Grass	Cottonwood
Bermuda Grass	Careless Weed	Dahlia

List of Hay Fever Pollen Extracts—*Continued*

Daisy	Orchard Grass	Sage, Hill
Dandelion	Perennial Rye	Sage, Pasture
Dock	Pine	Sage, Prairie
Elm	Plantain	Sagebrush
Goldenglow	Poplar	Saltbush
Goldenrod	Poppy	Sandbur
Greasewood	Quailbush	Sea Blite
Hemp	Rabbitt Bush	Shadscale
Hickory	Ragweed, False	Sorrel
Johnson Grass	Ragweed, High	Sudan Grass
June Grass (Blue Grass)	Ragweed, Low	Sugar Beet
Locust	Ragweed, Prairie	Summer Cypress
Maple	Ragweed, Slender	Sunflower
Marsh Elder	Ragweed, Southwestern	Sweet Vernal Grass
Mexican Tea	Ragweed, Western	Sycamore
Mountain Cedar	Red Top	Walnut, Arizona
Mugwort	Redroot Pigweed	Walnut, Black
Mulberry, Black	Rose	Walnut, California
Narcissus	Russian Thistle	Water Hemp
Nettle	Rye	Wild Sunflower
Oak, White	Sage, Carpet	Willow
Olive	Sage, Green	Yellow Dock

Dosage Forms Available—Extracts of a few of the more important pollens are supplied in 10, 15, and 20 dose treatment sets. The doses are graded and are intended to offer a convenient series suitable for the prophylaxis of cases of average sensitivity. Also supplied in vials of graduated concentrations, namely, 1 in 10,000, 1 in 5000, 1 in 1000, 1 in 500, and 1 in 100. Practically all are supplied in 5 cc. vials, in concentrations which lend themselves to such gradations of dosage as the physician may find it advisable to adopt.

Manufacturers—1, 2, 17, 43, 51, 52, 58, 67.

FOOD EXTRACTS, FOOD ATOPENS, FOOD ALLERGENS, AND FOOD ANTIGENS

Extracts of food substances are used in the diagnosis and desensitizing treatment in cases in which persons show a peculiar hypersensitiveness towards certain articles of the dietary. Their purpose is twofold: to identify the food which produces the untoward symptoms and, to a lesser extent, by their proper application to raise the tolerance of the patient. If the offending food cannot be eliminated entirely from the diet, specific desensitizing treatment is instituted.

Preparation—Several different methods of preparation are necessarily employed because of the wide differences in the composition and properties of the food substances concerned. Those interested in this phase of the subject will find a condensed review in the N. N. R.

List of Some of the Food Protein Extracts Offered by Biological Houses

Few, if any, of these preparations are stocked by druggists and the manufacturers usually make them up only on order.

Almond	Casein	Lamb
Apple	Cauliflower	Lettuce
Apricot	Celery	Lobster
Asparagus	Cheese	Mackerel
Banana	Chicken	Milk
Barley	Clam	Mushrooms
Bean, Lima	Cocoa	Oat
Bean, Navy	Corn	Onion
Bean, String	Coffee	Orange
Beef	Codfish	Oyster
Beet	Cucumber	Pea
Buckwheat	Eggplant	Peach
Cabbage	Egg Yolk	Peanut
Cantaloupe	Egg White	Pear
Carrot	Grapefruit	Pecan

List of Some of the Food Protein Extracts—*Continued*

Pepper, Black	Rye	Tea
Plum	Salmon	Tomato
Pork	Squash	Turnip
Potato	Spinach	Veal
Prune	Strawberry	Walnut, English
Rice	Sweet Potato	Wheat

Dosage Forms Available—Commonly supplied in 5 cc. vials, in concentrations which lend themselves to suitable gradation of dosage.

Manufacturers—1, 2, 17, 52, 58, 67.

ANIMAL EXTRACTS, ANIMAL ATOPENS, ANIMAL ALLERGENS, AND ANIMAL ANTIGENS

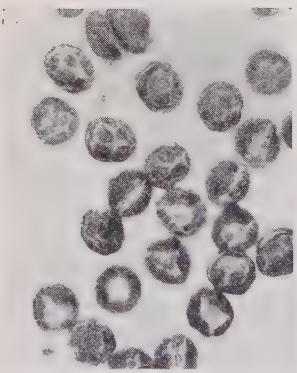
These products are extracts of animal hair and feathers and are used in the prophylaxis and relief of cases of asthma, perennial rhinitis, or other manifestations of sensitiveness to these substances. They are sometimes spoken of as epidermal extracts. They constitute an important cause of reactions, although by no means as numerous as cases of pollen sensitiveness. Frequent exposure is a factor in the development of sensitiveness. One whose occupation brings him in frequent contact with a given animal is more likely to become sensitive to it than to others encountered but rarely. Sensitiveness to animal atopens may be either slight or intense. In the mild cases, sneezing and itching of the eyes may be the only symptoms. In severe cases serious reactions, which may amount to shock, may occur on slight contact. Hair and feathers, being used extensively in the manufacture of wearing apparel, upholstery, rugs, bedding, etc., are frequently responsible for the so-called "house asthma".

Preparation—Various methods of preparation are employed. In most instances the finely divided hair, feathers, or dander are extracted with 0.2 per cent sodium hydroxide solution. The protein is then precipitated. The precipitate is redissolved and standardized by chemical determination of protein nitrogen.

List of Animal Extracts—Following is a composite list of animal extracts offered by biological houses. Few, if any, of these preparations are stocked by druggists and some of the less frequently used are made up by the manufacturers only on order.

Burro Hair	Cow Dander (Cattle Dander)	Horse Hair
Burro Dander	Dog Hair	Horse Serum
Cat Hair	Dog Dander	Human Hair
Cat Dander	Duck Feathers	Human Dander
Chamois Skin	Goose Feathers	Rabbit Hair
Chicken Feathers	Guinea Pig Hair	Rabbit Dander
Cow Hair	Horse Dander	Sheep's Wool

FIG. 800



Pollen grains of the Black Walnut, *Juglans Nigra* (greatly magnified). A cause of some cases of hay fever of the early spring type.

Dosage Forms Available—Commonly supplied in 5 cc. vials.

Manufacturers—1, 2, 17, 52, 58, 67.

MISCELLANEOUS PROTEIN EXTRACTS, MISCELLANEOUS ATOPENS, MISCELLANEOUS ALLERGENS, AND MISCELLANEOUS ANTIGENS

Certain substances which do not fall in the above groups, are sometimes factors in asthma or other manifestations of protein sensitization. There is ample evidence, for example, that some individuals are sensitive to dust, and in fact, to dusts of certain types. It has been shown that a patient may be sensitive to the dust of certain houses but not to the dust of others. Some patients react to mill dust or stable dust and other specific forms. Another rather frequent cause of illness is traced to orris root, and rice powder is likewise frequently incriminated.

Preparation—Methods of preparation vary with each item of the list. The reader is referred to the N. N. R. for a brief review of the principal methods of extraction used.

List of Miscellaneous Extracts —The following is a composite list of miscellaneous protein extracts supplied by biological houses.

Cottonseed	Kapok	Silk
Flaxseed	Orris Root	Tobacco
Glue	Rice Powder	Yeast
Hay		

Dosage Forms Available—Commonly supplied in 5 cc. vials.
Manufacturers—1, 2, 17, 52, 58.

BACTERIAL PROTEIN EXTRACTS, BACTERIAL ATOPENS, BACTERIAL ALLERGENS, AND BACTERIAL ANTIGENS

Bacteria or bacterial products may occasionally be responsible for symptoms of protein sensitization similar to those caused by pollens and the like. Nasal reactions or asthmatic breathing may be the result of an acute or chronic infection in the nose, nasal sinuses or bronchial tubes. The diagnosis of bacterial allergy or atopy is difficult and reactions which can be conclusively attributed to bacterial proteins are rare. When such conditions are found the treatment involves removal of the focus of infection, if possible, and the use of bacterial vaccines of the usual kind in desensitizing treatment.

Manufacturers—For the source of supply, see the manufacturers of bacterial vaccines, page 1936.

CHAPTER CXXII

BIOLOGICAL PRODUCTS USED AS DIAGNOSTIC AGENTS

Of the numerous biological products used in the diagnosis of disease, the pharmacist is called upon to handle and distribute chiefly the proteins (atopens, allergens, including hay fever pollens), the toxins and tuberculins. Other diagnostic reagents either do not have the requisite keeping qualities and therefore have to be made up fresh just before use, or their employment is limited to a few clinical or pathological laboratories. The proteins, toxins and tuberculins, on the other hand, lend themselves to practical use in the hands of the general practitioner even in communities remote from modern hospital and laboratory facilities.

The technic of using these products in testing is simple and easily carried out. The products themselves possess good keeping qualities. A brief description of the methods of making the tests is given here to explain how they are used. It should be added, however, that physicians do not depend upon these tests exclusively in arriving at a diagnosis, but depend to an equal, if not greater, degree upon clinical observations and the case history.

SKIN TEST METHODS

The Cutaneous or Scratch Test—This test is done by first cleansing the skin on the inner surface of the forearm with alcohol. When this has dried, abrasions or short scratches are made, one for each substance to be tested, and one or two extra for controls. In most cases a series of linear scratches, each about one-eighth of an inch long, and never more than one-fourth of an inch, are placed at least two inches apart. Care is exercised to see that these scratches penetrate only the outer layer of the skin and are not deep enough to draw blood. The scratches or abrasions may be made with a needle, as commonly done in vaccinating for smallpox, or with the point of a sharp scalpel, or with a Von Pirquet skin borer. Ten or more tests may be conducted at one time. A small droplet of tenth-normal sodium hydrate solution is applied to each scratch or abrasion. Then the foreign materials to be tested are applied in dried powdered form, one to each of the scarified areas. Sufficient of the powder in question is conveniently taken up on the end of a tooth-pick and applied by rubbing it gently into the scratch or abrasion. The control scratches receive the tenth-normal sodium hydrate only. Normal salt solution may be used instead of the sodium hydrate.

Fig. 801

Showing skin tests with hay fever pollens. Of 16 pollens applied, 5 gave positive reactions; 4 on patient's right arm and 1 on the left. Note characteristic wheals or hives, with "pseudopods". Photo by Dr. Holliger, Fresno, California.

Twenty minutes or one-half hour later the proteins are washed off and the results interpreted and recorded. Reactions, if any, will have reached their height by that time. A typical positive reaction consists of an urticarial wheal or hive, surrounded by an area of redness (erythema). The recent tendency is to attach greatest importance to those reactions which exhibit

a wheal with irregular margins (pseudopods). "Button reactions" (a wheal without pseudopods) or an erythema only, is regarded as negative or indicating only a partial degree of sensitization. A positive reaction, of course, must be read in comparison with the controls and must be definitely larger and more clearly defined. Usually the control test will show only a small area of slight redness around the site of the scratch, but in some individuals sensitive to sodium hydrate, considerable reaction may appear which may necessitate repeating the test with a different diluent, salt solution, for example, before the correct diagnosis of the protein sensitiveness can be arrived at.

The cutaneous or scratch method is easily performed, is fairly accurate, and has the advantage that if the patient shows extraordinary sensitiveness to the protein, excess protein can be washed off and thus absorption stopped before any severe effects are likely to develop. In making this test the physician may use proteins or pollens in dried powdered form, or pollens and proteins in paste or ointment form. Liquid preparations of proteins may also be used in the proper concentration, by applying a small droplet of the extract to the abrasion or scratch. In such case no other liquid is applied, sodium hydrate and salt solution being omitted as unnecessary and interfering with the direct action of the extract to be tested. As a general rule, reactions to proteins begin to fade after half an hour, but will continue in evidence for two or three hours.

The Intracutaneous or Intradermal Test—Standardized solutions of the diagnostic reagents, whether protein extracts or toxins or tuberculin solution, may be injected intracutaneously, that is, between the layers of the skin on the inner surface of the forearm, previously cleansed in the usual manner. A small syringe graduated in 10ths or 20ths of a cc. is used, with a 26 or 27 gauge needle. The test is made by holding the needle first at an angle of 45 degrees, with the bevel side up, and inserting it just far enough to engage the point. The syringe is then lowered so that the needle point will travel parallel to and between the layers of the skin. It is advanced until all the beveled portion of the needle is between the layers of the skin. The point of the needle and the opening can be seen through the thin membrane of the epidermis covering it. A tiny droplet of the solution, usually 1/20 (0.05) cc., or 1/10 (0.1) cc., is injected. This forms a tiny blister-like elevation at first. In allergic tests, results are read twenty to thirty minutes later. Typical reactions, corresponding to those observed with the skin or cutaneous test, consist of a wheal or hive with pseudopods and erythema. With the toxins and tuberculins the results do not appear as early as this and the appearances are different. These reactions are discussed on a later page.

The intradermal test is also comparatively simple and presents no particular difficulties to the practitioner. As Duke has stated, the difficulty in technic does not lie in the injection, but in the preparation of the solutions for testing. It is only natural, therefore, that preparation of the solutions should be generally left to the laboratory experts, and their general distribution to the pharmacist.

PROTEINS, ATOPENS, ALLERGENS OR ANTIGENS USED IN DIAGNOSIS

Practically all the pollen, food proteins, animal proteins, epidermal proteins, bacterial proteins and miscellaneous items, which have already been listed in Chapter CXXI, pages 1928 to 1930, are available in dried powdered form suitable for, and intended for, use by the cutaneous or scratch method.

Most of the items in these lists are also put up in paste form, in collapsible tubes. Paste is applied to the scratch or abrasion and rubbed in gently after the same manner as the

powder is used. The paste is washed off after twenty or thirty minutes and reactions interpreted as described above.

A number of items other than those mentioned in the lists above referred to are often available. Without repeating these lists, it will be sufficiently useful to give information here on the packages available.

Dosage Forms Available—Pollens and proteins, in the form of dried powder, are available in 25 mg. vials, containing sufficient material for ten or twelve tests, and in 50 mg. vials, containing sufficient material for twenty-five tests; also in capillary tubes containing enough material for one test. These are supplied singly or in packages of six.

Manufacturers—2, 52, 67.

Pollens and proteins, in paste form, for diagnostic use are supplied in collapsible tubes containing 1.5 Gm. of the paste, or sufficient material for about 50 tests.

Manufacturer—1.

PROTEIN MIXTURES FOR DIAGNOSIS

Group Tests—Mixtures of closely related proteins are made available for testing, with the idea that preliminary group tests will help to reduce the total number of skin tests required to reach a specific diagnosis, because they may often indicate whether the patient's sensitiveness is in a certain class, like sea foods, grains, animal epidermal products, or the like. If sensitiveness to a given group is indicated by a positive reaction, then further tests with the individual members of the group will serve to identify the inciting agent. These protein mixtures include most of the common food, animal and bacterial proteins, and are arranged in some 27 groups, each containing from three to six more or less related substances.

FIG. 802

Series of cutaneous tests on leg of hay fever patient, showing three strongly positive reactions; to June Grass, Sweet Vernal Grass and Timothy. Photo by Dr. Holliger, Fresno, California.

Dosage Forms Available—Supplied in powdered form for diagnostic use by the cutaneous or scratch tests, in vials containing 25 mg.

Manufacturer—52.

Supplied in paste form in collapsible tubes containing approximately 1.5 Gm. of a paste containing mixed proteins sufficient for fifty tests.

Manufacturer—1.

TOXINS USED IN DIAGNOSIS

The Diphtheria Immunity Test or Schick Test—This test is the means by which those who are susceptible to diphtheria may be detected. It consists essentially of an injection between the layers of the skin of a very minute amount of diluted diphtheria toxin, and its diagnostic value depends upon the fact that a person who has no free antitoxin in his blood will develop a circumscribed area of redness and infiltration of from one to two centimeters in diameter around the site of the injection. Should the patient have free antitoxin in his blood no reaction occurs. In non-immune persons the reaction appears in twenty-four to forty-eight hours, is at its height from forty-eight to seventy-two hours, and then gradually disappears, so that after seven to fourteen days only a brownish pigmentation and surface scaling remain to indicate the site of the test.

Preparation—Schick Test Toxin is a diphtheria bacillus toxin, filtered and carefully tested and standardized. Both potency and clinical tests are carried out and the product is adjusted to a strength such that the amount commonly used in the ordinary Schick Test represents only 1/50 of the fatal dose for a 250 gram guinea pig. This conveys some idea of the safety of the toxin, when diluted for use in testing human beings. It means that it would require fifty human doses to cause the death of a medium sized guinea pig.

Diphtheria Toxin for the Schick Test does not keep well in diluted form. The dilution must be freshly prepared just before use. The product is therefore usually supplied in packages of two containers, in one of which will be found the Diphtheria Toxin and in the other, sterile sodium chloride for use as the diluent.

Uses—The Schick Test is of value in institutions, schools, and in groups of persons exposed to diphtheria, for the purpose of determining who are susceptible and thereby indicating those who should be given a temporary immunizing dose of Diphtheria Antitoxin, or the active-immunity stimulant—Toxin-Antitoxin Mixture (see page 1916).

Dosage Forms Available—Packages ordinarily supplied consist of two containers, one, a vial or capillary tube containing a definite volume of Diphtheria Toxin, the other con-

taining sterile physiological solution of sodium chloride, with which the toxin is to be diluted before administration. They are to be had in packages containing sufficient for 10, 20, 50 and 100 tests. Some are supplied in dilutions so that 2/10 (0.2) cc. of the dilution is the correct intradermal dose. Others are supplied in dilutions of which 1/10 (0.1) cc. represents the proper intradermal dose.

Diphtheria Toxin Control for the Schick Test is also available. This represents Diphtheria Toxin heated sufficiently to destroy the specific exotoxins. This material is supplied already diluted, for use in doses of the same size as the toxin in the Schick Test.

Manufacturers—1, 2, 8, 14, 17, 52, 56, 63, 64, 65.

Scarlet Fever Immunity Test or Dick Test—Approved products, under license from the Scarlet Fever Committee, Inc., are supplied under the name Scarlet Fever Streptococcus Toxin for the Dick Test. It is a soluble toxin derived from the hemolytic streptococci of scarlet fever. Intradermal injections of this toxin, properly diluted, give positive skin reactions in susceptible persons, but no reaction in those immune to scarlet fever. The nature of the reaction is quite similar to that produced by Diphtheria Toxin in the Schick Test, except that it produces somewhat less inflammation of the skin and the reactions are more transient. An area of redness is the principal characteristic of a positive reaction, and the rule is to regard any reddening of the skin, however faint, measuring over 1 cm. in diameter, as a positive reaction. The reaction reaches its height in from eighteen to twenty-four hours, and the reaction is read and recorded within that period.

Preparation—Scarlet Fever Streptococcus Toxin for the Dick Test is prepared by the proper dilution of the toxin obtained from cultures of scarlet fever streptococci, and standardized so that 1/10 (0.1) cc. contains one skin test dose. Standardization is done by comparison with a toxin of known strength, distributed by the U. S. Public Health Service.

Dose—1/10 (0.1) cc., injected intradermally or intracutaneously.

Dosage Forms Available—Marketed in 1 cc. containers sufficient for ten tests, and in 10 cc. containers sufficient for 100 tests.

Manufacturers—2, 52.

TUBERCULINS USED IN DIAGNOSIS

It has already been noted, page 1923, that tuberculins are not toxic for normal nontuberculous individuals, and that no reactions follow their application to the skin or injection into or under the skin. Subjects of tuberculous infection, whether in the active or inactive stage, are, on the other hand, very susceptible to small amounts of tuberculin. This susceptibility manifests itself as a so-called tuberculin reaction. The reaction may appear (a) simply as a local reaction at the site of injection and may vary in intensity from a slight redness and tenderness to severe inflammation; or (b) a focal reaction may appear in the region of the tubercular lesions, or (c) there may be a general constitutional reaction, with fever, loss of appetite and rapid pulse. Tuberculins are used in diagnosis with the realization that a tuberculin reaction simply points to the presence of a tubercular infection, but does not necessarily mean that the individual is suffering from an active or progressive form. Individuals with an arrested or inactive lesion will give positive reaction but they will remain healthy without developing symptoms of the disease. The tuberculin test is therefore never solely depended upon in diagnosis, but is of value when interpreted in connection with other signs and symptoms.

The tuberculin test may be applied by various methods, of which the following are the best known. They are arranged in the order of their sensitiveness and the descriptions are taken from Kolmer's textbook on Infection, Immunity and Biologic Therapy, 3rd Edition.

The Intracutaneous Tuberculin Test (Mendel and Mantoux) consists in injecting into the superficial layers of the skin 1/20 (0.05) cc. of diluted Old Tuberculin. A positive reaction is denoted by infiltration and congestion (hyperemia) about the site of the injection.

The Subcutaneous Tuberculin Test consists in the subcutaneous injection of diluted Old Tuberculin. A positive reaction manifests itself in a constitutional disturbance accompanied by fever, a local reaction at the site of injection, and frequently a focal reaction at the site of the lesions.

The Cutaneous Tuberculin Test or Von Pirquet Test consists in the local application of Old Tuberculin to a superficial abrasion of the skin. A positive reaction is indicated by redness, swelling, and other inflammatory signs.

The Percutaneous Tuberculin Test (Moro and Doganoff) consists in the application of Tuberculin Ointment prepared by mixing equal parts of Old Tuberculin and anhydrous lanolin, and applying it to the skin over the upper portion of the abdomen. A positive reaction is indicated by the appearance of papules on the anointed skin.

The Conjunctival Tuberculin Test (Wolff-Eisner or Calmette Test) consists of local application to the conjunctiva of one eye of a drop of 1 per cent solution of Old Tuberculin or Purified Tuberculin. A positive reaction is indicated by congestion and lacrymation.

OLD TUBERCULIN O. T.

Dosage Forms Available—Marketed in 0.5 cc., 1 cc., 3 cc. vials, and in various serial dilutions.

Manufacturers—1, 2, 8, 14, 17, 56, 63. There are also available special diagnostic tuberculin packages, as follows:

TUBERCULIN INTRACUTANEOUS for the intracutaneous test of Mantoux. Supplied ready diluted in syringes adapted for intradermal injection, in single test, five test, and fifty test packages. Dose, 1/20 cc. containing 0.00,005 cc. Old Tuberculin. The bovine type of O. T. Tuberculin is similarly supplied for diagnostic use.

Manufacturer—2.

Also marketed in packages of two vials, one containing concentrated Tuberculin and one of diluent, to be thoroughly mixed and used in 0.1 cc. amounts intradermally. This dose contains 0.00,001 Gm. of Tuberculin.

Manufacturer—17.

TUBERCULIN FOR THE VON PIRQUET OR CUTANEOUS TEST—For use in this test O. T. Tuberculin, both human and bovine types, is supplied in capillary tubes. Contents of each tube sufficient for one test. Packages of three and ten capillary tubes.

Manufacturers—1, 2, 17.

TUBERCULIN OINTMENT for the Moro Reaction or Percutaneous Test—O. T. Tuberculin in ointment form, both human and bovine types, are available in one gram and two gram tubes and in capsules. One gram tubes contain sufficient for four tests. Contents of each capsule is intended for one test.

Manufacturers—1, 2, 8.

TUBERCULIN DISKS for the Conjunctival Test—Tablets designed for ophthalmic diagnosis of tuberculosis in man. One tablet dissolved in 5 minims or 1/3 cc. sterile distilled water gives a 1 per cent solution, the strength generally recommended for instillation. Dose, one drop. Supplied in tubes, ten disks or tablets per tube.

Manufacturer—1.

THE DETRE-DIFFERENTIAL TEST—As stated in the N. N. R., Detre claims to be able to determine whether a patient is infected with human or bovine tubercle bacilli, and whether the disease is active or latent, by carrying out a Von Pirquet test with Old Tuberculin, human bacilli filtrate and bovine bacilli filtrate at the same time and measuring the size of the respective papules produced. The theoretical basis of this test is not thoroughly established. Many regard it as of little practical value.

Materials for the test are supplied in packages of three tubes of 1 cc., one each of Tuberculin O.T., Tuberculin B. F. Human, and Tuberculin B. F. Bovine.

Manufacturer—8.

KEY TO MANUFACTURERS OF BIOLOGICAL PRODUCTS

Biological products distributed in the United States are prepared under license from the U. S. Public Health Service, in accordance with the act of Congress approved July 1, 1902, entitled "An act to regulate the sale of viruses, serums, toxins, and analogous products in the District of Columbia, to regulate interstate traffic in said articles, and for other purposes." Licenses granted by the Public Health Service mean that inspections of the establishments concerned, and laboratory examination of samples of their products, are made regularly to insure observance of safe methods of manufacture, to ascertain freedom from contamination, to determine potency, etc., but do not imply an endorsement of the claims made by the manufacturers for their respective preparations.

Manufacturers of biological products licensed by the U. S. P. H. S. are here listed in the order of the number of the license which has been issued to them.

License No.	*Manufacturer*
1.	Parke, Davis & Co., Detroit, Mich.
2.	H. K. Mulford Company, Philadelphia, Pa.
6.	Slee Laboratories, Swiftwater, Pa.
8.	The Cutter Laboratory, Berkeley, Calif.
11.	Institut Pasteur de Paris, Paris, France.
14.	Bureau of Laboratories, Dept. of Health, New York City.
17.	Lederle Antitoxin Laboratories, Pearl River, N. Y.
24.	Farbwerke Hoechst, vorm. Meister Lucius und Bruning, Hoechst am Main, Germany.
30.	Dr. G. H. Sherman, East Jefferson Ave., Detroit, Mich

License No.	*Manufacturer*
43.	The Abbot Laboratories, 4735 E. Ravenswood Ave., Chicago, Ill.
45.	Beebe Laboratories, St. Paul, Minn.
49.	Dr. W. T. McDougall, 640 Minn. Ave., Kansas City, Kans.
50.	St. Louis Pasteur Institute, 3514 Lucas Ave., St. Louis, Mo.
51.	The Upjohn Co., Kalamazoo, Mich.
52.	E. R. Squibb & Sons' Research and Biological Laboratories, New Brunswick, N. J.
53.	Laboratory of Clinical Pathology, 1208 Wyandotte St., Kansas City, Mo.
54.	Dr. James McI. Phillips, 2057 N. High St., Columbus, O.
56.	Eli Lilly & Co., Indianapolis, Ind.
58.	Swan Myers Co., 219 N. Senate Ave., Indianapolis, Ind.
63.	Gilliland Laboratories, Marietta, Pa.
64.	Antitoxin and Vaccine Laboratory, Dept. of Public Health, Commonwealth of Mass., Jamaica Plain, Boston 30, Mass.
65.	United States Standard Products Co., Woodworth, Wis.
66.	D. L. Harris Laboratories, Metropolitan Bldg., St. Louis, Mo.
67.	The Arlington Chemical Co., Yonkers, N. Y.
73.	Connaught Antitoxin Laboratory, University of Toronto, Canada.
74.	Les Etablissements Poulenc Freres, 92 Rue Vieille-du-Temple, Paris, III, France.
79.	Persson's Laboratories, Mount Clemens, Mich.
84.	Terrell Laboratories, 311 State Bank Building, Fort Worth, Tex.
85.	Jensen-Salsbury Laboratories, Kansas City, Mo.
86.	Cook Laboratories, 536 Lake Shore Drive, Chicago, Ill.
87.	Instituto Sieroterapico Milanese, Milan, Italy.
89.	W. F. Straub Laboratories, 5514–5520 Norwood Park Ave., Chicago, Ill.

PART XV

TOXICOLOGY AND ANTIDOTES

CHAPTER CXXIII

THE pharmacist is often called on in emergency to treat cases of poisoning. As time is so momentous a factor in these cases, he is not only justified but morally obliged to trespass on what may be, technically, the physician's field. It should be remembered that the pharmacist's duty, or license, never extends beyond the emergency first treatment; to neglect to call a physician at once is not only to fail in responsibility to the patient but also to lay oneself open to suit for manslaughter. As the pharmacist is not concerned with the management of these cases after the first emergency is past, consideration here has been limited to what must be done immediately, and to those measures which the pharmacist may reasonably be expected to be able to perform.

Promptness of action is perhaps the most important of all virtues in treating cases of poisoning; in a very large proportion of instances the fate of the patient depends on what is done in the first fifteen minutes after the ingestion of the drug.

Emetics—In a very large number of forms of poisoning, the emptying of stomach is of more practical utility than the administration of the antidote. Emetics are *contraindicated* in poisoning by mineral acids, by caustic alkalies or by strychnine. The most thorough means of evacuating the stomach is by means of the stomach tube (or "pump"); this, however, requires a familiarity with its use; in the hands of the unskilled it is capable of very serious damage. Practically the pharmacist will rely on emetic drugs; the frequent recommendation to provoke vomiting by tickling the back of the throat is so likely to fail and the need of quickness so urgent that one should not waste the time trying it; if some one else is obtaining the emetic drug, or if none is at hand, tickling the throat—which can best be done with a feather—may be practiced temporarily.

Among the emetics, for general use first place should be given to ZINC SULPHATE. Twenty grains, in a couple of ounces of tepid water, may be given at a dose and if emesis has not occurred, repeated in five minutes. APOMORPHINE HYDROCHLORIDE is perhaps the most certain, and one of the quickest, of the emetics but requires to be given hypodermically; the dose should not exceed one-tenth of a grain. A useful emergency emetic is MUSTARD; it is very efficient and prompt but unpleasant; give half a tablespoonful stirred up in a wineglassful of water. A lukewarm solution of ordinary SALT, 2 tablespoonfuls to a glass of water, will sometimes provoke vomiting, especially if combined with the throat tickling. COPPER SULPHATE (5 grains) may also be used.

Antidotes—There is much misunderstanding and consequent misuse of antidotes. First, a distinction is to be made between antidotes and antagonists; an antidote, properly speaking, is a substance which chemically lessens or destroys the activity of a poison; agents which are used to combat the baneful effects of poisons should be called antagonists.

In a great many cases the action of the antidote is only to lessen, not to abolish, the toxic properties of the poison; for instance, the precipitate formed

by either tannic acid or iodine with the alkaloids is by no means inert; it is simply relatively insoluble and the antidote therefore delays absorption of the poison until the stomach and intestines can be emptied. In most instances one should not trust to the antidote alone, but should use it in connection with methods for evacuation of the alimentary canal.

Universal Antidote—The dream of the ancients of finding some drug or combination of drugs, which would counteract the injurious effects of all poisons is about as likely of realization as the hope of Ponce de Leon of finding the fount of perpetual youth. Nevertheless, there have been devised mixtures which have more or less antidotal effect to so many substances that the high-sounding title of universal antidote is not altogether ridiculous. The most important of these are powders which depend for their value on their adsorptive properties. There are some colloidal powders which have the property of mechanically, or at least without causing any alteration of chemical structure, removing certain dissolved substances from their solution. Among these should be mentioned in particular certain clays, as *fuller's earth* and Lloyd's reagent, and the charcoals, especially *animal charcoal.* Of these, charcoal, while not the most efficient, is usually the one most quickly obtainable and therefore to be recommended; it may be given in tablespoonful doses; it is not necessary to stop to measure it accurately, for it is quite incapable of harm, only be sure to give enough. Many writers recommend that with the charcoal be combined magnesium oxide. The latter will neutralize any acid, lessen the irritative effects of many heavy metals (as copper sulphate, alum, etc.), tend to delay the absorption of alkaloids, and perhaps have some effect against arsenic. In view of the frequency of arsenical poisoning it is commonly advised to add ferric hydroxide to the universal antidote, but unless the ingredients for its preparation be readily at hand time should not be wasted trying to make it. In a case of poisoning by an unknown agent, emetics stand first in importance but it may be well to follow them with a mixture containing about one tablespoonful of magnesia and two tablespoonfuls of charcoal.

Where several antidotes are named choose the one that can be obtained most quickly. *Do not mix antidotes* either in the patient's stomach or outside. Generally speaking they are more likely to neutralize each other rather than the poison. Tannic acid, iodine, and potassium permanganate are all antidotal to the alkaloids but are all mutually incompatible.

Acids, Mineral, including **Hydrochloric, Sulphuric, Nitric,** or **Phosphoric Acids**—*Do not give emetics* because the stomach may be so weakened by the caustic effect of the chemical that it will rupture during the vomiting. Give an alkali; the one which can be used most quickly is the best. Where there is opportunity for choice, preference should be given to the Milk of Magnesia (2 tablespoonfuls) or Magnesium Oxide (1 teaspoonful), because they do not liberate carbon dioxide gas which may distend and overstrain the weakened walls of the stomach; this danger is, however, generally overestimated and should not lead to the withholding of carbonates when other alkalies are not available. Calcium carbonate in the form of Chalk (2 teaspoonfuls), or Chalk Mixture (2 fluidounces), has more neutralizing effect for the same amount of CO_2 gas than Sodium Bicarbonate (dose, 1 tablespoonful). In the absence of other alkali, Soap, or well diluted solutions of the hydroxides, may be used. Lime Water is often recommended but it should be remembered that it requires about two quarts of lime water to neutralize the same amount of

acid as one ounce of milk of magnesia. WHITE OF EGG may be used if no alkali is available.

Acid, Oxalic, and the Oxalates (**Salt of Sorrel, Ink Eradicator,** etc.)—The best antidote is some form of lime: CALCIUM CHLORIDE (20 grains); CHALK (a teaspoonful); most tooth-powders contain chalk and may be used as an antidote. In the absence of lime, magnesia may be used as an antidote either in the form of MAGNESIUM SULPHATE (1 tablespoonful) or MILK of MAGNESIA (2 tablespoonfuls).

Aconite—A rapid and exceptionally dangerous poison. Give EMETICS—ZINC SULPHATE (20 grains) or ground MUSTARD (2 teaspoonfuls). LUGOL'S SOLUTION (Liq. Iodi Comp., dose, 20 drops) is probably the best chemical antidote, although none are of much value. *Keep the patient in a horizontal position*; do not allow him to sit up even to vomit, turn the head to one side when vomiting. Keep the patient warm.

Alkalies, including **Sodium Hydroxide** (**Caustic Soda**), **Potassium Hydroxide** (**Caustic Potash** or **Lye**), **Calcium Oxide** (**Quicklime**), and **Ammonia**—*Do not give emetics!* The chemical antidote is any dilute acid; the best is VINEGAR (1 or 2 tablespoonfuls), diluted with an equal amount of water. DILUTED HYDROCHLORIC ACID (official) may be used (one-half to 1 teaspoonful), well diluted, according to the amount of alkali which has been taken. LEMON JUICE or ORANGE JUICE (2 or 3 tablespoonfuls), diluted, are also useful. OLIVE OIL or any bland fixed OIL (2 or 3 tablespoonfuls) are of service, both because of neutralizing effect and soothing action.

Ammonia Water—See Alkalies.

Antimony or **Tartar Emetic**—Give TANNIC ACID (20 grains) or GLYCERITE OF TANNIN (1 teaspoonful). Other tannin-containing drugs, as FLUIDEXTRACT OF GERANIUM (2 teaspoonfuls), or TINCTURE OF KINO, or of GAMBIR (2 or 3 teaspoonfuls) may be substituted. *Keep the patient in a horizontal position.*

Arsenic or **Fowler's Solution**—("Rough on Rats" and some other rat poisons contain arsenic). EMETICS are the most important; ZINC SULPHATE (20 grains) or ground MUSTARD (2 teaspoonfuls). The best chemical antidote is the official arsenic antidote FERRI HYDROXIDUM CUM MAGNESII OXIDO (one-half a tumblerful). It may be extemporized by adding either a solution of SODIUM CARBONATE or MILK OF MAGNESIA, to TINCTURE OF FERRIC CHLORIDE, and straining the precipitate through cheesecloth. Give 1 or 2 tablespoonfuls of the precipitate. MILK OF MAGNESIA has some antidotal effect but is less valuable than the iron.

Atropine—See Belladonna.

Barium Sulphide, or other salt of barium—Give any soluble non-toxic SULPHATE, as EPSOM SALT or GLAUBER'S SALT (the dose should be at least equal to the quantity of barium salt; if this is unknown, give 3 tablespoonfuls); SULPHURIC ACID may be used in an emergency but is less valuable because the large quantity of acid may irritate the stomach (the dose of Aromatic Sulphuric Acid to be given should be about 1 tablespoonful, well diluted). Follow the antidote by an emetic such as ZINC SULPHATE (20 grains).

Belladonna, Atropine, Stramonium (**Jimson Weed**), **Hyoscyamus** and allied drugs—Give EMETICS—ZINC SULPHATE (20 grains) or MUSTARD (2 teaspoonfuls); best chemical antidote is LUGOL'S SOLUTION (10 minims); TANNIC ACID (20 grains) is less valuable; CHARCOAL (2 teaspoonfuls) is also of some value. Whatever antidote is given the stomach should be emptied,

as none of them forms entirely harmless compounds. Poisoning by the Solanaceous drugs although often very alarming is not usually fatal.

Bichloride of Mercury—See Mercury.

Cannabis—No antidote known. Give Emetics. Very rarely does this cause dangerous poisoning.

Calabar Bean—See Physostigma.

Cantharides—Give Emetics—Zinc Sulphate (20 grains) or Mustard (3 teaspoonfuls). There is no chemical antidote but Charcoal (2 teaspoonfuls) may be useful for its adsorbent effect. After emptying the stomach give Mucilage of Acacia to soothe the stomach; avoid anything fatty or oily.

Carbolic Acid—See Phenol.

Caustic Potash or Soda—See Potassium Hydroxide.

Carbon Monoxide is the poisonous factor in illuminating gas, automobile exhausts, and mine "choke-damp". The most important treatment is maintaining oxygenation of blood by Artificial Respiration; Oxygen inhalation is also useful.

Chloroform—If taken by mouth give Emetic. Practice Artificial Respiration, if patient is not breathing well.

Colocynth—See Drastics.

Chloral Hydrate—No chemical antidote. If seen immediately after taking of poison give Emetics; if more than half an hour has elapsed emetics are more likely to do harm than good. *Keep the patient in a horizontal position*; try to prevent sleep.

Cocculus Indicus—See Picrotoxin.

Codeine—See Opium.

Colchicum—Give Emetics—Zinc Sulphate (20 grains) or Mustard (2 teaspoonfuls). Tannic Acid (20 grains) is of some value as an antidote.

Conium—Give Emetics—Zinc Sulphate (20 grains) or Mustard (2 teaspoonfuls), Lugol's Solution (10 drops) or Tannic Acid (20 grains). Artificial Respiration should be practiced if the patient shows signs of asphyxia.

Convallaria—See Digitalis.

Copper Sulphate or other copper salts—Potassium Ferrocyanide (Yellow Prussiate of Potash) (10 grains). Milk of Magnesia (1 tablespoonful) or White of Eggs is of some value if ferrocyanide is not at hand.

Cocaine—If taken by mouth, give Emetics or Lugol's Solution (10 drops) or Tannic Acid (20 grains).

Croton Oil—See Drastics.

Corrosive Sublimate—See Mercury Bichloride.

Cyanides—See Hydrocyanic Acid.

Digitalis—If the patient has not already vomited, give an Emetic. There is no chemical antidote known; treatment, aside from evacuation, in general, is of little avail.

Drastics—The drastic cathartics include **Colocynth, Gamboge, Croton Oil, Elaterin, Scammony, Jalap,** etc. If vomiting has not already occurred, give Emetics or Demulcents, Mucilage of Acacia (2 tablespoonfuls) or White of Eggs.

Elaterin—See Drastics.

Ergot—Give Emetic—Zinc Sulphate (20 grains) or Mustard (2 teaspoonfuls). No satisfactory antidote.

Eserine—See Physostigmine.

Ether—See Chloroform.

Fish-berries—See Picrotoxin.

Formaldehyde—Ammonia (Aromatic Spirits) (1 teaspoonful); Ammonia Water, U. S. P. (30 drops); Ammonium Carbonate (10 grains) well diluted. If the patient has not vomited, give Emetics.

Gamboge—See Drastics.

Fowler's Solution—See Arsenic.

Gas, Illuminating—See Carbon Monoxide.

Gelsemium—Treat same as Conium.

Hydrocyanic Acid—Treatment must be prompt, as this is one of the most quickly acting of poisons, indeed it is so quick that few remedies have time to act. Probably the most practically useful antidote is Solution of Hydrogen Dioxide (2 teaspoonfuls). Ferri Hydroxidum Cum Magnesii Oxido (one-half a tumblerful) has been recommended. Artificial Respiration, and Oxygen inhalations are also of service.

Hyoscyamus—Treatment same as Atropine.

Ignatia—See Strychnine.

Indian Hemp—See Cannabis.

Illuminating Gas—See Carbon Monoxide.

Iodine—Starch or Flour (2 tablespoonfuls) stirred up in water to make a paste. If the patient has not vomited, give Emetics.

Larkspur—Treat as under Aconite.

Lead Acetate or other lead salts—Magnesium Sulphate (Epsom Salt) or Sodium Sulphate (2 tablespoonfuls). As Emetic, preference is for Zinc Sulphate (20 grains).

Lye—See Alkalies.

Mercury Bichloride or other salts of Mercury—Give Emetic—Zinc Sulphate (20 grains) or Mustard (2 teaspoonfuls). The commonly recommended white of egg is of no value. Probably the best antidote is Fantus's Antidote; this is made as follows: Sodium Hypophosphite, 5 Gm., Solution of Hydrogen Dioxide, 25 cc., Water, 50 cc. (this is the amount to neutralize one antiseptic tablet (0.5 Gm.), if more has been taken the dose must be correspondingly increased); the stomach should be washed out afterwards. Carter's (or Linhart's) antidote consists of Sodium Phosphite (not hypophosphite or phosphate) and Sodium Acetate; it is efficient but as the first ingredient is not ordinarily found in drug stores is of small practical value. Calcium Sulphide (Calx Sulphurata) is also efficient but is poisonous of itself; it may be used when other remedy is not at hand in doses of not over 5 grains.

Methanol (Methyl Alcohol, Wood Alcohol, etc.)—Empty the stomach with Emetic. Follow by Sodium Bicarbonate (2 teaspoonfuls) in water; the soda should be repeated as it tends to neutralize the decomposition products of the poison in the system.

Morphine—See Opium.

Nux Vomica—See Strychnine.

Oil of Bitter Almond—See Hydrocyanic Acid.

Oils, Volatile, including Tansy, Rue, Cloves, Pennyroyal, etc., poison by their local irritant effects. Empty the stomach if the patient has not already vomited; afterwards give demulcents as Mucilage of Acacia (2 tablespoonfuls), or White of Eggs.

Oxalic Acid—See Acid, Oxalic.

Paris Green—See Arsenic.

Phenol—Give Emetics, preferably Zinc Sulphate (20 grains), follow with Magnesium Sulphate (2 tablespoonfuls); then with Mucilage of

Acacia (2 tablespoonfuls). *Avoid the use of oils or of alcohol.* External burns by phenol should be washed with alcohol.

Phosphorus—As Emetic, preference should be given to Copper Sulphate (5 grains), but if not at hand other emetics may be used. The chemical antidotes are Copper Sulphate or Potassium Permanganate (5 grains) in a tumblerful of water. *Avoid all oils or fats.*

Opium, Morphine or Codeine—If seen early give Emetics—Zinc Sulphate (20 grains); after narcosis has set in emetics fail to act. The best antidote is Potassium Permanganate (5 grains) in a tumblerful of water. Tannic Acid (20 grains), or Lugol's Solution (10 minims) may be used if the permanganate is not available. Keep the patient awake by shouting, do not use the commonly advised method of walking him; the best way of preventing sleep, if available, is the electric brush. If breathing becomes very low, practice Artificial Respiration.

Physostigma—Give Emetics—Zinc Sulphate (20 grains) or Mustard (2 teaspoonfuls). Chemical antidotes are Potassium Permanganate (5 grains) or Tannic Acid (20 grains). Artificial Respiration may become necessary.

Phytolacca—If the patient has not already vomited, give an Emetic—(Zinc Sulphate (20 grains) or Mustard (2 teaspoonfuls). There is no chemical antidote known.

Picrotoxin—Give Emetics—Zinc Sulphate (20 grains) or Mustard (2 teaspoonfuls). There is no known antidote. Chloroform may be used cautiously to control convulsions.

Potassium Cyanide—See Hydrocyanic Acid.

Potassium Hydroxide—See Alkalies.

Prussic Acid—See Hydrocyanic Acid.

Pilocarpine—If taken by mouth give Emetics. As antidote use Lugol's Solution (10 minims) or Tannic Acid (20 grains). Atropine is so valuable as a physiological antagonist that the pharmacist is justified in giving 1/100 grain without waiting for physician.

Rough on Rats—See Arsenic.

Silver Nitrate—Give Sodium Chloride (2 teaspoonfuls) in a glass of water. Follow by White of Egg.

Squill—Treat as under Digitalis.

Staphisagria—Give Lugol's Solution (10 minims). *Keep the patient in a horizontal position*; the drug acts much like Aconite but is not so dangerous.

Stramonium—See Belladonna.

Strophanthus—Treat same as Digitalis poisoning.

Tartar Emetic—See Antimony.

Veratrum Viride—Give Lugol's Solution (10 minims) or Tannic Acid (20 grains). *Keep the patient in a horizontal position;* do not allow him to arise to vomit; keep him warm. Artificial Respiration may be necessary.

Wood Alcohol—See Methanol.

Yellow Jessamine—Treat the same as Conium.

Zinc Sulphate or other Zinc Salt—Chemical antidote is an alkali; Sodium Bicarbonate (1 teaspoonful) or Sodium Carbonate (15 grains), well diluted; or the corresponding salts of potassium. After administering these follow with White of Egg or Mucilage of Acacia.

PART XVI

A LABORATORY COURSE IN MANUFACTURING PHARMACY AND DISPENSING

CHAPTER CXXIV

THE following outlines are offered as a suggestion for the teaching of manufacturing pharmaceutical processes and prescription compounding. Three courses are suggested in order to comply with the requirements of modern pharmaceutical education.

The outline of the first year starts with practice in the simpler technical operations, such as weighing, measuring, etc., with special emphasis upon efficient technic.

As this book discusses elsewhere not only the details of all processes, but also explains reactions, assays, and the individual preparations, no attempt is made to give other than the subjects for the lesson, and the points that must be covered, reference being made to the details found elsewhere in the book.

The *Pharmaceutical Syllabus, Third Edition*, has been taken as the basis for the instruction although its order of presentation is not followed. It is understood, of course, that each teacher should further elaborate upon the suggested instruction, so that there is ample opportunity for individuality of courses. Furthermore, methods of teaching may be varied, subject to the existing conditions.

A laboratory course usually involves preliminary explanation by the instructor. This is followed by practical work in the laboratory, carried out individually under careful supervision. The third step should be a complete report of operations, covering reactions if any are involved, and other essential features. Every lesson should be followed within a week by either an oral or a written review.

The instructor in the initial discussion should not cover every feature of the operation, but should expect the student to acquire much of the detailed information about every process through study or reading or by actual experience in the laboratory.

If an immense amount of technical information is given at the beginning of a lesson it fails to make a proper impression and may even detract from the interest. During the lesson the student should be given careful personal supervision and errors pointed out and corrected, without taking away too much initiative.

An absolute rule should be established that no preparations may be turned in for credit until they are satisfactory. Wherever possible there should be coördination in work between departments. For instance, drugs should be identified in the botanical laboratory; they should then be milled, if possible, with the assistance of advanced students. If chemicals are involved they should be, wherever possible, passed upon for quality in the chemical laboratory. When preparations have been made, those which are assayable should subsequently be checked up and the quality determined. Advanced students can be given practice in carrying out these tests and assays.

It has been found desirable to use a form for each lesson upon which the student makes out a report. This at least is applicable to the manufacture of Pharmacopœial or National Formulary preparations (see Fig. 803). It will be noted that this requires a student to examine the physical characteristics of the preparation, and this is considered an important part of the training. This can be supplemented from time to time by examination of specimens which are not labeled, the idea being to familiarize the student with the color, odor, and taste of many of the products he will handle so that when they are used in prescription filling it will constitute an additional check upon the accuracy of compounding.

FIG. 803

OPERATIVE PHARMACY LABORATORY

REPORT ON PREPARATION MADE..... 19 .

LATIN TITLE
ENGLISH TITLE
SYNONYMS

PHYSICAL DESCRIPTION
(The descriptive words below are only suggestive. Write your own description.)

COLOR—(Colorless, Red, Brown Black, Yellow, Green, Etc.)—

VISCOSITY—(Like Water, Like Syrup, Very Viscous, Etc.)—

ODOR—(Aromatic, Pungent, Floral, Acetous, or, if distinctive, name the peculiar odor as of anise, rose, Etc.)—

TASTE—(Sweet, Bitter, Aromatic, Pungent, Astringent, Acid Etc.)—

OTHER CHARACTERISTICS—(Volatile, Oily, Sticky, Etc.)—

FORMULA AND DIRECTIONS
(WRITE OUT IN ABSTRACT)

CHEMICAL REACTIONS INVOLVED

SPECIAL INSTRUCTIONS OR CAUTIONS

STANDARD OF STRENGTH—
IMPORTANT TESTS (over)

DESK No.

(Always sign here)
SIGNATURE

Form for reporting manufacturing operations

There are certain points in laboratory teaching which may be mentioned to an advantage.

Apparatus — The apparatus named in Fig. 804 has been found satisfactory for the majority of the laboratory lessons, special apparatus, such as pill machines, suppository molds, tablet triturate molds, etc., being supplied as required for individual lessons.

The student is required to purchase a three-inch spatula since this can rarely be handed on to another student and is always useful.

The student is required to inspect this apparatus upon being assigned to his desk or working counter and sign a receipt for its perfect condition. The apparatus from that time until the end of the school year is under the care of the student, who keeps it in a locked closet. Any special apparatus loaned for an individual lesson is charged against the student and must be returned for credit.

At the close of the course, the complete set of apparatus must be returned at which time proper receipts are given by the stock clerk. An appropriate breakage deposit has been held by the clerk during the interim and the amount unexpended is returned to the student. This plan insures a complete set of equipment ready for the next year's work, but it must be inspected by the instructor before a release is given the student.

A balance of appropriate type and sets of apothecary and metric weights, should be separately loaned to the student, upon which he places a deposit. This deposit is returned in part at the close of the course. The practice followed has been to lend each student a new or rebuilt balance, to insure accurate weighing, and at the close of each year have all balances repaired or rebuilt by the manufacturer. This service has been supplied by the Henry Troemner Company of Philadelphia.

Neatness and Cleanliness—The student should be impressed with the importance of keeping apparatus, closet, and working area in a creditable condition of cleanliness and neatness. This should be verified by frequent inspection. In fact, the exterior of the working counter (or laboratory table), should be examined during and at the close of every lesson. This is not for the purpose of avoiding janitor service, but for proper training, as it is considered

FIG. 804

OPERATIVE PHARMACY LABORATORY

Receipt

.....19.....

The following articles were received in good condition by the undersigned for use in the Operative Pharmacy Laboratory and will be returned in equally good condition at the close of the school term or if compelled to leave school.

1 Key
1 Metric graduate 250 cc.
1 Metric graduate 15 cc.
1 Solution mortar and pestle
1 Pill mortar and pestle
1 Small funnel
1 Large funnel
1 Pint wide-mouthed bottle
1 Quart wide-mouthed bottle
2 Retort rings
1 Glass rod
1 Pint flask
1 Pint evaporating dish
6 (4-oz) wide-mouthed bottles
2 Test tubes
1 Water bath and wire frame
1 Bunsen burner
1 Wire gauze
1 Asbestos plate

Name .....

Desk Number.....

Receipt for minimum list of loaned apparatus

essential that all manufacturing and prescription filling should be as carefully carried out, from the standpoint of cleanliness, as is the preparation of foods or any other product involving health. Furthermore, a training in neatness is a factor in the development of care and accuracy.

Every student is required to supply himself with soap, a bottle brush, such as the Lenox brush (Fig. 597), and a towel. Laundry facilities should be provided so that the student can exchange a soiled towel for a clean one, at any time and at a nominal cost. This will be found a valuable adjunct to the rule for cleanliness.

First Year Pharmacy Laboratory Outline

The following outlines are presented without any attempt to divide them into lessons, it being recognized that the length of lesson periods varies greatly in different schools. It is left for the teacher to make the assignments to conform to the conditions.

Assign all desks. The student should inspect and give a receipt for all apparatus. This may be followed by a brief consideration of the several textbooks and laboratory guides required for the course. These should include the United States Pharmacopœia and the National Formulary and some other books which should be accessible for reference, such as a general textbook on pharmacy, a dispensatory, a good general formulary and such additional books as may be needed for the special work assigned.

Weighing

1. Construction and care of balances (pages 42 to 48).
2. Proper use of balances (page 47).
3. Metric weights for all manufacturing operations and for chemical analyses (pages 48 and 1431).
4. Apothecary weights for prescription filling (pages 48 to 50, and 1431).
5. Determine the weight by the metric system of various apothecary weights and likewise the equivalent in the apothecary system of various metric weights, noting especially the equivalent of the gram and the grain.
6. Weigh the following amounts of a powdered drug, such as glycyrrhiza: 1 gram (Gm.), 35 Gm., 0.1 Gm., 3.25 Gm., 0.01 Gm., 9.40 Gm., 0.06 Gm., and others.

   Also weigh 1 grain (gr.), 15.43 gr., 1 drachm (ʒ), 1 scruple (℈), 45 grains, $\frac{1}{10}$ grain, $\frac{1}{2}$ grain, and others.

Measuring Liquids

1. Method of holding and pouring from a graduate (page 53).
2. Reading the meniscus (page 53).
3. Measuring quantities from 10 cc. to 500 cc. (pages 51 and 53).
4. Measuring fractions of a cc. (page 53).
5. Graduate a pint wide-mouthed bottle into 50 cc. divisions, marking the graduations with a pencil, on an inch wide strip of adhesive plaster attached to the bottle.
6. Measuring large volumes (page 50).
7. Measuring minims (pages 53 and 214).
8. Comparison of quantities in metric and apothecary measures. Note the volume of 1 fluidounce (f ℥i) of water in cubic centimeters (cc.) (pages 77, 31, and 36).

   Note the comparison between 1000 cc. and 1 quart (pages 31 and 33). Make other comparisons to familiarize the student with other volumes.

Measuring Lengths

1. Measure the length of the desk and the width of the desk by the metric system, and also by the use of the ordinary system, using feet and inches (pages 31, 39, and 77).
2. Determine the length in millimeters (mm.), centimeters (cm.), and also in inches or fractions of inches, of a number of familiar objects such as a notebook, the diameter of a glass rod, the height of a graduate, etc.

Filtration

1. Filtering devices (pages 196 to 210).
2. Types of funnels and their proper use (pages 200 to 206).
3. Folding and using a paper filter (pages 197 to 199).
4. Filtering adjuncts, talc, kieselguhr, etc. (page 204).

Trituration

1. The use and method of handling various mortars:
   (a) Solution (pages 173 and 1651).
   (b) Trituration (pages 151 to 153).
   (c) Contusion (page 155).
   (d) Pill making (page 1691).
2. Reduce 10 Gm. of digitalis leaves to a fine (No. 60) powder (page 169).
3. Use a No. 60 sieve in the above operation (page 166).
4. Prepare a 10 per cent triturate of arsenic trioxide (page 485) with lactose as the diluent. Add 1 per cent of powdered Cudbear. The latter is of assistance in checking uniformity of distribution and accuracy of weight.

Evaporating Dish

1. Use of retort stands (pages 138 and 205).
2. Kinds of evaporating dishes and their use (pages 117, 118, and 129).

Bunsen Burners and Stoves—Devices for supplying heat (pages 98 to 101) (gas stoves, Bunsen burners, electric stoves, etc.). The regulation of heating devices should be practiced.

Baths—Use of sand baths, water baths, steam baths, etc. (pages 112 to 119).

Thermometers

1. Compare Fahrenheit and Centigrade thermometers (pages 91 and 102).
2. Practice in converting Fahrenheit (F.) degrees to Centigrade (C.) and *vice versa* (pages 91 and 103).
3. Check the freezing point temperature in melting ice and salt.
4. Check the boiling point reading of thermometers with the use of boiling water in a flask.

Absorption of Heat by Solution—Dissolve salt in water and note the diminishing temperature (page 172).

Evolution of Heat by Solution—Dissolve sodium hydroxide in water and note the rise in temperature (page 173).

Absorption of Heat by Evaporation—Evaporate a volatile liquid (chloroform or alcohol) from a dish and note the fall in temperature.

Melting Points—Determine the melting points of various substances (page 106).

Boiling Points—Determine the boiling points of several liquids, noting that the boiling point is always the same under uniform conditions (page 120).

Sublimation—Devise a suitable apparatus and sublime such substances as naphthalene and iodine (page 151).

Viscosity—Note the difference in the "body", or viscosity, of such liquids as ether, glycerin, liquid petrolatum, water, syrup, etc. Determine their exact viscosity if apparatus is available (page 1526). Illustrate the effect of changes in temperature upon viscosity.

Miscellaneous Technical Processes—The following individual operations should be taught in making the official or other preparations which follow:

Simple solution
Saturated solution
Compound solution
Crystallization
Granulation
Precipitation
Filtration
Clarification
Purification
Decoloration
Evaporation
Simple distillation
Percolation

Drug Store Packages

1. Properly wrap, label, and tie such substances as granular ammonium chloride, in packages of one ounce and four ounces (page 1673).
2. Discuss and demonstrate cartons as a desirable substitute for the old-style drug store package.
3. Properly cap, wrap, and tie, various sizes of bottles.
4. Wrap and tie pill and powder boxes and other small, odd-shaped packages.
5. Wrap and tie together a number of small packages.

   NOTE—For package wrapping, a paper of good quality, preferably on rolls, should be employed and also suitable twine. It is recommended that white paper be used for all small packages and either red or blue "druggists twine". For large packages Manila paper in sheets and heavier twine are best adapted (page 1673).

Waters—Definition, characteristics and preparations (pages 250 to 256).

1. Prepare 100 cc. of Camphor Water (page 253) without a distributing medium.

   NOTE—The camphor may be powdered by the addition of a drop or two of alcohol, which should be allowed to evaporate. Add 3.6 Gm. of sodium chloride to 10 cc. of the finished camphor water and agitate thoroughly. The camphor separates and provides an optical evidence of its previous solution in the water.
2. Prepare 500 cc. of Cinnamon Water using purified talc (page 254), as a distributing and filtering medium.
3. Prepare 500 cc. of Chloroform Water (page 253).
4. Prepare 500 cc. of Anise Water (page 252), using purified siliceous earth as the distributing and filtering medium.

Acids—Definition, characteristics, and preparation, page 552. Consider here only the dilution of stronger acids and the compound forms.

1. Note the strength and specific gravity of the official liquid acids, (pages 553 to 556).
2. Prepare 500 Gm. of Diluted Hydrochloric acid. Note especially that diluted acids are officially made by *weighing* the components. If measured, the specific gravity of the strong acid must be taken into consideration. A taring balance or a tare must be employed to counterbalance the vessel in which the acid and water are mixed.
3. Prepare 100 cc. of Diluted Nitrohydrochloric Acid (page 566). (Apply the official test for activity.) Note constituents in the finished acid and also the reaction involved (page 565).
4. Prepare 100 cc. of Aromatic Sulphuric Acid (page 565).

Mucilages—Definition and preparations (pages 285 to 287).

1. Prepare 100 cc. of Mucilage of Acacia by the official process (page 286).
2. Prepare 100 cc. of Mucilage of Acacia extemporaneously, using granular acacia, preferably. Powdered acacia may be used. In this process add a volume of water at the start, equal at least to the amount of acacia taken or all of the water may be added at the beginning. Unless sufficient water is added the acacia forms lumps and dissolves very slowly.
3. Prepare 100 cc. of Mucilage of Chondrus (page 286).
4. Prepare 100 cc. of Mucilage of Sassafras Pith (page 287).

Syrups—Definition and preparations (pages 261 to 284).

1. Prepare 500 cc. of Syrup (Simple Syrup) by the percolation process (page 265).
2. Prepare 500 cc. of Syrup by the hot process (page 265). Compare process and products, noting all advantages and disadvantages of each. Demonstrate preparation of syrup on a large scale by percolation (page 263).
3. Prepare 500 cc. of Syrup of Tolu (page 271).
4. Prepare 500 cc. of Syrup of Orange (page 266).
5. Prepare 500 cc. of Syrup of Wild Cherry (page 268).
   NOTE—This syrup may be reserved until the consideration of percolation if desirable.
6. Prepare 500 cc. of Compound Syrup of Hypophosphites (page 278).

Glycerites—Definition and preparations (pages 300 to 304).

1. Prepare 20 Gm. of Glycerite of Tannic Acid (page 300).
2. Prepare 50 Gm. of Glycerite of Boroglycerin (page 301).
3. Prepare 50 Gm. of Glycerite of Starch (page 300).

Elixirs—Definition and preparations (pages 315 to 339).

1. Prepare 500 cc. of Aromatic Elixir (page 315).
   NOTE—Preferably, before filtration, divide the mixture into two equal portions, adding purified talc to one and purified siliceous earth to the other. Make a comparison of the two filtering media. Note the advantage of combining oils for flavoring as in the Compound Spirit of Orange (page 308).
2. Prepare 200 cc. of Elixir of Gentian (page 327). Note the use of sodium citrate to avoid discoloration with iron.
3. Prepare 100 cc. of Elixir of Iron, Quinine and Strychnine (page 326).
   NOTE—Compare this with the unofficial Elixirs of the Phosphates of Iron, Quinine and Strychnine (page 338).
4. Prepare 100 cc. of the Compound Elixir of Pepsin (Compound Digestive Elixir) (page 331).

Mixtures—Definition and preparations (pages 291 to 297).

1. Prepare 100 cc. of Compound Mixture of Glycyrrhiza (page 291).
   NOTE—This is not to be filtered.
2. Prepare 100 cc. of Chalk Mixture (page 291).
3. Prepare 100 cc. of Compound Mixture of Rhubarb (page 296).

Liniments—Definition and preparations (pages 345 to 350).

1. Prepare 100 cc. of Soap Liniment (page 346).
2. Prepare 100 cc. of Lime Liniment (page 345).
3. Prepare 100 cc. of Camphor Liniment (page 345).
4. Prepare 100 cc. of Calamine Liniment (page 347).
5. Prepare 100 cc. of Acetic Turpentine Liniment (page 349).

Petroxolins—Definition and preparations (pages 351 to 354).
1. Prepare 100 cc. of Liquid Petroxolin (page 352).
2. Prepare 20 cc. of Iodine Petroxolin (10 per cent) (page 353).

Honeys and Oxymels—Definitions and preparations (pages 284 to 285).
1. Prepare 100 Gm. of Honey of Rose (page 284).
2. Prepare 25 Gm. of Honey of Sodium Borate (page 285).
3. Prepare 25 Gm. of Oxymel of Squill (page 285).

Confections—Definition and preparations (pages 488 to 489).
1. Prepare 25 Gm. of Confection of Rose (page 289).

Masses—Definition and preparations (page 487 to 488).
1. Prepare 50 Gm. of Mass of Ferrous Carbonate (pages 487 and 713).
2. Prepare 50 Gm. of Mass of Mercury (page 488).

Compound Powders—Definition and preparations (page 478).
1. Prepare 25 Gm. of Compound Chalk Powder (pages 478 to 484).
2. Prepare six (6) sets of Seidlitz Powders (page 478).
3. Prepare 50 Gm. of Compound Powder of Glycyrrhiza (page 479).
4. Prepare 25 Gm. of Rubefacient Spice Powder (page 482).

Triturations—Definition and type formulas (page 485).
1. Prepare 20 Gm. of a 10 per cent Triturate of Corrosive Mercuric Chloride.

NOTE—Have the instructor check ingredients and weighings.

Solutions—Definition and preparations (page 256 to 260).
1. Prepare 100 cc. of Antiseptic Solution (page 339).
2. Prepare 100 cc. of Alkaline Aromatic Solution (page 340).

NOTE—Solutions involving more complex chemistry will be taken up in the second year.

Spirits—Definition and preparations (pages 305 to 315).
1. Prepare 100 cc. of Aromatic Spirit of Ammonia (page 307).
2. Prepare 100 cc. of Spirit of Peppermint (page 310).

Infusions—Definition and preparations (page 357).
1. Prepare 500 cc. of Infusion of Digitalis (page 360).
2. Prepare 100 cc. of Compound Infusion of Senna (page 361).

Decoctions—Definition and preparations (page 362).
1. Prepare an unofficial decoction such as Cetraria, by the general formula.

Vinegars—Definition and preparations (page 449).
1. Prepare 100 cc. of Vinegar of Squill (page 449).

Tinctures—Definition and preparations (pages 364 to 401).
TYPE PROCESS P.
1. Prepare 500 cc. of Compound Tincture of Gentian (page 373).

TYPE PROCESS M.
1. Prepare 200 cc. of Tincture of Benzoin (page 368).
2. Prepare 100 cc. of Tincture of Sweet Orange Peel (use fresh fruit) (page 367).

Fluidextracts—Definition and preparations (pages 402 to 442)
TYPE PROCESS "A".
1. Prepare 100 cc. of Fluidextract of Rhubarb (page 414).

TYPE PROCESS "B".

1. Prepare 100 cc. of Fluidextract of Krameria (page 431).

TYPE PROCESS "C".

1. Prepare 100 cc. of Fluidextract of Gentian (page 428).

TYPE PROCESS "D".

1. Prepare 100 cc. of Fluidextract of Cascara Sagrada (page 408).
2. Prepare 100 cc. of Aromatic Fluidextract of Cascara Sagrada (page 408).

Extracts—Definition and preparations (pages 451 to 470).

1. Prepare Pilular Extract of Taraxacum using 200 Gm. of drug (page 469).
2. Prepare 50 Gm. of Powdered Extract of Cascara Sagrada (page 457).

Ointments—Definition and preparations (pages 502 to 512, and Chapter CVII).

1. Prepare 100 Gm. of Ointment of Rose Water (page 503).
2. Prepare 25 Gm. of Belladonna Ointment (page 503).
3. Prepare 50 Gm. of Stronger Mercurial Ointment (page 504).
4. Prepare 25 Gm. of Iodine Ointment (page 505).
5. Prepare 25 Gm. of Ointment of Phenol (page 506).
6. Prepare 25 Gm. of Sulphur Ointment (page 506).
7. Prepare 25 Gm. of Ointment of Zinc Oxide (page 507).
8. Prepare 25 Gm. of Stainless Iodine Ointment (page 509).
9. Prepare 25 Gm. of Ointment of Mercuric Nitrate (page 509).

Cerates—Definition and preparations (pages 512 to 514).

1. Prepare 50 Gm. of Compound Rosin Cerate (page 514).

Inunctions—Definition and preparations (page 512).

1. Prepare 25 Gm. of Compound Menthol Inunction (page 512).

Dermatologic Pastes—Definition and preparations (page 516).

1. Prepare 25 Gm. of Zinc Paste (page 517).

Poultices—Definition (page 517).

1. Prepare 50 Gm. of Cataplasm of Kaolin (page 517). Show the domestic method of preparing flaxseed poultices, mustard poultices, spice poultices, etc.

Specific Gravity—Definition and methods of determination (pages 55 to 69, and 78).

Specific Gravity is considered at the close of the first year to insure familiarity with many of the theoretical considerations involved.

1. Make a pycnometer, or specific gravity bottle, as follows (see Fig. 805):
   (a) Cut a piece of lead so that it *exactly counterbalances* the weight of a dry and clean pycnometer flask.
   (b) Pour distilled water into the flask, until it reaches a point midway on the neck, then determine the weight accurately. (Adjust the volume, if possible, so that it weighs an even number of grams.)
   (c) Adjust the temperature of about 1000 cc. of water, in a quart wide-mouthed bottle, to 25° C. (add hot water slowly to the bottle of cold water until the desired temperature is reached).

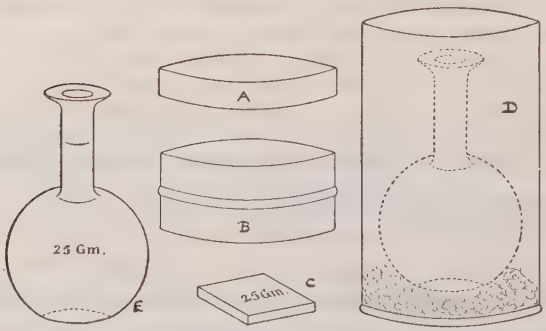
(d) Immerse the pycnometer flask of weighed water in the quart, wide-mouthed bottle of water, adjusted to 25° C. Keep it there for ten minutes.

(e) After sufficient time has been given to adjust the temperature of the water in the pycnometer, carry the flask of water, while yet in the water bath, to the main desk for graduation. Take with you to the desk a memorandum of the weight of water contained in the pycnometer so that this can also be marked on the flask. The assistant will then graduate the flask at the bottom of the meniscus, using a marking diamond, and also mark the weight of water on the flask.

(f) To complete the apparatus also stamp the lead weight with the amount of water which the bottle holds at 25° C., when filled to the graduation point.

(g) Finally wrap the finished pycnometer in cotton, and place it in the tin case.

FIG. 805



Specific gravity bottle, counterpoise, and case

2. Take the specific gravity of solution of ferric chloride at 25° C. Compare with the official requirements and estimate the comparative strength.
3. Take the specific gravity of simple syrup at 25° C. Compare with the official requirements and estimate the comparative strength.
4. Take the specific gravity of a sample of alcohol at the room temperature. Calculate the per cent of absolute alcohol, by volume, in the sample, using the U. S. P. alcoholometric table (page 909), and the temperature corrections (page 912).
5. Determine the per cent of absolute alcohol, by volume, in at least five different samples of dilute alcohol.
6. Determine the specific gravity of several liquids by weighing a glass stopper successively in water and in the liquid to be determined.
7. Determine the specific gravity of clean sand, using the pycnometer.
8. Determine the specific gravity of granulated sugar, using the pycnometer and oil of turpentine of known specific gravity, in place of water.
9. Determine the specific gravity of several liquids both heavier and lighter than water, by the use of hydrometers.

Second Year Pharmacy Laboratory Outline

Working desks and apparatus should be issued and receipted for as outlined for the first year.

The lessons of the second year begin with the more difficult official preparations, especially those requiring the understanding of chemical reactions.

Drugs which are to be used in preparations during this year or in the senior year should be purchased unground, and they should then be identified and passed upon for U. S. P. quality by advanced students, who should assay them if necessary. The drugs should then be ground in the college drug milling plant, under the direction of advanced students.

Preparations made by the second year students, and requiring assay, should be standardized by students of the third year.

Acids—Prepare 100 Gm. of Diluted Nitrohydrochloric Acid (page 555).

Syrups—Prepare 100 cc. of Syrup of Ferrous Iodide (pages 267 and 718).

Solutions

1. Prepare 100 cc. of Solution of Ammonium Acetate (page 652).
2. Prepare 100 cc. of Solution of Iron and Ammonium Acetate (page 722).
3. Prepare 100 cc. of Compound Solution of Cresol (page 814).
4. Prepare 100 cc. of Crude Solution of Cresol (Creolin type) (page 815).
5. Prepare 100 cc. of Solution of Ferric Chloride (page 714).
   NOTE—This solution should be tested for absence of ferrous salts and nitrate. It should also be assayed by advanced students and adjusted to conform to the U. S. P. specific gravity and strength (page 715).
6. Prepare a bottle of Solution of Magnesium Citrate (page 666).
7. Prepare 100 cc. of Solution of Lead Subacetate (page 738).
8. Prepare 100 cc. of Solution of Potassium Arsenite (page 766).
9. Prepare 100 Gm. of Solution of Chlorinated Soda (page 569).
10. Prepare 100 cc. of Solution of Sulphurated Lime (page 681).
11. Prepare 100 cc. of Compound Solution of Chlorine (page 573).
12. Prepare 100 cc. of Surgical Solution of Chlorinated Soda (Modified Dakin's Solution) (page 570).
13. Prepare 100 cc. of Solution of Ferric Citrate (page 725).
14. Evaporate and scale ½ of the solution of Ferric Citrate just prepared (page 725).
15. Prepare 100 cc. of Solution of Aluminum Acetate (page 702).
16. Prepare 100 cc. of Compound Solution of Sodium Borate (page 641).
17. Prepare ⅕ of the official formula for Solution of Calcium Hydroxide (page 672).
18. Prepare 25 cc. of Solution of Potassium Citrate (page 608).

Effervescent Salts—Definition and preparations (pages 475 to 477).

1. Prepare 100 Gm. of Effervescent Magnesium Sulphate (page 670).
2. Prepare 100 Gm. of Effervescent Artificial Vichy Salt (page 477).

Tinctures—Prepare 100 cc. of Tincture of Belladonna (page 367).

NOTE—This tincture is to be assayed by advanced students and adjusted to conform with the U. S. P. standard.

Prepare 100 cc. of Tincture of Digitalis (page 372).

NOTE—This tincture is to be assayed biologically by advanced students and the volume adjusted to conform to the U. S. P. standard.

Fluidextracts

1. Prepare 100 cc. of Fluidextract of Cinchona (page 409).
   NOTE—This fluidextract is to be assayed by advanced students and the finished product adjusted to conform to the U. S. P. standard. The alcohol per cent also is to be determined, using the official process (page 908).

Extracts

1. Prepare 50 Gm. of Extract of Nux Vomica (page 462).
   NOTE—This extract is to be assayed by advanced students and the finished product adjusted to conform to the U. S. P. standard.

Spirits

1. Prepare ethyl nitrite by the U. S. P. 1890 method (pages 305 and 919), and using the ester produced, prepare official Spirit of Ethyl Nitrite.
   NOTE—Preserve at least 1 ounce of this spirit as directed by the Pharmacopœia (page 920). A portion of the product should be assayed by advanced students and the report entered as a part of the record.

Oleoresins—Definition and preparations (pages 445 to 447).

1. Prepare Oleoresin of Cubeb, using 100 Gm. of drug (page 447).

Resins—Definition and preparations (pages 471 to 473).

1. Prepare Resin of Podophyllum, using 100 Gm. of drug (page 473).
   NOTE—The resin should be assayed by advanced students and the result entered upon the records.

Soft Soap—Prepare 100 Gm. of Soft Soap (page 1055) and test for alkalinity.

Magmas—Definition and preparations (page 297).

1. Prepare 100 cc. of Magnesia Magma (page 664).
2. Prepare 100 cc. of Bismuth Magma (page 774).
3. Prepare Arsenic Antidote (page 717).

Magistral Pharmacy—Following the lessons in the manufacture of pharmaceutical preparations, the second year students should be given an opportunity to practice the technic required for extemporaneous pharmacy, usually called *magistral pharmacy*. Many of the operations are required in prescription filling but it is considered desirable to train the student in the technic of these operations before applying them to dispensing.

Emulsions—The student should be taught the English method, the Continental method and the "Forbes", or bottle, method for the preparation of emulsions and the advantages, limitations, and applications of each (pages 1655 to 1661).

1. Prepare the U. S. P. Emulsion of Cod Liver Oil (pages 288 and 1658).
2. Prepare the N. F. Emulsion of Cod Liver Oil with Egg (page 289).
3. Prepare a 50 per cent Emulsion of Cod Liver Oil, using the U. S. P. proportions of oil and acacia but following the English method (page 1657).
4. Prepare a 50 per cent Emulsion of Cod Liver Oil, with 4 per cent of acacia and 1 per cent of tragacanth, using the English method.

5. Prepare a 50 per cent Emulsion of Cod Liver Oil, with 12 per cent of powdered milk (Klim), using the English method.
6. Prepare a 25 per cent Emulsion of Castor Oil, with 7½ per cent of acacia, using the English method. Add methyl salicylate to flavor.
7. Prepare the N. F. Emulsion of Castor Oil (page 290).
8. Prepare the N. F. Emulsion of Petrolatum (page 290).
9. Prepare the U. S. P. Emulsion of Oil of Turpentine (page 288).
10. Prepare the U. S. P. Emulsion of Asafetida (the asafetida may be replaced by ammoniac) (page 287).
11. Prepare the N. F. Emulsion of Cod Liver Oil with Hypophosphites (page 289).

Suppositories—Thorough training should be given in the making of rolled or hand-made suppositories and also in the preparation of fused or molded suppositories (see page 1733).

Fused or molded suppositories—(Using Oil of Theobroma).

1. Prepare adult, rectal suppositories each containing 5 gr. of quinine sulphate.
2. Prepare adult, rectal suppositories each containing 5 gr. of ichthyol.
3. Prepare adult, rectal suppositories each containing 0.1 Gm. of tannic acid.
4. Prepare adult, rectal suppositories each containing 0.125 Gm. of tannic acid and 0.125 Gm. of extract of stramonium.
5. Prepare adult, rectal suppositories each containing 0.02 Gm. of extract of belladonna and 0.06 Gm. of lead acetate.
6. Prepare adult, rectal suppositories each containing 3 per cent of phenol. Use sufficient spermaceti to harden the suppository.
7. Prepare U. S. P. Glycerin Suppositories (page 523).

Fused or molded suppositories—(Using Glycerinated Gelatin).

1. Prepare vaginal suppositories, each of 10 Gm. weight, using the following formula.

Zinc Oxide	1.0 Gm.
Boric Acid	0.5 Gm.
Water	3.0 cc.
Glycerin	6.6 Gm.
Glycerinated Gelatin	10 Gm.

2. Prepare vaginal suppositories, each of 10 Gm. weight, containing 50 per cent of glycerite of boroglycerin.

Hand-made or rolled suppositories—(Using Oil of Theobroma). Try the making of rolled suppositories without dusting powder, also separately try powdered starch, and lycopodium.

1. Prepare rectal, cone-shaped, suppositories of adult size from any convenient suppository formula, or one suggested for molded suppositories.
2. Prepare suppositories similar to No. 1 but of infant size.
3. Prepare adult, rectal, suppositories, shaped as recommended by Wellcome (see page 1737).
4. Prepare vaginal suppositories, weighing 4 Gm. each.

Troches (see pages 498 and 1697).

1. Prepare the U. S. P. cut Troches of Ammonium Chloride (page 498).
2. Prepare the N. F. cut Troches of Elm (page 499).
3. Prepare the U. S. P. IX cut Troches of Cubeb (page 499).
4. Prepare 100 troches from the following formula, rolling the mass into a pill pipe or cylinder, cutting it into sections about twice the length of the diameter:

Menthol	0.1 Gm.
Benzoic acid	0.3 Gm.
Powd. Ext. of Glycyrrhiza	32.5 Gm.

Make into 100 troches.

Powders—The general subject of official compound powders and also triturations has been considered in the first year. At this point, the technic of dividing and folding powdered substances, extemporaneous dispensing, is to be taken up (page 1675).

1. Prepare 12 powders, each containing 1/10 gr. of calomel and 1 gr. of sodium bicarbonate. Triturate thoroughly and using a spatula, form the powder into a rectangular block, divide into 12 squares, transfer each to a powder paper, and fold, using a powder folder.
2. Prepare a mixture containing 1½ dm. each of saccharated pepsin and sodium bicarbonate to which is added 1 drop of oil of peppermint. Distribute this directly upon 12 waxed powder papers (or instead of waxed papers use parchment papers or paraffin papers inside of ordinary powder papers). Fold these, using the powder box which is intended for dispensing.

Cachets (page 1685).

1. Prepare 6 cachets, using two wide-mouthed bottles for sealing, and a moistened filter paper as a moistening pad. Each cachet is to contain 5 gr. of acetylsalicylic acid.
2. Prepare 12 cachets, each containing 3 gr. of quinine dihydrochloride, using a cachet machine.

Capsules

Hard capsules (page 1678).

1. Prepare a mass from 3 Gm. of powdered aloes, and 2 Gm. of powdered sugar. Roll into a cylinder on a pill machine, cut into 12 sections, and insert into No. 2 hard capsules. (Be careful to avoid the soiling of the exterior of the capsule.)
2. Prepare 12 capsules, each containing 2½ gr. of quinine sulphate and 2½ gr. of phenyl salicylate. Mix the powders thoroughly in a mortar, reducing them to a fine powder, and fill into No. 1 hard capsules, seeing that each is of correct weight. Clean the capsules by dropping them into granulated sugar in a box, shaking thoroughly and separating.
3. Mix 4 cc. of oil of turpentine with 5 Gm. of starch, by trituration in a mortar. Then add water, drop by drop, with trituration, until the mass becomes pulverulent. Insert into 12 No. 1 hard capsules.
4. Fill 1 dozen No. 1 hard capsules with oil of turpentine, using a medicine dropper and sealing the capsules with hot water or diluted alcohol.

NOTE—Dip the top of the capsule into the sealing liquid to a depth of about only 1.5 mm. (1/16 inch).

Soft elastic capsules (page 1681).

1. Fill 12 (15 min.) soft elastic capsules with cod liver oil and seal with a hot solution of gelatin, made by dissolving 3 parts of gelatin in 2 parts of glycerin and adding enough water for the proper consistence. A loop of galvanized wire should be used for the sealing, the size of the loop corresponding to the opening in the capsule. In filling the capsule use a medicine dropper or a burette, wiping clean the exterior of the point with cotton each time before inserting it into the capsule.

Enteric capsules (page 1683). Capsules treated with formaldehyde are also called "*glutoid capsules*".

1. Incorporate 2.4 Gm. of monohydrated sodium carbonate with 1.2 Gm. of prepared suet and 0.6 Gm. of paraffin, without heat, by massing them in a mortar, and divide the mass equally between 12 No. 2 hard capsules.

   NOTE—It is claimed that this mixture will pass through the stomach because of insolubility and dissolve in the intestine.

2. Prepare 12 hard capsules each containing 5 gr. of sodium phenolsulphonate. Seal with hot water and immerse for exactly 30 seconds in a 1 per cent solution of formaldehyde. Remove the capsules immediately and dry. Hold for two weeks and test for their enteric quality, as suggested below.
3. Salol coating. Coat 12 filled capsules with phenyl salicylate, as directed on page 1731. See that the ends of the capsules are completely covered and caution the patient to avoid pressing the capsule, as the elastic walls are likely to cause the breaking of the coating.

Test Capsules—Always prepare several test capsules, each containing a small amount of calcium sulphide and methylene blue, and treat these by whatever method is employed for rendering the capsule enteric and do it at the same time. These test capsules are to be administered to prove their enteric character. If they dissolve in the stomach, the taste of sulphide is at once apparent. If the sulphide taste is absent, there is reasonable indication that the capsule has not dissolved in the stomach. A bluing of the urine is proof of its subsequent solution in the intestines. If both are absent the capsule has been proved to be completely insoluble.

Pills (see pages 489 and 1691).

1. Prepare 50 Pills of Ferrous Carbonate (page 490) using the pill tile. Shape the pills with the fingers.
2. Prepare 50 Compound Pills of Mild Mercurous Chloride, cutting and shaping the pills on a pill machine without reshaping by hand.
3. Prepare 50 Pills of Phosphorus, coating the pills with tolu (page 491).
4. Prepare 24 Pills of Silver Nitrate, using the following formula:

Silver nitrate	0.8 Gm.
Kaolin	1.6 Gm.
Hardened petrolatum[1]	0.8 Gm.
Rosin cerate	0.2 Gm.

[1] Hardened petrolatum:

Yellow petrolatum	2 parts
Paraffin	1 part

Melt together and cool.

5. Prepare 48 pills from the following formula:

Aloes	75 gr.
Extract of belladonna	6 gr.

6. Prepare 24 *white* pills, each containing 2 gr. of quinine sulphate.

Pill Coating

1. Coat 25 of the Pills of Ferrous Carbonate already prepared, using silver leaf (see page 1721).
2. Coat 25 of the Compound Cathartic Pills already prepared, using phenyl salicylate (see page 1731).

Molded Tablet Triturates (see page 1701).

1. Prepare unmedicated tablet triturates, using a mixture of 1 part of sucrose and 5 parts of lactose, and moistening with a mixture of alcohol 7 parts and syrup 1 part. Dry the tablets and determine their weight as the basis for subsequent formulas.
2. Prepare 100 tablet triturates each containing 1/20 gr. of arsenic trioxide. Use as the diluent a mixture of 1 part of sucrose and 5 parts of lactose. Moisten with 90 per cent alcohol or a mixture of alcohol 7 parts and syrup 1 part. Dry the finished tablets.
3. Prepare tablet triturates each containing ½ min. of tincture of aconite. Add the tincture to a proper quantity of the sugar mixture, made as before. Distribute uniformly and dry without heat. Moisten the dry powder with the alcohol and syrup mixture, mold, and dry the tablets.

Compressed Tablets (see pages 500 and 1704 to 1712)—Study and set up the several types of tablet machines.

1. Prepare 5 gr. tablets of granular sodium bromide, using a hand compression machine, consisting of a cylinder and punches, and produce the compression by the blow of a mallet.
2. Prepare 5 gr. tablets of commercial granular potassium chlorate without further granulation, using a small power tablet machine like the Eureka (page 1709).
3. Prepare several granulations, using formulas on pages 1712 to 1719, and make tablets on a hand, and also on power machines, if available.

Plasters (see pages 518 and 1751 to 1755).

1. Spread a cantharides plaster suitable for behind the right ear, spreading it upon adhesive plaster, the student drawing and cutting the pattern from "tag" board, or a similar hard-surfaced flexible card.
2. Spread a back plaster, using "Burgundy pitch" plaster. Make the plaster about 4 by 6 inches. Spread it upon adhesive plaster or "tag" board, using a large spatula. The student should prepare the pattern.

Second Year Dispensing

The student having been taught the manipulative technic for most of the magistral operations required in dispensing, it is now appropriate to consider the professional responsibilities and duties of the dispenser. The term "*professional pharmacy*" has been subjected to severe strain during the rapid commercial development of modern drug stores. The difference between professional service and purely mercantile activities should be clearly understood. This is discussed in Chapter XCVI, under "*Filling the Prescription*", and the student who would aspire to the highest professional pharmaceutical service,

the intelligent and conscientious filling of prescriptions, must be imbued with the ideals of pharmacy and should make every effort to secure training and experience in its practice. The chapter on *"Filling the Prescription"* should be carefully studied before any prescriptions are filled in this dispensing course.

When the correct attitude of mind and the deep sense of responsibility which must be assumed by the pharmacist when filling prescriptions has been understood, the student may proceed to fill prescriptions. The prescriptions first filled should involve no serious complications. They are to be given for the purpose of thoroughly grounding the beginner in prescription routine. Every point of the technic of dispensing, as explained in Chapter XCVI, should be strictly maintained. The amount of time to be devoted to dispensing in this preliminary study, and the actual prescriptions to be filled, must be determined by the instructor in charge of each laboratory. Typical prescriptions will be found on pages 1804 to 1819, and these may be supplemented by others from the files of nearby pharmacies.

Third Year Pharmacy Laboratory Outline

During the third year the pharmacy student, who has already received the fundamental instruction in practically all pharmaceutical technic, should be given opportunity to coördinate the training in the various departments in the college, all of which is required in the proper selecting of materials, in the handling of pharmaceutical machinery, and in the ultimate production and standardization of products.

Pharmaceutical Control of Manufactured Products—The Chapter on a Control Laboratory (see page 1577) describes the responsibilities which must be assumed by the trained manufacturing pharmacist. He is called upon first to develop suitable formulas for the particular preparations required. Frequently this calls for experimental production on a smaller scale, before the formula is satisfactory. This applies to preparations which are unofficial, although many official processes require modification for large-scale production.

The formula having been satisfactorily developed, the ingredients must then be ordered, market conditions and business acumen being a factor in the purchase.

When the stock is received it must be approved; vegetable or animal drugs being passed upon by the experts in the botanical laboratory, the student conducting the examination under proper supervision.

If the materials needed are chemicals they must also be passed upon by the student in the chemical laboratory, the necessary tests and assays being applied. Drugs which are assayable must also be tested chemically (see page 1485) or biologically (see page 1503).

Having approved the ingredients, the drugs must be milled, if necessary, and then the preparation is made.

After the product is manufactured, again the skill of the pharmacist or chemist is called upon to pass upon the completed product and this frequently involves some form of assay.

The preparation is not complete without a final report upon the total and unit cost of the finished product in which due consideration must be given to the overhead cost.

This broad viewpoint of the manufacturing laboratory problems will develop skill in managing and should be carried out as far as practicable in the manufacture of elixirs, official solutions, emulsions, tinctures, fluidextracts, extracts, suppositories, and in the production of tablets, both plain and coated.

It is not necessary here to indicate any specific formula as any of the official preparations or the formulas for tablets (see page 1704) are suitable and may be selected as convenient by the instructors.

Frequently the products of large-scale manufacture may be disposed of through a local hospital, and perhaps much of the raw material will be supplied by the hospital, the finished product, after final approval, being turned over for hospital use. In this way, the cost of a course of this type is greatly reduced.

Pharmaceutical Journal Seminar—Each month throughout the third year each member of the class should be assigned a current pharmaceutical journal for review. A feature of the review should consist of the preparation of an abstract of several leading articles. These should be read before the group and handed in for correction and rating. They should be systematically written up on 5 × 8 inch index cards, and should include the title of the article, the author's name, and the name of the journal, with the year, and page number. The abstract should be signed by the student.

In the seminar, students should briefly describe the scope and field of the journal reviewed. Journals reviewed should cover the following fields: Professional pharmacy, commercial interests, journals covering both fields popularly, medical journals, like the *Journal of American Medical Association*, and *Hygeia*, chemical journals, like the *J. A. C. S.*, and the *Journal of Industrial and Engineering Chemistry*, journals of the perfumery and soap trade, foreign pharmaceutical journals, State association journals, and house organs. These reviews should be presented by the students at a regular seminar period.

Library Assignments—A regular feature of certain laboratory operations should be the specific assignment of a subject to each student who is to proceed to the library and make a careful review of the standard books and journal articles dealing with the subject. Attention should be called to, and the student should use, the "Digest of Comments on the U. S. P. and N. F.," prepared by the Hygienic Laboratory and also to the "Year Book of the A. Ph. A." These abstracts of literature should be presented by the student before the class and should be also written up and handed in.

Advanced Dispensing—The third year student should be given an opportunity in the latter part of the year to study prescriptions involving difficult manipulation or incompatibilities, demanding broad knowledge and excellent judgment.

The prescription should be placed in the hands of the dispenser without advice or suggestion, the filling of the prescription being accomplished through the initiative of the student alone. A complete report should be required and the finished product and the method of procedure subjected to group discussion. The aim of this course is to develop initiative and the ability to independently study the complicated problems often met in dispensing. Prescriptions may be selected from those on pages 1804 to 1819 for this study.

Sterilization (see pages 1779 to 1803).

1. Test the flasks and ampuls for the insolubility of the glass and their suitability for use with sterilized liquids. Follow the directions of the N. F., given on page 1791.
2. Sterilize the following glass apparatus, but first thoroughly clean, plug the flasks with non-absorbent cotton, and wrap in paper. Use dry heat for 2 hours at a temperature of 170° C.
    1. Insoluble glass flasks of 1 pint capacity.
    2. Insoluble glass ampuls of 5 cc. and 1 cc. capacity.

3. Sterilize the following pieces of apparatus in an autoclave, wrapping each outfit in a clean towel:
   1. Büchner funnel.
   2. Berkefeld-type filtering outfit (see Fig. 780).
   3. Burette, graduated in $\frac{1}{10}$ cc. divisions, with glass stopcock, and with rubber connections for a needle to be attached to the burette (see Fig. 781).
   4. Glass mortar and pestle.
   5. Glass funnels.
4. Prepare 500 cc. of physiological solution of sodium chloride, and filter it through a Büchner filter, using a hard paper filter. The solution must be filtered into an insoluble glass flask which has been previously sterilized. The solution must be free from all foreign particles or filaments. The sterilization should be conducted in an autoclave, under steam pressure and for thirty minutes after the temperature in the flask has reached 115° C. The flask should be closed with non-absorbent cotton, wrapped in gauze.
5. Prepare 500 cc. of sterilized, freshly distilled water, using a sterilized insoluble glass flask, and boiling at 100° C. for one hour. The flask must be closed with non-absorbent cotton which has been wrapped in gauze.
6. Prepare 25 (1 cc.) ampuls, each containing 1 gr. of green ferric citrate, in sterile aqueous solution, using the sterile outfit already prepared and the sterile ampuls. Sterilize the sealed ampuls and then label each ampul. Prepare other solutions (see pages 1795 to 1803).
7. Prepare 5 cc. ampuls of sterilized distilled water.
8. Test representative ampuls for sterility (see page 1794).

Perfumery and Cosmetics—Students in the third year should be given an opportunity to prepare some of the simpler perfumes and cosmetics. (See Perfumery, pages 1207 to 1243.) The laboratory work should be accompanied by a suitable study of the entire subject of perfumery so that the student will be qualified to discuss the history and the basic materials employed in perfumery. This materially assists in giving advice to customers and increases selling ability.

It is possible for the student to manufacture small lots of almost all varieties of perfumes. These should include concentrated perfume extracts, toilet waters, colognes, sachets, face creams of all kinds, face powders, talcum powders, hair preparations, especially shampoos, cuticle specialties, shaving cream, hand lotions, depilatories, etc.

It is not economically practicable for many of the basic perfume oils to be prepared by students, but formulas should be given and concentrated perfume oils, prepared by these formulas, may be used in perfuming some of the products. Other basic perfume oils of the more common type, as purchased upon the open market, should also be used by the class. The products of at least a half-dozen firms should be available for comparison.

PART XVII

CHAPTER CXXV

GLOSSARY

OF

UNCOMMON PHARMACEUTICAL AND TECHNICAL NAMES, TERMS, OR SUBSTANCES

A.

Abasier. Animal charcoal.
Abercrombies Lotion. Infusion of tobacco, 1 : 200.
Abric. Sulphur.
Acetum Acerrimum. Concentrated acetic acid.
Bezoardicum. Aromatic vinegar.
Saturni. Solution of lead subacetate.
Theriacale. Aromatic vinegar.
A. C. E. Anesthetic mixture of 1 volume of absolute alcohol, 2 volumes of chloroform and 3 volumes of ether.
Acid, Apple. Malic acid.
Azotic. Nitric acid.
Battery. Sulphuric acid and potassium dichromate.
Boroboracic (Acid Boroboric). Mixture of equal parts of borax and boric acid.
Borussic. Prussic. Hydrocyanic.
Carbazotic (Picronitric acid). Picric acid.
Catholicon. Sulphuric acid.
Cetylacetic. Stearic acid.
Chlorazotic. Aqua regia.
Dioxysuccinic. Tartaric acid.
Dipping. Sulphuric acid.
Electrolyte. Sulphuric acid.
Lithic. Uric acid.
Nancic. Lactic acid.
Orthoboric. Boric acid.
Phenic. Carbolic acid.
Phenylformic. Benzoic acid.
Pickling. Sulphuric acid.
Sozoiodolic. Diiodoparaphenolsulphonic acid. (Antiseptic.)
Sozolic. Orthophenolsulphonic acid.
Stearophanic. Stearic acid.
Sugar. Oxalic acid.
Sulphhydric. Hydrogen sulphide. Sulphuretted hydrogen. Hydrosulphuric acid.
Thiolinic. Sulphurated and sulphonated linseed oil.
Acid, Tumenolsulphonic. Obtained by treating the distillate of a mineral oil with sulphuric acid.
Vinegar. Acetic acid.
White. A mixture of hydrofluoric acid and ammonium bifluoride, used for etching glass.
Acidum Chloronitrosum. Nitrohydrochloric acid.
Cœruleum (Blue acid). Hydrocyanic acid.
Muriaticum Oxygenatum. Chlorine.
Nitrico-Nitrosum. Fuming nitric acid.
Ossium. Glacial phosphoric acid.
Scytodepsicum. Tannic acid.
Actol. Silver lactate.
Acusto. Potassium nitrate.
Adeps Anserinus. Goose grease.
Gadi. Cod liver oil.
Ovillus. Mutton suet.
Adipsos. Licorice.
Adragante. Tragacanth.
Aer Fixus. Carbonic acid gas.
Aerosus Lapis. Lapis calaminaris.
Ærugo. Crude copper acetate.
Æs. Copper.
Æs Aeratum. Copperas.
Æther Vegetabilis. Acetic ether.
Æthiops Antimonialis. Chiefly a mixture of black antimony and mercury.
Martialis. A black iron oxide; formed by keeping iron filings covered with water for a long time.
Mineralis. Mixture of mercuric sulphide and sulphur.
per se. Mercury oxide.
Vegetabilis. Charcoal of seaweed.
Affium. Extract of poppy-heads (opium).
African saffron. Carthamus.
After-damp. Carbon dioxide in mines following fire damp explosions.
Alabastic. A variety of gypsum.
Alabastine. An improved calcimine.
Alanin-Mercury. Mercury amidopropionate.
Albocarbon. Naphthalene.

Album Græcum. Excrement of dogs.
Nigrum. Excrement of mice or rats.
Alcohol Sulphuris. Carbon disulphide.
Alcoolat (French). A distilled spirit.
Alcoolature (French). An alcoholic tincture of a fresh plant. ("Green tinctures".)
Alcoolé (French). An alcoholic solution of a substance entirely soluble in the alcohol.
Alegar. Ale vinegar. (Made by fermenting ale upon raisins or vine cuttings.)
Algaroth, Powder of. Antimony oxychloride.
Alkali, Vegetable. Potassium carbonate.
Volatile. Ammonium carbonate.
Aloxite. Artificial oxide of alumina.
Alum, Cake. Aluminum sulphate.
Concentrated. Aluminum sulphate.
Cube. Potassium alum.
Patent. Aluminum sulphate.
Porous. Sodium aluminum sulphate.
Rock (Alumen Rupeum). Lump alum as it occurs with the earth attached.
Roman. See Rock Alum.
Alumen Plumosum. Asbestos.
Rubrum. Rock salt.
Alundum. Artificial aluminum oxide.
Amadou. Punk; tinder.
Ambretta Seeds. Musk seeds.
Amianthus. Asbestos.
Amidon. Starch.
Amino-Mercuric Chloride. Ammoniated mercury.
Ammonium Carbonicum Pyro-Oleosum. A mixture of ammonium carbonate with "animal oil".
Sulpho-Ichthyolate. Ichthyol.
Amphion. Opium.
Amplosia. An unfermented juice of the grape.
Amylhydride. Pentane.
Amylit. A trade name for an enzymic preparation used in the textile industry.
Amylodextrin. Soluble starch.
Analgesine. Antipyrin.
Anaphromeli. Clarified honey (Mel despumatum).
Angioneurosin. Nitroglycerin.
Anima Articulorum (Life of the Limbs). A name given to colchicum.
Rhei. Aqueous tincture of rhubarb.
Annidalin. Aristol. (Antiseptic.)
Anodynin. Antipyrin.
Anthion. Potassium persulphate.
Anthos (Flores or Herba). Rosemary (flowers or herb).
Anthrakokali. Coal treated with caustic potassa.
Anthrarobine. Dioxyanthranol. Leucoalizarin. (Antiseptic dermic.)
Antidotum Fuchsi. Hydrated ferric oxide (Arsenic antidote).
Antifungin. Magnesium borate.
Antihypo. Potassium percarbonate.
Antimonine. Antimony lactate.
Antimonium Album. Bismuth.
Antimony, Diaphoretic. Potassium antimonate.
Antimony, Needles. Antimony sulphide.
Antisepsin. Monobromacetanilid. Paramonobromphenylacetamide.
Antiseptol. Cinchonine iodosulphate.
Ant Oil, Artificial. Furfural.
Antlia Gastrica. Stomach pump.
Apple Oil. Amyl valerate.
Apyonin. French designation for yellow pyoktanin. (Antiseptic.)
Apyrothium. Sulphur.
Aqua Adstricta. Ice.
Ærata. Carbonated water.
Æris Fixi. Carbonated water.
Binelli. Creosote water.
Bullientis (Aquæ). Boiling water.
Cerasorum. Diluted bitter almond water.
Coloniensis. Cologne water.
Communis. Common water, tap water.
Crotonis. Water from Croton Lake, New York (that is, hydrant water).
Flava. Yellow wash.
Fluvialis. River water.
Fontana. Spring water.
Fœtida Antihysterica. A distillate from asafetida, galbanum, myrrh, valerian, etc.
Gaseosa. Carbonated water.
Gummosa. Diluted mucilage of gum arabic (about 1 part of gum in 64 of water).
Hydrothionica. Sulphuretted hydrogen water.
Laxativa Viennensis. Compound infusion of senna. (Modified black draught.) (Also known as Elixir Lax. Vien.)
Marina. Sea water.
Artefacta. Artificial sea water.
Maris, Arte Paranda. Artificial sea water.
Metallorum. Mercury.
Mineralis. Mineral water.
Naphæ. Orange flower water.
Nigra. Black wash.
Nivalis. Snow water.
Phagedænica. Yellow wash.
Pluvialis. Rain water.
Pura. Distilled water.
Saturnina. Lead water.
Vitæ. Brandy or whisky.
Aquila Alba. Calomel.
Arcanum Duplicatum. Potassium sulphate.
Argentum Fugitivum. Quicksilver.
Musivum. Mosaic gold. Tin bisulphide.
Vivum. Quicksilver.
Argilla. Clay. (In pharmacy it means alumina.)
Sulphurica Alcalisata. Alum.
Arquebusade. An agreeably smelling vulnerary water, which might be called "compound sage water".
Art Metal. An alloy of copper, tin and lead.

Asa Dulcis. Benzoin.
Asaprol. Calcium salt of betanaphtolalphamonosulphonic acid. (Antiseptic.)
Asbolin. An alcoholic distillate of soot.
Aseptol. Sozolic acid. Orthophenylsulphonic acid (33 per cent aqueous solution).
Astral Oil. Kerosene.
Ater (Atra). Black (Niger).
Atramentum. Black ink.
Indicum (Sinense). India ink.
Auramin. Yellow pyoktanin. (Antiseptic.)
Aureoline. Hair bleach. (A more or less diluted solution of hydrogen peroxide.)
Aurum Musivum (Mosaic Gold). Tin bisulphide.
Axungia. Adeps. (Fat.)
Azurite. Native copper carbonate.

B.

Baker's Ammonia. Ammonium subcarbonate.
Balata. A caoutchouc-like product resembling chicle.
Baldwin's Phosphorus. Calcium nitrate which when heated and exposed to sunlight becomes luminous in the dark.
Balsam, Hungarian. Exudation from Pinus pumilio.
Riga. By distillation from the leaves of *Pinus Cembra.* A thin fluid; odor resembling juniper; properties similar to turpentine.
Sulphur. Sulphurated linseed oil.
Balsamum Arcæi. An ointment of elemi.
Gileadense. Balm of Gilead.
Judaicum. Balm of Gilead.
Nucistæ. An ointment containing the volatile and fixed oils of nutmeg.
Ophthalmicum Rubrum. Ointment of red precipitate.
Saponaceum. Opodeldoc.
St. Yves. Ointment of red precipitate.
Traumaticum. Compound decoction of aloes—also applied to compound tincture of benzoin.
Universale. Ointment of lead subacetate, made with yellow wax and rapeseed oil.
Verum. Balm of Gilead.
Vitæ Hoffmanni. Alcoholic solution of sundry balsamic oils.
Banks Oil. Cod liver oil.
Bannal. Scoparius.
Bardana. Burdock (Lappa).
Barbotine. See Semen Contra.
Barm. Yeast.
Basofor. A trade name for barium sulphate.
Baudruche. Goldbeaters' skin.
Baume de Vie. Compound decoction of aloes.
Bay Salt. Sea salt.
Bell Metal. An alloy of copper and tin.
Bengal Isinglass. Agar.
Benzoic Ether. Ethyl benzoate.
Benzonaphthol. Betanaphthylbenzoate. Betanaphthol-benzoate. (Intestinal antiseptic.)
Benzophenoneid. Apyonin (yellow pyoktanin).
Benzosol. Benzoyl-guaiacol. Guaiacol benzoate (Antitubercular).
Berlin Blue. Prussian blue.
Betel Nut. Areca nut.
Betol. Betanaphthyl salicylate. Betanaphthol salicylate. (Intestinal antiseptic.)
Bhang. Cannabis.
Bicalcic Phosphate. Calcium phosphate dibasic.
Bilis Bovinum. Ox gall.
Bi-Palatinoid. Gelatin capsule divided by a partition, to keep two powders separate until swallowed.
Bitter Chips. Quassia.
Earth. Magnesia.
Root. Gentian.
Salts. Epsom salt.
Sticks. Chirata.
Wood. Quassia.
Bitumen Judaicum. Asphaltum.
Black Balsam. Peru balsam.
Draught. A compound infusion of senna; must not be confounded with "Black Drop".
Drop. Vinegar of opium.
Flux. A mixture of charcoal and potassium carbonate.
Blancard's Pills. Pills of ferrous iodide.
Blanc Fixe. Artificial barium carbonate or sulphate.
de Troyes. Prepared chalk.
Blankit. A proprietary name of a bleaching compound composed of sodium formaldehyde sulphoxylate.
Blue, Berlin. Prussian blue.
Black. A name for ivory-black.
Chinese. Prussian blue.
Copperas. Copper sulphate.
Bluestone. Copper sulphate.
Bolus Alba. Kaolin.
Armenia. Armenian bole.
Bone Ash. Crude calcium phosphate.
Char. Animal charcoal.
Borax, Red. Red oxide of mercury.
Bran Oil. Furfural.
Brass, An alloy of copper and zinc.
Brassil. Pyrites.
Brasium. Malt.
Brazilian Cacao. Guarana.
Brazil Wax. Carnauba wax.
Bromol. Tribromophenol. (Antiseptic.)
Brucite. Magnesium hydroxide.
Butter Color. Annatto.
of Antimony. Solution of antimony chloride.
of Tin. Stannous chloride.
of Zinc. Zinc chloride.
Butylhypnal. Butylchloral-antipyrin.
Butyrum Majoranæ. Ointment of sweet marjoram.
Nucistæ. Expressed oil of nutmeg.

Byne (Bynin). Apparently a favorite name in England for malt and malted preparations.

C.

Caffa. Camphor.
Calcined Plaster. Plaster of Paris.
Calcitea (calcitrea). Sulphuric acid.
Calcithos. Copper subacetate.
Calcium Phosphide. Phetophor.
Calomelanos. Calomel.
Calx Bismuthi. Bismuth subnitrate.
Viva. Quicklime.
Camphor Julep. Camphor mixture.
Tonka Bean. Coumarin.
Canadol. Petroleum ether.
Cancrorum Lapilli. Crabs' stones.
Chelæ. Crabs' claws.
Candelæ Fumales. Fumigating pastilles.
Capita Papaveris. Poppy-heads.
Carbon Black. The soot of natural gas.
Carborundum. Artificial silicon carbide, an abrasive.
Cashoo. Extract of cutch.
Cassius's Purple. A compound of tin with gold oxide.
Celanese. Cellulose acetate.
Cera Sigillata. Sealing wax.
Cerate, Compound Camphor. Camphor ice.
Ceratum Citrini (P. L. 1745). Resin cerate.
Epuloticum (P. L. 1745). Ceratum calaminaris. Turner's cerate.
Galeni. Cold cream.
Labiale. Lip salve.
Lithargyri Acetati Compositum. Goulard's cerate. (P. L. 1787.)
Ceruse. Lead carbonate.
Ceresin. Earth-wax. An impure paraffin.
Cerussa Acetata. Acetate of lead.
Chalcanthum. Copperas.
Charlton White. Lithopone.
Charpie. Lint.
Chelen (Kelene). Ethyl chloride. (Local anesthetic.)
Chemick. A cold dilute solution of chlorinated lime (in textile industry).
China Oil. Balsam Peru.
Chinese Blue. Prussian blue.
Red. Vermilion.
White. Zinc oxide.
Chinium. Quinine.
Chloral Carmine. Staining fluid. Heat 0.05 Gm. carmine, 20 cc. dehydrated alcohol and 30 drops HCl (sp. gr. 1.124) for half an hour on water bath, add 25 Gm. hydrated chloral, and filter.
Choke-damp. A mixture of CO_2 and CO in mines.
Chrome Yellow. Lead chromate.
Chrysotile. Fibrous serpentine—a variety of asbestos.
Christia. Manila paper made waterproof with chrome gelatin.
Chymosin. Pepsin.
Cibus Deorum. Asafetida.
Cina Flores. Santonica.
Cineres Clavellati. Crude potassium carbonate.
Cinnabar (Vermilion). Mercuric sulphide.
Coal-Tar Naphtha. Benzol.
Codoil. Rosin oil.
Coffee, Soudan. Kola.
Cognac. Brandy.
Colcothar. Crude ferric oxide.
Colla Piscium. Isinglass.
Comitissæ Palmæ Pulvis. Magnesium carbonate.
Collaurin. Colloidal gold.
Conchinine (of the German chemists). Quinidine.
Condy's Fluid. A solution of potassium permanganate similar to Liquor Potassii Permanganas B. P., containing 1 per cent of the salt in aqueous solution.
Confectio Cardiaca. Aromatic chalk powder.
Damocratis. *Damocrates' confection.* An aromatic astringent confection containing opium. Originally it contained 64 ingredients.
Connecticut Lead. Barytes.
Constant White. Barium sulphate.
Copra. The dried meat of the coconut.
Corn Sugar. Dextrose.
Cornu Cervi. Hartshorn. Ammonium carbonate.
Cervi Ustum Nigrum. Bone-black.
Cremor Tartari. Cream of Tartar.
Crocus Martis. Ferric oxide.
Metallorum (Antimonii). Brown antimony oxide.
Saturni. Red lead.
Crow Fig. Nux vomica.
Cryst Alba. Refined naphthalene. (Disinfectant.)
Crystalli Tartari. Cream of tartar.
Crystallose. Soluble saccharin.
Crystals of Venus. Cupric acetate.
Cuca. Coca.
Cullet. Broken glass for remelting.
Cuprum Scoriatum. Crude copper acetate. (Verdigris.)
Cutch. Dark (black) gum catechu.
Cyanegg. A proprietary form of egg-shaped lumps of sodium cyanide.
Cyanfran. A proprietary form of granular sodium cyanide.
Cynosbatæ. See Hips.

D.

Dactyli. Dates.
Dagutt. See Daggett, Oil of.
Decoctum Album. A kind of chalk mixture.
Diaphoreticum. Compound decoction of guaiacum.
Lignorum. Compound decoction of guaiacum wood.
Zitmanni. Compound decoction of sarsaparilla.
Degras. Crude wool fat.
Denver Mud. Cataplasm of kaolin.
Derosne's Salt. Narcotine.

Diabolus Metallorum. Tin.
Diacodium. Poppy-heads. (Old name for syrup of poppies.)
Diagrydium. Scammony.
Diana. Silver.
Diapente. A tonic powder, or electuary, composed of 5 ingredients.
Dilapsus. As an adjective to several salts means effloresced.
Dioxytoluene. Orcin.
Dipterix. Tonka bean.
Draco Mitigatus. Calomel.
Drumstick. Cassia fistula.
Dulcin. A new sweetening agent. Paraphenetolcarbamid. (Sucrol.)
Dutch Drops. Haarlem oil.
Liquid. Oil. The chloride of olefiant gas.
Dutch Metal. A cheap imitation of gold leaf made of copper and zinc.
Tea. A variety of St. Germain tea. (Laurent.)
White. White lead.

E.

Earth, Japan. Catechu.
Nut. Peanut.
Wax. Ceresine.
Eau de Broccherai. Creosote.
Luce. Aromatic spirit of ammonia.
Rabel. See Elixir, Haller's.
Ebur Ustum. Bone-black.
Egyptian Privet. Henna.
Eikonogen. Sodium salt of the amidobetanaphtholbetamonosulphonic acid. (For photographic purposes.)
Electrolon. Artificial silicon carbide, an abrasive.
Electrum. Amber. Also applied to a natural alloy of gold and silver—containing approximately 40 per cent of silver.
Electuarium. Confection. (Soft.)
Dentifricium. Tooth paste.
Elephant Louse. The nut of cashew.
Elixir Adjuvans. The U. S. P. elixir of glycyrrhiza.
Anisi. Aniseed cordial.
Aperitivum. Compound tincture of aloes.
Aurantiorum Compositum. A compound elixir of orange peel and gentian.
Corrigens. Aromatic elixir of yerba santa.
Daffy's. Compound tincture of senna.
Garus. Mixture of syrup with an alcoholic distillate of aloes and spices.
Haller's. 3 parts alcohol and 1 part sulphuric acid, mixed slowly.
of Long Life. A modification of the well-known Swedish Bitters.
ad Longam Vitam. Elixir of Long Life.
Pectorale. Compound ammoniated elixir of liquorice with oils of fennel and anise.

Elixir Proprietatis (Paracelsi). Compound tincture of aloes and myrrh.
Purgans. Compound tincture of jalap.
Rhei Darelii. Tinctura rhei dulcis.
Roborans Whyttii. Compound tincture of cinchona (containing safron).
Salutis. Compound tincture of senna.
Stomachic. Stoughton's. Compound tincture of gentian.
Viscerale. Compound tincture of orange peel and gentian.
Vitrioli Mynsichti. Aromatic sulphuric acid.
Emerald green. Copper acetoarsenite, or copper arsenite.
Emplastrum Cantharidum Perpetuum. A mild cantharidal plaster.
Fuscum. Mother plaster. Universal plaster. Brown salve.
Gummosum. Compound plaster of galbanum.
Emulsio Communis. Mistura amygdalæ.
English White. Calcium carbonate.
Ens Martis. Ammoniated iron.
Essence (French). Volatile oil.
of Mirbane. Nitrobenzol. (Artificial oil of bitter almonds.)
of Vinegar. Concentrated acetic acid.
Essentia Bina. Caramel.
Ether, Pyroacetic. Acetone.
Éthérolat, Éthérolaturé, Éthérolé (French). Correspond to the alcoholic terms. (See Alcoolat, etc.)
Eucasin. A compound of casein and ammonia.
Exalgin. Methylacetanilid. Methylphenylacetamide. (Anodyne.)
Expectorant, Stokes'. Senega and squill cough mixture with ammonium carbonate.
Extractum Catholicum. Compound extract of rhubarb.
Martis Pomatum. Crude iron malate in the form of extract.
Panchymagogum Crollii. Compound extract of rhubarb. (Rhubarb, aloes, jalap, soap.)
Eyestones. Crabs' eyes.

F.

Faba Porcina. Suilla. The fruit of Hyoscyamus niger.
Purgatrix. Castor oil bean.
Fæcula. Starch. (Amylum).
Farina Hordei Præparata. Barley flour heated in a steam bath for about thirty hours.
Ferri Scobs. Iron filings.
Ferro Pagliari. Solution of ferrous chloride.
Silicon. An alloy of iron and silica used in metallurgy.
Ferrugo. Iron rust.
Ferrum Alcoholisatum. Finely powdered iron, which is not the same as reduced iron.
Limatum. Iron filings.

Ferrum Pomatum (extract, tincture, etc.). Iron malate.
Fire-damp. Methane.
Fixed Air. Carbon dioxide.
Flake Lead. Lead carbonate.
White. Carbonate of lead.
Flea Seeds. Seeds of Nigella.
Wort. Psyllium seeds, used in chronic constipation.
Florence Oil. Olive oil.
Flores Antimonii. Antimony sesquioxide.
Benzoes. Benzoic acid.
Bismuthi. Bismuth oxide.
Martis. Ferric chloride.
Zinci. Zinc oxide.
Flos Æruginis. Copper acetate.
Salis. Sodium subcarbonate.
Flowers of Antimony. Oxide of antimony.
of Benjamin. Benzoic acid.
of Zinc. Oxide of zinc.
Fluorol. Sodium fluoride.
Fluor Spar. Calcium fluoride.
Flystone. A mixture of cobalt and arsenic.
Fool's Gold. Pyrites.
Formol. Formaldehyde.
Formylum Chloratum. Chloroform.
Fossil Alkali. Sodium Carbonate.
Flour. Kieselguhr.
Wax. Ozokerite.
Fossiline. Similar to petrolatum, vaseline, etc. Vaseline.
Frankincense. Olibanum.
Fraude Reagent. Acid perchloric.
Freezing Salt. Calcium chloride.
Freezine. A name applied to formaldehyde illegally used as a milk preservative.
French Polish. An alcoholic solution of shellac.
White. Pulverized talc.
Fuligokali. An alkaline solution of soot evaporated to dryness.
Fructose. Levulose.
Fruit Sugar. Levulose.
Furol. Furfuraldehyde (Furfural).
Furfur. Bran.
Fustic, Old. The wood of Morus tinctoria.
Young. The wood of Rhus cotinus.

G.

Galactic. Lactic.
Galena. Lead sulphide.
Gallacetophenone. Methylketotrioxybenzol. Methylketotrioxybenzene. Trioxyacetophenone. Alizarin-yellow "C".
Gallein. Coal-tar color. Used as an indicator.
Gallipoli. An impure olive oil used in the textile industries.
Gallobromol. Dibromogallic acid.
Gamene. Madder.
Gannal's Solution. Solution of aluminum acetate.
Garantose. Saccharin.
Gas Black. Lampblack.
Gentian, White. A German rural domestic medicine, which is dried white dog-dung.
German Silver. An alloy of zinc, nickel and copper.
Germantown Black. Lampblack.
Glacies. Ice.
Mariæ. Isinglass-stone; Muscovy glass. (A variety of calcium sulphate.)
Glandes Quercus (Tostæ). Acorns. (Acorn coffee.)
Glass Gall. The scum forming on the surface of melting glass.
of Antimony. Vitrified antimony oxide.
Globuli Martiales. A crude iron tartrate in the form of balls or marbles.
Glutol. Formaldehyde gelatin.
Glycerolé (French). Liquid glycerin preparations.
Glyceryl Borate. Boroglyceride.
Gommeline. Crude dextrin.
Grains d'Avignon. French berries (Rhamnus infectorius).
Grains of Paradise. The pungent seed of Amomum melegueta.
Griffith's White. Lithopone.
Guano. The dried excrement of sea fowl.
Guaza. Cannabis.
Guhr. Kieselguhr.
Guinea Grains. Grains of Paradise.
Gum Barbary, Brown. Acacia.
Benjamin. Benzoin.
Dragon. Tragacanth.
Thus. Frankincense. Sometimes applied to turpentine oleoresin.
Gummi Elasticum. India rubber.
Guttæ (Gutti). Gamboge.
Rubrum Gambiense. Kino.
Scorpionis. } Gum arabic.
Thebaicum. }
Gunjah. Cannabis Indica.
Guru. Kola.
Gypsum. Plaster of Paris.

H.

Hæmatite. Iron ore, bloodstone.
Halite. Rock salt. Sodium Chloride.
Halowax. A proprietary name for a non-inflammable chlorinated naphthalene.
Hamburg Drops. A kind of "Swedish Bitters".
Tea. Identical with St. Germain tea, differently flavored.
Harmaline. Fuchsine.
Hayo. Coca leaves.
Helcosal. Bismuth pyrogallate.
Hepar. Liver (of sulphur, antimony, lime, etc.).
Antimonii. An impure antimonium and potassium sulphide.
Calcis. Calcium sulphide.
Sulphuris. Potassa sulphurata. "Liver of sulphur".
Hickery-Pickery. Powder of aloes and canella.
Hicra Picra. Same as Hiera Picra.
Hips. The fruit of dog-rose.
Holywood. Guaiacum.

Homberg's Phosphorus. Calcium chloride which when fused and exposed to the sun, becomes phosphorescent in the dark.
Pyrophorus. A mixture of alum and brown sugar, or of potassium sulphide, alumina, and charcoal.
Honey Sugar. Dextrose (misnamed as honey is principally levulose).
Horse Salt. Glauber's salt.
Huxham's Tincture of Bark. Compound tincture of cinchona.
Hydracetine. Acetophenylhydrazine. Pyrodine. Acetylphenylhydrazine.
Hydrargyri Oxymurias. Corrosive chloride of mercury.
Hydrargyrus Calcinatus. Red mercuric oxide.
Muriatus. Corrosive chloride of mercury.
Hydrochrite. Barley water.
Hydrolat (French). A distilled water.
Hydrolé (French). An aqueous solution.
Hydropege. Spring or hydrant water.
Hydrophilous (Hygrophilous) Cotton. Absorbent cotton.
Hypnal. Chloral-antipyrin. Trichloraldehydphenyldimethylpyrazolone. (Hypnotic.)

I.

Ibit. Bismuth oxyiodo tannate.
Ichthyocolla. Isinglass.
Imperial Green. Copper acetoarsenite.
Indian Pink. Spigelia marilandica.
Indicum. Indigo.
Inflammable Air. Hydrogen.
Invar. Ferro-nickel alloy.
Iodo Hydromal. Thymol Iodide.
Iodosol. Thymol Iodide.
Iodothymol. Thymol Iodide.
Iodopyrin. Iodoantipyrin. Antipyrin monoiodide.
Ipado. Coca leaves.
Iron Pyrolignite. Crude ferric acetate liquor used in mordanting.
Issue Peas. Small orange berries, or round pills turned from orris root.
Itrol. Silver citrate.

J.

Jaggery. Crude or raw sugar from the date palm.
Japan Earth. Catechu.
Java Pepper. Cubeb.
Jesuits' Balsam. Copaiba.
Bark. Cinchona.
Drops. Contain guaiacum, sarsaparilla, and Peruvian balsam, also a synonym for compound tincture of benzoin.
Jewelers' Rouge. Ferric oxide made by igniting iron oxalate.
Jews' Pitch. Asphaltum.
Judas's Ear. A fungus of elder-tree. (Exidia.)
Jupiter. An ancient name for tin.
Jusculum. Broth (of beef, veal, turtle, etc.).

K.

Kali Aeratum. Potassium carbonate.
Kalicum Hydras. Fused potassa.
Kefir. A kind of kumyss.
Kelene. Chelen. Ethyl chloride.
Ketopropane. Acetone.
King's Yellow. Yellow arsenic sulphide.
Knock-out-drops. Chloral hydrate.

L.

Lac Magnesiæ. Milk of magnesia.
Virginis. See Virgin's Milk.
Lacca Cœrulea. Litmus.
Musica (Lakmus). Litmus.
Lactin. Sugar of milk.
Lady's Blush. Carmine.
Lamotte's Drops. Ethereal tincture of ferric chloride.
Lanain. Adeps lanæ. Lanolin.
Lanalin. Lanolin.
Lanesin. Lanolin.
Lanichol. Lanolin.
Laniol. Lanolin.
Lana Philosophica. Zinc oxide.
Lapides Cancrorum. Eyestones.
Lapilli Cancrorum. Crab's eyes, crab stones; concretions found in the stomach of the European crawfish.
Lapis Amianthus. Asbestos.
Baptista. Ancient name for talcum.
Calaminaris. Impure zinc carbonate.
Causticus. Potassa. (In sticks.)
Cœruleus. Copper sulphate.
Divinus. Copper aluminate.
Hæmatites. Bloodstone.
Infernalis. Lunar caustic. (Fused silver nitrate.)
Alkalinus. Caustic potash.
Lazuli. Ultramarine.
Ophthalmicus. Eyestones.
Smiridis. Emery.
Lead Flake. Lead carbonate.
Leiocom. Dextrin.
Leipzig Yellow. Lead chromate.
Lenitive Electuary. Confection of senna.
Leucœnus. White wine.
Leucogene. Sodium bisulphite.
Levant Nut. Cocculus Indicus. (Fish berries.)
Lichen Islandicus. Iceland moss.
Life-Everlasting. Gnaphalium polycephalum.
Lignia Nitrica. Gun-cotton.
Lignum Sanctum. Guaiacum wood.
Vitæ. Guaiacum wood.
Lilacine. Terpineol.
Limatura Ferri. Iron filings.
Liquor Anodynus (Hoffmanni). Hoffmann's anodyne.
Cornu Cervi (Liquor C.C.). Solution of ammonium carbonate, containing empyreumatic oil.

Liquor Cornu Cervi Succinatus (Liquor C.C. Succinatus). Solution of ammonium succinate.
Electropœicus. Battery fluid consisting of sulphuric acid and potassium dichromate.
Ferri Oxychlorati. Dialyzed iron.
Fumans Boylii. Ammonium hydrosulphide.
Seriparus. Liquid rennet.
Stypticus Loofii. Solution of ferric chloride.
Lithopone. A pigment consisting of a mixture of barium sulphate, zinc sulphide, and zinc oxide.
Lixivium Saponarium. Liquor potassii hydroxidi.
London Paste. Soda with lime.
Looch Album. An emulsion of almonds and oil of almonds.
Loofah. "Vegetable sponge"; the skeleton of a gourd.
Love-Apple. Tomato.
Luna. Silver.
Lustron. Cellulose acetate.

M.

Magisterium Bismuthi. Bismuth subnitrate.
Coccionellæ. Carmine.
Sulphuris. Washed sulphur.
Magnalium. An alloy of aluminum and magnesium.
Magnesia Alba. Magnesium carbonate.
Nigra. Black manganese oxide.
Mala. Poma (apple).
Manna Metallorum. Calomel.
Manganese, Battery. Manganese dioxide.
Manganin. An alloy principally consisting of copper and manganese.
Marcasit. Metallic bismuth also applied to a form of iron pyrites.
Marine Acid. Hydrochloric acid.
Salt. Sodium chloride, sea salt.
Mars, or Martis. Iron (Tinctura Martis is tincture of iron).
Massicot. Lead protoxide.
Mater Metallorum. Mercury.
Matta. The cortical portion from a variety of millet-seed, used for adulterating pepper.
Maw-Seed. Poppy-seed.
Meadow Saffron. Colchicum.
Meconium. The juice of the poppy.
Medulla Bovis. Ox-marrow.
Lactis. Butter.
Sassafras. Sassafras pith.
Mel Ægyptiacum. Liniment of copper.
Melagueta Pepper. Grains of Paradise.
Meleguette Pepper. Grains of Paradise.
Melanosmegma. Soft (green) soap.
Mephite of Soda. Impure sodium carbonate.
Mercurius Dulcis. Calomel.
Præcipitatus Albus. A name for calomel.
Mortis. / **Vitæ.** } Antimony oxide.
Mercury, Hahnemann's Soluble. Black mercury oxide.
Chloramide. Ammoniated mercury.
Coagulated. Red oxide of mercury.
Metal, Fusible. An alloy melting below 100° C. used in safety sprinklers, fusible plugs and castings of perishable objects. Usually consisting of lead, tin and bismuth.
Monel. An alloy of nickel, copper, cobalt and iron.
Methacetine. Paraacetanisidine. Paraoxymethylacetanilid. Acetylmethylparamidophenol. (Antipyretic.)
Methanilid. Exalgin.
Metheglin. Honey wine. Mead.
Methonal. Dimethylsulphonedimethylmethane.
Methylacetal. Acetone.
Methyl Benzol. Toluol.
Theobromine. Caffeine.
Metol. Salt of monomethylparaamidometacresol (for photographic uses).
Metopium. Expressed oil of almonds.
Metozin. Antipyrin.
Metpozin. Antipyrin.
Metrenchyta. Vaginal injection; sometimes a vaginal syringe.
Mica Panis. Bread crumb.
Microcidin. Sodium betanaphthol. Sodium betanaphtholate (75 per cent). (Antiseptic.)
Microcosmic Salt. A mixture of sodium and ammonium phosphates.
Mikozone. Hypnotic and sedative. (A variety of chlorodyne.)
Milk of Sulphur. Precipitated sulphur. (Strictly only that precipitated by sulphuric acid.)
Virgin's. Rose water rendered milky by the addition of tincture of benzoin.
Mineral Gum. Soluble glass; sodium or potassium silicate.
Mineral Wax. Ceresin or ozokerite.
Wool. Asbestos. Also applied to an artificial product made from slag or lava spun into fine threads.
Minium. Red lead.
Græcorum, Minium Purum. Red mercuric sulphide.
Mirabilite. A naturally occurring form of crude Glauber's salt.
Miraculum Chemicum. Magnesium carbonate.
Mithridate. See Confectio Damocratis.
Mistura Acaciæ. Mucilage of gum arabic of variable strength.
Oleoso-Balsamica. An alcoholic solution of Peru balsam, oil of amber, and sundry volatile oils.
Mixtura Alba. Compound chalk mixture.
Salina. Potio Riveri. (Effervescent mixture of potassium citrate.)
Solvens. Solution of ammonium chloride with liquorice.

Mixtura Solvens Stibiata. Solution of ammonium chloride with liquorice and tartar emetic.
Mixture, Antidysenteric. Acid camphor mixture.
Dysmenorrhœa. Guaiac mixture with corrosive sublimate.
Mohr's Salt. Ferrous ammonium sulphate.
Mollin. A proprietary name for a potash coconut oil soap.
Molybdos. Lead.
Monel Metal. A non-corroding alloy of nickel, copper, cobalt and iron.
Montau Wax. A waxy substance obtained from European lignite.
Mosaic Gold. Tin bisulphide.
Mountain Fat. Paraffin.
Muride. } Bromine.
Murina. }
Muscus. Moss. (Iceland, Irish, etc.).

N.

Nægelis Solution. Solution of zinc chloro-iodide.
Naphæ Flores (Aqua). Orange flowers (water, etc.).
Naphtha. A volatile solvent.
Coal Tar. Benzene C_6H_6.
Petroleum. Benzin.
Vitrioli. Ether.
Naphthalol. Betol.
Naphthosalol. Betol.
Naphthyl. Naphthol.
Natrium Sodium Natron. Sodium carbonate.
Natro-Kali Tartaricum. Rochelle salt.
Neapolitan Ointment. Mercurial ointment.
Neogale. Fresh milk.
Nichrome. A nickel-chromium alloy.
Nico. Nickel carbonmonoxide.
Nigramentum. Black ink.
Nigrosine. A member of a class of blue or black dyestuffs of coal-tar origin.
Nihil Album. Crude zinc oxide.
Griseum. Zinc oxide.
Nitratine. Sodium nitrate.
Nitre Cake. Acid sodium sulphate.
Rough. Magnesium chloride.
Nitrum Flammans. Ammonium nitrate.
Saturninum. Lead nitrate.
Nix Zinci. Zinc oxide.
Norit. A proprietary name for a form of animal charcoal used in decolorizing.
Nulomoline. A proprietary form of invert sugar.
Number Six. Tincture of capsicum and myrrh. (Hot drops.)
Nux Aromatica. Nutmeg.
Metella. Nux vomica.
Moschata. Nutmeg.
Nucista. Nutmeg.

O.

Ocher or Ochre. An earthy iron oxide, yellow, red or brown, used as a pigment.
Œnanthic Ether. Artificial oil of cognac.
Œsipus. Suint. Impure wool fat.
Oil, "American". Scandinavian for castor oil.
Animal. See Dippel's oil.
Astral. Kerosene.
Banana. Amyl acetate.
of Bay. Oil of laurel berries. (Generally is understood to mean oil of bay rum.)
of Ben (or Behen). Comes from a Moringa, and is not the same as oil of benne, which comes from a Sesamum.
Bone. See Dippel's oil.
of Cassia, Artificial. Cinnamic aldehyde is sometimes sold under this title.
Colza. Oil of rapeseed.
Copra. Coconut oil.
Crude. Petroleum.
Dagget. Empyreumatic oil of birch. (Oil of Russia leather.)
Dippel's. Also called *Dippel's animal oil*, an evil smelling distillate from bones or other animal matter.
of Eggs. By expression from hard-boiled yolks.
Grain. Amyl alcohol.
Hardened. Hydrogenated oils.
of Niobe. Methyl benzoate.
Rock. Petroleum.
Seneka. Crude petroleum.
of Smoke. Creosote.
Sod. Crude wool fat.
Solar. Kerosene.
Swallow. Infused oil of elder flowers.
Sweet. Olive oil.
of Tartar. Solution of potassium carbonate.
Ointment, Black Basilicon. Basilicon ointment with pitch.
Maury's. A compound rhubarb ointment.
Neapolitan. Mercurial ointment.
Troopers'. Mercurial ointment.
Volatile. Volatile liniment.
Oleite. Sodium sulphoricinoleate.
Oleum Animale Fœtidum. Crude oil of hartshorn. Dippel's animal oil.
Anthos. Oil of rosemary.
Betulinum. Empyreumatic oil of birch. (Oil of Russia leather.)
Bubulum. Neatsfoot oil.
Cedræ (de Cedro). Oil of lemon.
Chaberti. Rectified animal oil.
Chamomillæ Citratum. Oil of lemon, distilled over German chamomile.
Cocois. Oil of coconut.
Coctum. Fixed oil (olive oil) infused with the respective herb, etc.
Cornu Cervi (Fœtidum). Crude animal oil.
Fermentationis. Fusel oil.
Juniperi Oxycedri (Empyreumaticum). Oil of cade.
Laurinum. Expressed oil of laurel berries.

Oleum Lumbricorum. Infused oil of earthworms.
Napi. Rapeseed oil.
Nervinum. Neatsfoot oil.
Nucis Moschatæ. Besides the two kinds of oils (volatile and fixed) see also Balsam Nucistæ.
Nucistæ. Expressed or volatile oil of nutmeg.
Omphacinum. Crude olive oil.
Palmæ Christi. Castor oil.
Pear. Amylacetate.
Petræ. Crude petroleum. (Seneka oil.)
Philosophorum. Olive oil distilled over hot bricks.
Portugallicum. Oil of bergamot.
Rusci. Empyreumatic oil of birch. (Oil of Russia leather.)
Tartari per Deliquium. Concentrated solution of potassium carbonate.
Templinum. Oil of pine cones and small branches of Pinus pumilio.
Terræ. Crude petroleum.
Omal. Trichlorphenol.
Opodeldoc, Steers's. Solid opodeldoc.
Orellana. Annatto.
Orleana. Annatto.
Orr's White. Lithopone.
Oryza. Rice.
Os Sepiæ. Cuttlefish bone.
Oxalium. Potassium binoxalate.
Oxy-di-methyl-chinizin. Antipyrin.
Oxymel Æruginis. Honey with copper acetate.
Oxone. Sodium peroxide.
Ozokerite. Earth-wax; an impure paraffin.

P.

Pack Tong. German silver.
Palacetyrus. Old cheese.
Palsy Drops. Compound tincture of lavender.
Panacea Mercurialis. Calomel.
Panchymagogum Minerale (P. Quercetani). Calomel.
Paraffin Scale. Paraffin.
Paris Black. Animal charcoal.
Green. Copper arsenoacetate.
Yellow. Lead chromate.
White. Calcium carbonate.
Parkesine. Celluloid.
Parodyne. Antipyrin.
Passulæ. Raisins.
Minores. Corinthian raisins. (Grocers' "currants".)
Pearlash. Crude potassium carbonate.
Pearl Moss. Chondrus.
White. Bismuth subnitrate, also bismuth subcarbonate.
Pear Oil. Amyl acetate.
Pental. Trimethylethylene. Betaisoamylene. (Anesthetic.)
Pepperette. Olive pits. (For adulterating pepper.)
Perborin. Sodium perborate.
Permanent White. Barium sulphate.
Permutit. An artificial zeolite used for water softening and purification.
Petrol. Gasoline. Motor fuel.
Petrolene. Asphalt.
Pewter. An alloy of tin and antimony.
Phalaris. Canary seed.
Phenates. Carbolates.
Phenetol. Ethyl phenate.
Phenic Acid. Carbolic acid.
Phenocoll. Amidoacetoparaphenetidine. Glycocoll-paraphenetidine. (Antipyretic.)
Phenolin. Mixture of soap with cresols.
Phenylic Acid. Carbolic acid.
Phenylone. Antipyrin.
Phosgene. Carbonyl chloride.
Photophor. Calcium phosphide.
Photoxylin. Similar to gun-cotton, but made from wood-pulp.
Phyllis Amara. Bitter almond bran.
Pills, Eternal. Pills of metallic antimony, about 15 grains each, which, after use, were recovered from the stools and washed.
Perpetual. See Pills, Eternal.
Pinguedo. Lard.
Pinguoleum. Fixed oil.
Pink Salt. Stannic chloride.
Piperonal. Heliotropin.
Pisselæum Indicum. Petroleum.
Plasma. Glycerite of starch.
Plaster, Diachylon. Lead plaster.
Nuremberg. Brown plaster. Mother plaster.
Plumbago. Black lead. Also a genus of herbs.
Plumbum Album. Tin.
Scytodepsicum. Moist lead tannate.
Plutonium. Barium.
Poison Nut. Nux vomica.
Parsley. Conium.
Tobacco. Hyoscyamus.
Poivrette. Olive pits; adulterant of pepper.
Poma Aurantii (-iorum). Orange buds.
Pompholix. Zinc oxide.
Potassium Chromate (neutral). Yellow potassium chromate.
Hydriodate. Potassium iodide. (Kalium hydro-iodicum of German prescriptions.)
Hyperoxymuriate. Potassium chlorate.
Rhodanate. Potassium sulphocyanide (-cyanate).
Potato Spirit. Fusel oil.
Potstone. Talc.
Potpourri. Fumigating species, chiefly flowers, generally preserved with salt.
Powder, Digestive. Compound powder of pepsin.
of Algaroth. Antimony oxide.
Précipité Blanc (French). This, in French prescriptions, for internal use, is calomel (by the wet process), and for external use it generally means white precipitate.
Preparing Salt. Sodium stannate.

Preservaline. A proprietary name applied to a line of food preservatives consisting of formaldehyde, sulphites, borax, etc., all of which are illegal.
Preston's Salts. Ammonium carbonate.
Propanone. Acetone.
Propenal. Acrolein.
Prussian Blue. Ferric ferrocyanide.
Pudding Pipe. Cassia fistula.
Stick. Cassia fistula.
Pulvis Ærophorus. Effervescing powder. (Soda, Seidlitz.)
Albus Romanus. Magnesium carbonate.
Diatragacanthæ. Starch, liquorice root, gum arabic, and sugar.
Digestivus. Rhubarb, saltpetre, and cream of tartar.
Gummosus. See Pulvis Diatragacanthæ.
Infantum. When for internal use: magnesia and rhubarb, with oil of fennel. When for external use: baby dusting-powder.
Jacobi. Antimonial powder.
Puerorum. See Pulvis Infantum (internal use).
Purple of Cassius. Gold precipitated from solution by tin chloride.
Purple Oxide. Ferric oxide.
Putty. A plastic mixture of whiting and linseed oil used by painters and glaziers.
Powder. Polishing substance. Tin oxide.
Putz Pomade. A polishing ointment, containing ferric oxide, and probably pumice-stone.
Pyracine. Antipyrin.
Pyrene. A fire extinguishing fluid consisting of carbon tetrachloride.
Pyroalcohol. Methyl alcohol.
Pyrodine. Acetophenylhydrazine. Hydracetin. Acetylphenylhydrazine.
Pyrœnus. Alcohol.
Pyrophorus. A mixture of certain substances which ignite spontaneously when exposed to the air.

Q.

Quaker Button. Nux vomica.
Quaker's Black Drop. Vinegar of opium.
Quassation. In pharmacy, the act of reducing roots and tough barks to morsels.
Quickwater. Solution of mercuric nitrate.

R.

Radical Vinegar. Glacial acetic acid.
Radumine. A proprietary name for a synthetic form of oxalic acid.
Raisins, Corinthian. Grocers' currants.
Ramenti Ferri. Iron filings.
Realgar. Red arsenic sulphide.
Red Cerate. Calamine cerate.
Reddle. Red chalk.
Red Liquor. Aluminum acetate solution.
Oil. Crude oleic acid.
Tartar. Argols.
Regulus (Antimonii, etc.). The pure metals, when separated by fusion.
Resina Elastica. India rubber.
Empyreumatica Liquida. Tar.
Empyreumatica Solida. Pitch.
Flava. Rosin. (Colophony.)
Pini. Turpentine (solid, hard).
Retinol. Rosin oil. Rosinol.
Rex Metallorum. Gold.
Rizine. Rice, partially acted upon by superheated steam.
Rob (Roob). Inspissated juice (of elderberries, carrot, juniper berries, etc.).
Rock Crystal. Quartz—SiO_2.
Salt. Native sodium chloride.
Roman Vitriol. Copper sulphate.
Rongalite. A proprietary name for a bleaching compound composed of sodium hydrosulphite.
Rottenstone. Tripoli.
Rose Pink. Whiting colored with decoction of Brazil wood and pearl ash.
Rosinol. Rosin oil.
Rouge. Red ferric oxide.
Rubigo Ferri. Iron-rust.
Rubramentum. Red ink.
Ruddle. A kind of red chalk. Reddle.
Rufus's Pills. Pills of aloes and myrrh.

S.

Sacchari Fœx. Molasses.
Saccharolé (French). Any moist liquid preparation (except syrup) which contains sugar in large proportions.
Saccharum Acerinum. } Maple sugar.
Canadense. }
Candum (Candisatum). Rock candy.
Saturni. Sugar of lead.
Sacred Elixir. Compound tincture of rhubarb.
Saffron, American. Safflower.
Saim. Adeps.
Sal Absinthii. Potassium carbonate.
Acetosellæ. Potassium oxalate. (Generally oxalic acid is expected.)
Æratus. Potassium bicarbonate, usually applied at present to sodium bicarbonate.
Alembroth. A mixture of mercuric and ammonium chlorides.
Amarum. Magnesium sulphate.
Ammoniacum Martiale. Iron ammoniochloride.
Ammoniacum Secretum Glauberi. Ferrous sulphate.
Ammoniacum Volatile. Ammonium carbonate.
Anglicum. Magnesium sulphate.
Antihystericum. Potassium acetate.
Argenti. Silver nitrate.

Sal Armeniacum. Ammonium chloride.
Artis. A mixture of mercuric and ammonium chlorides.
Benjamin. } Benzoic acid.
Benzoin. }
Catharticus Amarus. Magnesium sulphate.
Catharticus Anglicanus. Magnesium sulphate.
Catharticus Glauberi. Sodium sulphate.
Chalybis. Iron sulphate.
Communis. Sodium chloride.
Culinaris. Sodium chloride.
Cornu Cervi. Ammonium subcarbonate.
de Duobus. Potassium sulphate.
Diureticus. Potassium acetate.
Enixum. Potassium bisulphate.
Essentiale Tartari. Tartaric acid.
Febrifugum. Potassium acetate.
Fossilis. Sodium chloride.
Fuliginis. Ammonium carbonate.
Gemmæ. Sodium chloride.
Lactis. Milk sugar.
Magnesia Vitriolata. Magnesium sulphate.
Marinum. Sea salt.
Martis. Ferrous sulphate.
Microcosmicum. Salts of urine.
Mirabile Glauberi. Sodium sulphate.
Nitrum. Potassium nitrate.
Ossium. Ammonium carbonate.
Panchrestum. Potassium tartrate.
Perlatum. Sodium phosphate.
Petræ. Potassium nitrate.
Polychrestum Seignetti. Rochelle salt.
Polychrestus. Potassium sulphate.
Glaseri. Potassæ sulphas cum sulphure.
Prunella. Potassium nitrate fused.
Rupellensis. Rochelle salt.
Sapientiæ. Sal alembroth.
Saturni. Lead acetate.
Scientiæ. Sal alembroth.
Sedativus Hombergi. Boracic acid.
Sedlicensis. Magnesium Sulphate.
Sennerti. Potassium acetate.
Seydschutzense. Magnesium sulphate.
Soda. Ordinary crystallized washing soda or sodium carbonate.
Succini. Succinic acid.
Tartari. Potassium carbonate.
Essentiale. Tartaric acid.
Thermarum (Carolinarum). Carlsbad salt.
Urinæ. Sodium phosphate.
Vegetabile. Potassium tartrate.
Vitæ. Sal alembroth.
Vitrioli. Zinc sulphate.
Vitrioli Narcoticum. Boracic acid.
Volatile. Ammonium carbonate.
Volatile Liquid. Ammonia water.
Vomitorium Vitrioli. Zinc sulphate.
Salamander's Blood. Fuming nitric acid.
Salmiac (German). Ammonium chloride.
" Salts ". Usually Epsom salt.
Salt Cake. Crude acid sodium sulphate obtained as a by-product in chemical industries.
Fruit. A variety of Seidlitz (or Seltzer) aperient.
Herapath's. Quinine iodosulphate.
of Mars. Ferrous sulphate.
Microcosmic. Sodium and ammonium phosphate.
Mordant. Tartar emetic.
of Saturn. Lead acetate.
Seignette. Rochelle salt.
Sore-Throat. Sal prunellæ.
of Tartar. Pure potassium carbonate.
of Tin. Tin chloride.
Salzburg Vitriol. Copper sulphate.
Sand Acid. Acid hydrofluosilicic.
Sandiver. See Glass Gall.
Sandyx. Red lead oxide.
Sapo Medicatus. A good quality of neutral white Castile soap.
Satin Spar. Gypsum.
Saturatio. Solution of sodium citrate.
Saturnus (Saturni). Lead.
Saxin. Saccharin.
Schweinfurth's Green. Copper arsenite.
Scotch Soda. Crude sodium carbonate.
Sea-Onion. Squill.
Sebum (Sevum). Suet. Tallow.
Seignette's Salt. Rochelle salt.
Selenite. Gypsum.
Semen Contra. Wormseed from Barbary.
Cynæ. Santonica. Levant worm-seed.
Sanitum. The seed of Artemisia santonica.
Semencina. Levant wormseed. (Santonica.)
Semina Strychni. Nux vomica.
Sepia. Cuttle fish bone.
Sepiolite. Meerschaum.
Sericose. Cellulose acetate.
Serum (Lactis, etc.). Whey (milk, etc.).
Shikimol. Safrol.
Sideros. Iron.
Silex. Quartz.
Siliqua Dulcis. St. John's bread.
Silocel. A proprietary form of kieselguhr used for heat insulation.
Slag Wool. Mineral wool.
Sludge Acid. Spent sulphuric acid in chemical industries.
Smalt. A potash cobalt glass, used as a pigment and in ceramics.
Sod Oil. Degras.
Soilime. A lime containing residue of the cyanimide industry, used in agriculture.
Sol. Gold.
Soluble Glass. Sodium silicate.
Solvin. See Polysolve.
Spanish White. Bismuth subnitrate, also calcium carbonate.
Sparadrap. Spread adhesive plaster
Spadium Stearite. Zinc oxide.
Spathum Fluoricum. Fluor-spar.
Spelter. Zinc.
Speltrum. Zinc.

Sperma Mercurii. Mercury acetate.
Spiegeleisen. Ferromanganese alloy.
Spina Cervina (Baccæ, etc.). Buckthorn berries, etc.
Spirit of Nitre. Crude nitric acid.
Pyro-Acetic. Acetone.
of Salt. Crude muriatic acid.
of Turpentine. Oil of turpentine.
Spiritus. See also Liquor.
Inflammabilis. Alcohol (sometimes whisky).
Juniperi. Generally gin.
Lethalis. Carbonic acid.
Mindereri. Solution of ammonium acetate.
Muriatico-Æthereus Martiatus. Tinctura ferri chloridi ætherea.
Nitri Dulcis. Sweet spirit of nitre.
Duplex.
Fumans.
Glauberi.
} Nitric acid.
Nitrico-Æthereus. Sweet spirit of nitre.
Odoratus. Cologne.
Pyroxylicus. Methylic alcohol.
Sacchari. Rum.
Salis Fumans. Muriatic acid.
Sulphurico-Æthereus. Spirit of ether. (Hoffmann's drops.)
Veneris. Acetic acid.
Vitrioli. Diluted sulphuric acid.
Vitrioli Dulcis. Hoffmann's anodyne.
Spodium. Crude bone charcoal. (Ivory-black.)
Stannum Cinereum.
Glaciale.
} Bismuth.
Indicum. Zinc.
Starch Gum. Dextrin.
Steatite. Talc.
Steel Drops. Tincture ferric chloride.
Mixture. Mistura ferri composita.
Tincture. Tincture ferric chloride.
Stibio-Kali Tartaricum. Tartar emetic.
Stibium. Antimony.
Stipites Dulcamaræ. Dulcamara.
Storax Calamita. Solid storax. (Generally sawdust or residue of cinchona preparations mixed with liquid storax.)
Strike. Ammonia water.
Stypteria. Alum.
Styracol. Guaiacol cinnamate. Cinnamyl-guaiacol. (Antiseptic.)
Styrone. Cinnamyl alcohol.
Succata. "Citron" of the grocers.
Succinum (Oleum, etc.). Amber. (Oil, etc.)
Succolata. Chocolate.
Sucrol. Paraphenetolcarbamide. (Sweetener.)
Sugar Color. Caramel.
Suffitus. Fumigation.
Sugar Sand. Crude milk sugar.
Suint. Œsipus. Impure wool fat. (Antiseptic.)
Sulphas Americanus Australis. Quinine sulphate.
Sulphur Antimoniatum Fuscum. Precipitated sulphuret of antimony.
Auratum. Golden sulphur. (Antimony sulphide.)
Nigrum. Impure native sulphur.
Stibiatum Rubrum (Rubeum). Kermes mineral, antimony, sulphide and oxide.
Vivum. Impure native sulphur.
Sweet Oil. Olive oil.
Syrup, Cuisinier. Compound syrup of sarsaparilla.
Syrupus Balsamicus. Syrup of Tolu.
Communis. Molasses.
Diacodii. Syrup of poppy-heads.
Empyreumaticus. Molasses.
Fuscus. Molasses.
Hollandicus. Molasses.

T.

Tabloids. Trademark applied to compressed and other goods, etc. Burroughs, Wellcome & Co., London.
Tachiol. Silver fluoride.
Tailed Pepper. Cubeb.
Tartarus. Crude potassium bitartrate (argols). Then, several potassium salts.
Boraxatus. Potassium and sodium borotartrate.
Natronatus. Rochelle salt.
Tartarisatus. Potassium tartrate.
Vitriolatus. Potassium sulphate.
Terebinthina Cocta. Turpentine (hard, solid).
Terpilenol. Terpineol.
Terra Alba. Variously applied to barium sulphate, clays and other heavy white mineral products.
Blanche. Whiting. Crude calcium carbonate.
Cariosa. Rottenstone.
Foliata. Sulphur.
Mineralis. Impure sodium carbonate.
Tartari. Potassium acetate.
Fullonica.
Fullonum.
} Fuller's earth.
Japonica. Catechu.
Ponderosa. Natural barium sulphate.
Sigillata (Alba, Rubra). White and red bole.
Thebaicum. Containing opium.
Theriaca. Molasses.
Andromachi. An aromatic astringent confection containing opium, which originally had more than 70 ingredients.
Thermit. A mixture of powdered aluminum and iron oxide used in metallurgy and in incendiary war bombs.
Thiolin. Salts of thiosulphonic acid. Salt of thiolinic acid. Sulphonated and sulphurated linseed oil.
Thomas Balsam. Balsam Tolu.

Thymolol. Thymol iodide.
Tincal. Native borax.
Tinctura Hiera. Wine of aloes.
Japonica. Tincture of catechu.
Melampodii. Tincture of black hellebore.
Stomachica. Compound tincture of cardamom.
Thebaica. Tincture of opium.
Tincture, Antacrid. Guaiac mixture with corrosive sublimate.
Antiperiodic. A kind of Swedish bitters with quinine.
Tonquinol. Trinitroisobutyltoluol. Substitute for musk.
Tous-les-mois. Canna starch.
Traumaticine. Solution of gutta-percha.
Treacle. Originally "Theriac". In English prescriptions it means "molasses".
Venice. See Theriaca Andromachi.
Trifolium Fibrinum. Menyanthes. (Buckbean. Bogbean.)
Trimethylamine. Is not exactly the same as propylamine, though often prescribed thus.
Trip. Iron subcarbonate.
Tripoli. A natural friable siliceous rock used for polishing, not the same as kieselguhr.
Tripolite. Kieselguhr.
Turionis Pini. Pine cones.
Turnsol. Litmus.
"Turps". Oil of turpentine.
Tusche. India ink.
Tushy-Stone. A gray zinc oxide.
Tutenag. Zinc oxide.
Tutia. Impure zinc carbonate or oxide.
Tutty. Impure zinc oxide.

U.

Ultramarine. German blue.
Umber. A brown earthy ferruginous material, used as a pigment, either raw or burnt.
Unction. Mild mercurial ointment.
Unguentum Ægyptiacum. Honey with acetate of copper.
Cerussæ Acetatæ (P. L. 1787). Cerate of lead acetate.
Diapompholygos. Ointment of impure zinc oxide.
Myrrhæ. Ointment basis: 1 part of myrrh and 10 parts of wax melted together with oil.
Nervinum. Compound ointment of rosemary.
Ophthalmicum. A mild ointment of mercuric oxide.
Quercinum. Soft (moist) lead tannate.
Unguentum Scytodepsicum. Moist lead tannate.
Urao. Native hydrous sodium carbonate.

V.

Vandyke Brown. A ferruginous earthy pigment.
Vaporole. Trademark applied usually to capsules containing medicaments for inhalation, etc. Burroughs, Wellcome & Co., London.
Vegetable Gum. Dextrin.
Sulphur. Lycopodium.
Venetian Red. An artificial iron oxide used as a pigment.
Vermilion. Red mercuric sulphide.
Venus. Copper.
Crystals of. Copper acetate.
Vienna Powder. Potassa with lime.
Vinegar Naphtha. Ethylacetate.
Salts. Calcium acetate.
Vinum Adustum. Alcohol. (Sometimes brandy.)
Crematum. Brandy.
Virgin's Milk. A mixture of tincture of benzoin and rose water.
Viride Æris. Verdigris. (Crude copper acetate.)
Viscum Album. Mistletoe.
Vitriolum Cupri. Blue vitriol.
Vitriolum Romanum. Blue vitriol.
Vomiting Salt. Zinc sulphate.

W.

Waterglass. Sodium or potassium silicate.
White Cinnamon. Canella.
Copperas. Sulphate of zinc.
Flake. Lead carbonate.
Lead. Lead carbonate.
Liquor. Southern negro term for alcohol.
"Nix". Crude zinc oxide.
Pearl. Bismuth subnitrate or chloride.
Permanent. Artificial barium carbonate or sulphate.

Y.

Yellow Arsenic. Yellow arsenic sulphide.
Precipitate. Yellow mercuric oxide.

Z.

Zaffre. A pigment similar to smalts.
Zinc White. Zinc oxide.
Zootic Acid. Prussic acid.
Zooticum. As adjective to several salts Hydrocyanate.
Zylonite. Celluloid.
Z. Z. Anciently myrrh, now zingiber, Ginger.

CHAPTER CXXVI

GLOSSARY

OF

MEDICAL TERMS[1]

Abortifacient, *ab-or-te-fa'-shent*—Agents which terminate pregnancy.
Absorbents, *ab-sorb'-ents*—Drugs that absorb moisture, wound secretion, or gas.
Absorption, *ab-sorp'-shun*—The process of taking a drug into the general system.
Acidosis, *as-id-o'-sis*—A diminution of the normal alkali reserve of the body.
Acne, *ak'-ne*—Inflammation of the sebaceous glands from retained secretions (pimples).
Acromegaly, *ak-ro-meg'-al-e*—An abnormal development, chiefly of the bones of the face and extremities.
Agglutinin, *ag-glu'-tin-in*—An antibody which acts on bacteria in such a way as to cause them to come together in masses or clumps.
Albuminuria, *al-bu-min-u'-re-ah*—The presence of albumin in the urine.
Allergy, *al'-er-gy*—An altered reaction. A general term applied to various kinds of protein sensitivity.
Alteratives, *awl'-ter-a-tivs*—Agents which in some way alter the processes of nutrition and excretion and thereby are of benefit in many diseases of a chronic type.
Amenorrhea, *a-men'o-re'a*—Suppression of the menstruation.
Anaërobes, *an-a'-er-obs*—Microörganisms which thrive best when deprived of oxygen.
Analgesics, *an-al-je'-siks*—Medicines used to allay pain.
Anaphrodisiacs, *an-af-ro-diz'-e-aks*—Medicines used to allay sexual feeling.
Anaphylaxis, *an-ah-fil-ak'-sis*—A severe manifestation of increased susceptibility to a foreign protein when introduced some time after a primary injection.
Anemia, *an-e'-me-ah*—A deficiency of coloring matter (hemoglobin) of the blood.
Anesthetics, *an-es-thet'-iks*—Medicines used to destroy sensation.
Angina Pectoris, *an'-jin-ah pec'-tor-is*—A form of heart disease, usually accompanied with severe pain in the cardiac region; a sense of oppression.
Angioneurotic, *an-je-o-nu-rot'-ik*—Due to disease or injury to vasomotor nerves or center.
Anodynes, *an'-o-dins*—Medicines used to allay pain.
Antacids, *ant-as'-ids*—Medicines used to neutralize acidity.
Anthelmintics, *an-thel-min'-tiks*—Medicines used to get rid of intestinal parasites.
Antibody, *an'-ti-bod-y*—A substance in blood serum or body fluids which destroys microorganisms, neutralizes toxins, or otherwise counteracts antigens.
Antigen, *an'-te-jen*—In general, any product capable of stimulating the formation of antibodies.
Antihidrotics, *an-te-hi-drot'-iks*—Drugs used to stop sweating.
Antiperiodics, *an-te-pe-re-od'-iks*—Medicines used for the relief of malarial fevers.
Antipyretics, *an-te-pi-rĕt'-iks*—Medicines used to reduce temperature in fevers.
Antiseptics, *an-te-sep'-tiks*—Substances which prevent the development of bacteria.
Antispasmodics, *an-te-spaz-mŏd'iks*—Medicines which prevent or check fermentative processes in the digestive tract.
Aperients, *ah-pe'-re-ents*—Mild cathartics.
Aphrodisiacs, *af-ro-diz'-e-aks*—Substances used to increase sexual feeling.
Apoplexy, *ap'-o-pleks-e*—Paralysis from rupture of a cerebral vessel.
Aromatic Bitters, *ar-o-mat'-ik bit'-erz*—Medicines which unite the properties of the aromatics and the simple bitters.
Aromatics, *ar-o-mat'-iks*—Condiments or spicy, stimulating drugs.
Arteriosclerosis, *ar-te'-ri-o-skle-ro'-sis*—Hardening of the arterial walls.
Arthritis, *ar-thri'-tis*—Inflammation of the joints.
Asthma, *az'-mah*—A disease of respiration, characterized by difficult breathing, cough, etc.
Astringents, *as-trin'-gents*—Medicines used to contract organic tissue.
Atopy, *at'-o-pi*—Literally, a strange disease. A general term referring to conditions of protein sensitivity.

[1] This list is limited to the medical terms employed in this book in describing the uses of drugs.

Attenuate, *at-ten′-u-at*—Lowering of the virulence of microbes so that they can be safely used as a vaccine to confer immunity.
Bacillus, *bas-il′-us* (pl. *bacilli*)—Rod-shaped or elongated bacteria.
Bacteriolysins, *bak-te-ri-o-li′-sins*—Antibodies which destroy bacteria through a digestive or dissolving action.
Bacteriotropins, *bak-te-ri-o-tro′-pins*—Antibodies which make invading bacteria more amenable to phagocytosis.
Bitters, *bit′-erz*—Medicines having a bitter taste and the power to improve appetite, and impart tone to the digestive organs.
Botulism, *bot′-u-lizm*—A type of food poisoning caused by a toxin produced by B. Botulinus.
Bouillon, *boo-e-yon′*—A culture medium for bacteria made from lean beef, peptone, salt and normal sodium hydrate in fixed proportions.
Bright's Disease, *brits′ dis-ēz′*—A rather vague term applied to various diseases of the kidney.
Bronchitis, *bron-ki′-tis*—Inflammation of the bronchial tubes.
Bronchus, *brong′-kus* (pl. *bronchi*)—One of the two main branches of the trachea or windpipe.
Calculus, *kal′-ku-lus*—A stone-like concretion formed in the body.
Cancer, *kan′-ser*—A malignant form of tumor.
Carbuncle, *kar′-bunk-kel*—Circumscribed inflammation of the subcutaneous tissues, similar to a boil, but more extensive and severe.
Cardiac depressants, *kar′-de-ak de-pres′-ants*—Medicines used to lower the heart's action.
Cardiac stimulants, *kar′-de-ak stim′-u-lants*—Medicines used to increase the heart's action.
Carminatives, *kar-min′-at-ivs*—Medicines used to expel flatus (intestinal gas).
Catarrh, *kat-ar′*—Inflammation of a mucous membrane.
Catarrhal, *kat-ar′-al*—Relating to or affected with catarrh or inflammation of a mucous membrane.
Cathartics, *kath-ar′-tiks*—Drugs used to stimulate the movement of the bowels.
Caustics, *kaws′-tiks*—Medicines used to destroy living tissues.
Cerebrospinal, *ser-e-bro-spi′-nal*—Relating to the brain and the spinal cord.
Chalybeates, *ka-lib′-e-āts*—Ferruginous hematinics.
Chlorosis, *klo-ro′-sis*—A form of anemia most common in young women.
Cholagogues, *kol′-a-gogs*—Medicines which promote a flow of bile.
Cholera, *col′-er-ah*—A disease characterized by severe diarrhea, cramps, and prostration. The true *Cholera Asiatica* is caused by a specific germ. The terms *cholera morbus* and *cholera nostras* are applied to any severe diarrhea.
Chorea, *ko-re′-ah* (St. Vitus' Dance)—Involuntary muscular twitching.
Coagulability, *ko-ag-u-la-bil′-i-ti*—The capability of clotting or tendency to clot.
Colic, *kol′-ik*—Spasmodic pain in the abdomen.
Collapse, *kol-aps′*—Marked depression of the vital activities of the body, especially of the circulation.
Complement, *kom′-ple-ment*—A substance in the blood and normal serum resembling a ferment. Acts with the amboceptor (antibody) in causing lysis.
Conjunctivitis, *kon-jungk-tiv-i′-tis*—Inflammation of the mucous membrane of the eye.
Convulsion, *kon-vul′-shun*—Violent abnormal contraction of the muscles; a severe spasm.
Correctives, *ko-rek′-tivs*—Medicines used to correct, or render more pleasant, the action of other remedies, especially purgatives.
Coryza, *kor-i′-zah*—Catarrhal inflammation of the nose.
Counterirritants, *koun′-tĕr-ĭr′-i-tănts*—Drugs which relieve internal disorders by causing external inflammation.
Cycloplegic, *si′-klo-plē′-jik*—Destroying the power of the eye to focus on near objects.
Cystic, *sist′-ik*—Referring to the urinary bladder or gall bladder.
Cystitis, *sis-ti′-tis*—Inflammation of the urinary bladder.
Delirifacients, *de-lir′i-fā′-shĕnts*—Drugs causing delirium.
Delirium tremens, *de-lir-e-um trēmĕnz*—Mental aberration due to alcoholic poisoning.
Demulcents, *de-mul′-sents*—Mucilaginous substances used to soothe and protect irritated mucous membranes or other tissues.
Deodorants, *de-o′-dor-ants*—Substances which destroy or hide offensive odors.
Depilatories, *de-pil′-at-o-res*—Substances used to remove hair.
Depressants, *de-pres′-ants*—Drugs that lower function.
Detergents, *de-ter′-jents*—Medicines used to cleanse.
Detritus, *de-tri′-tus*—The remains of any broken-down tissue.
Diabetes insipidus, *di-ab-e′-tez in-sip′-i-dus*—A disease characterized by an excessive flow of urine.
Diabetes mellitus, *di-ab-e′-tez me-li′-tus*—A disease characterized by an excessive flow of urine containing sugar.
Diaphoretics, *di-af-or-et′-iks*—Medicines which produce sweating.

Diarrhea, *di-ar-e'-ah*—Excessive looseness of bowels.
Digestants, *di-jes'-tants*—Ferments and acids which have power of aiding in the digestion of food.
Diluents, *dil'-u-ents*—Medicines which dilute.
Discutients, *dis-ku'-shents*—Substances which aid in removing swellings.
Disinfectants, *dis-in-fek'-tants*—Substances which combat germs and the noxious properties of decaying organic matter.
Diuretics, *di-u-ret'-iks*—Medicines which increase the secretion of urine.
Dropsy, *drop'si*—An accumulation of fluid in the subcutaneous tissues.
Dysentery, *dis'-en-ter-e*—An infectious inflammation of the lower bowel characterized by bloody evacuations.
Dysmenorrhea, *dis-men-or-e'-ah*—Painful or irregular menstruation.
Dyspepsia, *dis-pep'-se-ah*—Indigestion.
Ecbolics, *ek-bol'-iks*—Medicines which produce contraction of the uterus.
Eclampsia, *ek-lamp'-se-ah*—A convulsive or epileptiform seizure, especially one in which consciousness is not lost.
Eczema, *ĕk'-zē-ma*—An inflammatory disease of the skin with exudation of lymph.
Edema, *e-de'-mah*—Swelling due to accumulation of watery fluid in lymph spaces of tissues
Embrocations, *em-bro-ka'-shuns*—Agents applied externally.
Emetics, *e-met'-iks*—Medicines which cause vomiting.
Emmenagogues, *em-en'-ag-ogs*—Medicines which stimulate menstruation.
Emollients, *e-mol'-yents*—Substances used to soften and protect tissues.
Empyema, *em-pi-e'-mah*—Pus in the pleural cavity.
Endermics, *en-der'-miks*—Relating to the administering of medicines through the skin by rubbing.
Endocarditis, *en-do-kar-di'-tis*—Inflammation of the lining membrane of the heart.
Endometritis, *en-do-me-tri'-tis*—Inflammation of the lining membrane of the uterus.
Enteric fever, *en-ter'-ik fe'-ver*—Typhoid fever.
Enuresis, *en-u-re'-sis*—Incontinence of urine.
Epididymitis, *ep-e-did-im-i'-tis*—Inflammation of the epididymis or excretory duct of the testis.
Epilepsy, *ep'-il-ep-se*—A nervous disease characterized by loss of consciousness, usually accompanied by convulsions, spasms, and foaming at the mouth.
Epispastics, *ep-i-spas'-tiks*—Blistering agents.
Erysipelas, *er-is-ip'-el-as*—An acute specific inflammation of skin and subcutaneous tissues, accompanied by fever and constitutional disturbances.
Erythema, *er-ith-e'-mah*—A superficial rash or redness of the skin.
Escharotics, *es-kar-ot'-iks*—Substances used to destroy pathologic tissue.
Evacuants, *e-vak'-u-ants*—Medicines which evacuate; applied chiefly to purgatives.
Excision, *ek-sizh'-un*—In surgery, any operative removal.
Excitants, *ek-si'-tants*—Drugs which increase functional activity.
Expectorants, *eks-pek'-tō-rants*—Agents used in the treatment of inflammations of the bronchial tract.
Febrifuges, *feb'-rif-ujs*—Medicines which dissipate fever.
Fibrous, *fi'-brus*—Composed of fibers, characteristic of connective tissue.
Flatulence, *flăt'-ū-lĕns*—The presence of gas in the digestive canal.
Focus, *fo'-kus* (pl. *foci*)—The center or starting point of a disease process.
Galactagogues, *gal-ak'-tag-ogs*—Medicines which increase the flow of milk.
Gangrene, *gang'-grēn*—Mortification or death of soft tissue.
Gastritis, *gas-tri'-tis*—Inflammation of the stomach.
Gastro-intestinal—Relating to both the stomach and the intestine.
Germicides, *jer'-mis-īds*—Agents which kill disease germs.
Globulin, *glob'-u-lin*—A protein substance of which several varieties are present in the blood.
Gluteal, *glu'-te-al*—Relating to the muscles of the buttocks.
Glycosuria, *gli-ko-su'-re-ah*—Presence of sugar in the urine.
Gout, *gowt*—A disease associated with joint inflammation, swelling, excessive uric acid in the blood, etc.
Hay fever—A catarrhal inflammation of respiratory mucous membranes due to pollens of certain plants.
Hematinics, *hem-at-in'-iks*—Agents which improve the quality of the blood.
Hemolytic, *hem-o-lit'-ik*—Destructive to blood cells.
Hemophilia, *hem-o-fil'-e-ah*—A tendency to profound hemorrhage due to a defect in coagulating power of the blood.
Hemorrhage, *hem'-or-āj*—A flow of blood from the vessels.
Hemorrhoids, *hĕm'-ŏ-roids*—Piles; small blood tumors at the anal orifice.
Hemostatics, *hem-o-stat'-iks*—Medicines which arrest hemorrhages.

Hydragogs, *hi'-dra-gogs*—Purgatives which cause profuse watery discharges.
Hydrophobia, *hi-dro-fo'-be-ah*—Rabies in man.
Hyperemia, *hi-per-e'-me-ah*—Congestion or excessive amount of blood in a part.
Hypnotics, *hip-not'-iks*—Medicines which cause sleep.
Hypochondriasis, *hi-po-kon-dri'-as-is*—Extreme depression, with morbid anxiety regarding the health.
Hysteria, *his-te'-re-ah*—Functional disturbance of nervous system.
Incision, *in-sizh'-un*—In surgery, the act of cutting into.
Infiltration, *in-fil-tra'-shun*—The permeation or penetration of a substance, cell or tissue by gas, fluid or dissolved matter.
Insecticides, *in-sek'-tis-īds*—Preparations for destroying insects.
Insomnia, *in-som'-ne-ah*—Inability to sleep.
Intradermal, *in-trah-der'-mal*—Intracutaneous or between the layers of the skin.
Intramuscular, *in-trah-mus'-ku-lar*—Within the muscles.
Intrascapular, *in-trah-scap'-u-lar*—Between the shoulder blades or scapulæ.
Intraspinal, *in-trah-spi'-nal*—Between spines. Refers to method of inserting needle between spines of adjacent vertebræ in order to make injection into or withdraw fluid from the spinal canal.
Intravenous, *in-trah-ve'-nus*—Within a vein.
Inunction, *in-ungk'-shun*—The rubbing of medicines into the skin.
Jaundice, *jawn'-dis*—A yellow coloration of the skin due to the absorption of bile into the blood.
Laryngitis, *lar-in-ji'-tis*—Inflammation of the larynx.
Laxatives, *laks'-at-ivs*—Mild cathartics.
Lesion, *le'-zhun*—A more or less circumscribed pathological change in tissues, due to injury or disease.
Leucocytes, *lu'-ko-sīts*—White blood cells.
Leukemia, *lu-ke'-me-ah*—A disease with a marked increase in the number of leucocytes in the blood.
Local Anesthetics, *lo'-kal an-es-thet'-iks*—Medicines which, when applied locally, destroy sensations.
Locomotor Ataxia, *lo'-ko-mo'-tor a-tak'-si-a*—A disease of the posterior columns of the spinal cord, marked by severe pains, incoördination, disturbances of sensations, etc.
Lumbago, *lum-ba'-go*—Pain in the loins.
Lumbar Puncture—The puncture into the spinal canal made in the lower region of the spine about level with the crests of the hip bones.
Lymph, *limf*—A clear fluid circulating in lymph spaces or lymphatic vessels of the body. Also smallpox vaccine lymph.
Lysins, *li'-sins*—A specific antibody which destroys cells and tissues.
Malaise, *mal-az'*—Feeling of general discomfort and uneasiness.
Malaria, *mal-a'-re-ah*—An infectious disease caused by a parasite in the blood.
Meningitis, *men-in-ji'-tis*—Inflammation of the membranes of the brain and spinal cord.
Menorrhagia, *men-or-a'-je-ah*—Excessive menstrual flow.
Microparasites, *mi-kro-par'-a-sits*—Bacterial and protozoön parasites too small to be seen with the unaided eye.
Mydriatics, *mid-re-at'-iks*—Agents which cause dilatation of the pupil.
Myeloma, *mi'-loma*—A tumor of medullary substances.
Myotics, *mi-ot'-iks*—Agents which contract the pupil.
Narcotics, *nar-kot'-iks*—Drugs which stupefy.
Nausea, *naw'-se-ah*—A sensation of sickness at the stomach with a desire to vomit.
Necrotic, *nek-rot'-ik*—Relating to necrosis or local degeneration and death of cells or tissues.
Nephritis, *nef-ri'-tis*—Inflammation of the kidney.
Neuralgia, *nu-ral'-je-ah*—Any painful condition not due to organic disease.
Neurasthenia, *nu-ras-the'-ne-ah*—Exhaustion of nerve force.
Neuritis, *nu-ri'-tis*—Inflammation of a nerve trunk.
Neurotic, *nu-rot'-ik*—A drug affecting the nervous system, or a person affected with nervous disorder.
Nutrients, *nu'-tre-ents*—Nutritious substances or foods.
Obesity, *o-bes'-it-e*—Fatness.
Ophthalmia, *off-thal'-me-ah*—Inflammation of the mucous membrane of the eye.
Opsonins, *op'-so-nins*—Antibodies which promote phagocytosis or the destruction of invading organisms by the white blood cells.
Oxytocics, *oks-e-tos'-iks*—Medicines which stimulate uterine contractions.
Palliatives, *pal'-e-a-tivs*—Agents which relieve but do not cure.
Papule, *pap'-ul*—A small circumscribed elevation of the skin containing no fluid.
Paralysis, *par-al'-is-is*—Complete loss of functional power, especially of muscles.

Parasiticides, *par-as-it'-is-ids*—Agents which inhibit the growth of or kill parasites on the body.
Paratyphoid, *par-a-ti'-foid*—A form of typhoid fever due to an organism closely related to the true Bacillus typhosus.
Parenteral, *par-en'-ter-al*—Introduction of substances into the body in some way other than by the intestinal tract.
Pathogenic, *path-o-jen'-ik*—Producing or causing disease.
Pericarditis, *per-e-kar-di'-tis*—Inflammation of the membranous sac around the heart.
Peristalsis, *per-is-tal'-sis*—The muscular movement of the bowels.
Peritonitis, *per-it-on-i'-tis*—Inflammation of the membrane lining the abdomen.
Phagocytes, *fag'-o-sīts*—White blood corpuscles which possess the property of ingesting and disposing of bacterial cells and foreign particles.
Phagocytosis, *fag-o-si-to'-sis*—The destruction of microbes by the action of phagocytes or cells possessing the property of absorbing.
Pharyngitis, *far-in-ji'-tis*—Inflammation of the pharynx.
Phthisis, *thi-sis, ti'-sis*—Tuberculosis of the lungs, commonly called consumption.
Placebo, *plas-e'-bo*—An inert drug used to satisfy patients.
Plague, *plag*—An acute infectious and epidemic disease due to the Bacillus Pestis.
Plasma, *plaz'-mah*—Fluid portion of the circulating blood and distinguished from serum obtained after coagulation.
Pleurisy, *plu'-ris-e*—Inflammation of the serous membrane covering the lungs.
Polyneuritis, *pol-e-nu-ri'-tis*—An inflammation affecting several nerves.
Polyvalent, *pol-iv'-al-ent*—Applied to serums containing antibodies for several strains of the same species of microörganism or to bacterial vaccines containing several strains of the same species.
Post-abortal, *post ab-ort'-al*—Following abortion.
Precipitins, *pre-sip'-i-tins*—Antibodies which precipitate bacteria of foreign substances.
Prophylactics, *pro-fil-ak'-tiks*—Medicines which prevent the development of disease.
Protectives, *pro-tek'tivs*—Medicines which mechanically protect a part when applied to it
Pruritis, *pru-ri'-tus*—An intense itching.
Pseudopods, *su'-do-pods*—An irregular process or protrusion resembling those of an amœba put forth for locomotion.
Psoriasis, *so-ri'-as-is*—A chronic inflammatory skin disease with scale formation.
Puerperal, *pu-er'-pe-ral*—Pertaining to childbirth.
Purgatives, *pur'-ga-tivs*—Medicines which produce copious discharges from the bowels.
Pustule, *pus'-tul*—Small circumscribed elevation of the skin containing pus.
Pyelitis, *pi-el-i'-tis*—Inflammation of the pelvis of the kidney.
Pyelography, *pi-log'-rah-fe*—X-ray treatment of a renal pelvis and ureter which have been filled with a silver salt solution.
Refrigerants, *re-frij'-er-ants*—Medicines which lessen the bodily temperature.
Restoratives, *re-stor'-a-tivs*—Medicines used to combat depression.
Rheumatism, *rum'-at-izm*—Applied to conditions characterized by pains of the muscles, joints and fibrous tissues.
Rhinitis, *ri-ni'-tis*—Inflammation of the nasal mucous membranes.
Rubefacients, *ru-be-fa'-se-ents*—Medicines which cause irritation and redness of the skin.
Sarcoma, *sar-ko'-mah*—A malignant form of tumor.
Scabies, *ska'-be-ēz*—Itch, a contagious, parasitic skin disease.
Sciatica, *si-at'-ik-ah*—Neuralgia of the sciatic nerve.
Scrofula, *skrof'-u-lah*—A constitutional condition with glandular tumors and a tuberculous tendency.
Scurvy, *skur'vi*—Diseased condition shown by hemorrhages into the skin, due to deficient or improper diet.
Sedatives, *sed'-at-ivs*—Medicines which allay irritability of an organ or nerve center.
Septic, *sep'-tik*—Relating to the presence of various pus forming or other pathogenic bacteria or their products.
Septicemia, *sep-tis-e'-me-ah*—Presence of microörganisms or toxins in the circulating blood.
Sequela, *se'-kwel-ah* (pl. *sequellæ*)—Morbid condition following or resulting from another disease.
Shock, *shok*—Profound depression resulting from severe injury, emotional disturbances, or operation.
Sialogogues, *si-al'-a-gogs*—Medicines which increase the secretion of saliva.
Somnifacients, *som-nif-a'-she-ents*—Drugs which produce sleep.
Soporifics, *so-por-if'-iks*—Medicines which produce sleep.
Spasm, *spazm*—Abnormal contraction of a muscle, or a group of muscles.
Specifics, *spe-sif'-iks*—Medicines which have a direct curative influence on certain individual diseases.

Sternutatories, *ster-nu'-ta-to-res*—Medicines which produce sneezing when applied to the nasal mucous membrane.
Stimulants, *stim'-u-lants*—Medicines which increase functional activity.
Stomachics, *stom-ak'-iks*—Stimulants to the stomach.
Stomatitis, *sto-mat-i'-tis*—Inflammation of the mouth.
Styptics, *stip'-tiks*—Agents which arrest bleeding by their local application.
Sudorifics, *su-dor-if'-iks*—Medicines which produce sweating.
Sycosis, *si-ko'-sis*—An inflammation of the hair follicles.
Syncope, *sin'-ko-pe*—Temporary failure of circulation; fainting.
Teniacides, *te'-ne-as-ids*—Medicines which kill the tapeworm.
Tonics, *ton'-iks*—Medicines which permanently increase the systemic tone by stimulating nutrition. This term is frequently misapplied to stimulants, especially the stomachics.
Trypanosomiasis, *tri-pan-o-so-mi'-as-is*—A diseased condition due to infection of a protozoan parasitic organism, commonly called *African Sleeping Sickness.*
Tuberculosis, *tu-bur-ku-lo'-sis*—A disease caused by the tubercle bacillus.
Ulcers, *ul'-sers*—Open sores on external or internal surfaces of the body with secretion of pus.
Uremia, *u-re'-mi-a*—Toxic condition of the blood from accumulation of substances normally excreted by the kidneys.
Urethritis, *u-re-thri'-tis*—Inflammation of the urethra.
Urticaria, *ur'-ti-ka'ri-ă*—Nettle rash; an ephemeral skin eruption with itching.
Vaccinia, *vak-sin'-e-ah*—Cowpox or eruptive disease occurring in cattle, similar to smallpox in man but milder. Inoculation with the virus confers immunity to smallpox.
Vaginitis, *vaj-in-i'-tis*—Inflammation of the vagina.
Vermicides, *ver'-mis-īds*—Medicines which kill intestinal worms
Vesicant, *ves'-ik-ant*—An agent producing a blister.
Vesicles, *ves'-ik-ls*—Small circumscribed elevations of the skin containing non-purulent fluid.
Virus, *vi'-rus*—The specific microörganism or poison of an infectious disease.
Wheal, *hwel*—A circumscribed elevation of the skin of varying shapes with white or pinkish surface and surrounded by a pink area.
Xerophthalmia, *zer-off-thal'-me-ah*—A dry and thickened condition of the conjunctiva.

NAMES AND ADDRESSES OF MANUFACTURERS

In previous editions of this book, apparatus and preparations were frequently illustrated or referred to without giving the names of manufacturers, with the result that many letters were received asking the sources of supply. The attempt is being made in this edition to remedy this deficiency and where apparatus is illustrated or preparations listed the manufacturer is being named. To make this information more complete the following list of names and addresses is appended solely for information.

Abbott Laboratories	Chicago, Ill.
Abbe Engineering Company, Broadway and Ann Streets	New York, N. Y.
Alsop Engineering Company, 47 West 63rd Street	New York, N. Y.
American Antiformum Company	New York, N. Y.
Arlington Chemical Company	Yonkers, N. Y.
Armour and Company	Chicago, Ill.
Arnold Electric Company	Racine, Wis.
Astier, P., Laboratories (George J. Wallau Inc.)	New York, N. Y.
Bayer Company	Rensselaer, N. Y.
B. B. Culture Laboratory, Inc.	Yonkers, N. Y.
Barker, Herman	Somerville, Mass.
Barnes, A. C., Company	Philadelphia, Pa.
Battle Creek Food Company	Battle Creek, Mich.
Bethlehem Laboratories	Bethlehem, Pa.
Bilhuber, E., Inc.	New York, N. Y.
Borcherdt Malt Extract Company	Chicago, Ill.
Brady, Geo. W., and Company	Chicago, Ill.
Britt, Loeffler and Weil	New York, N. Y.
Burroughs Adding Machine Company	Detroit, Mich.
Burroughs Wellcome and Company	London, Eng.
Calco Chemical Company	Bound Brook, N. J.
Central Scientific Company	Chicago, Ill.
Cereo Company	Tappan, N. Y.
Cheplin Biological Laboratories, Inc.	Syracuse, N. Y.
Chicago Dietetic Supply House	Chicago, Ill.
Chinosol Company	New York, N. Y.
Ciba Company, Inc.	New York, N. Y.
Coleman and Bell Company	Norwood, Ohio.
Coleman Laboratories	Wheeling, W. Va.
Connaught Laboratories, University of Toronto	Toronto, Canada
Cummings, W. L., Chemical Company	Lansdowne, Pa.
Cutter Laboratory	Berkeley, Calif.
Davis and Geck, Inc.	Brooklyn, N. Y.
Deshell Laboratories, Inc.	Los Angeles, Calif.
Diarsenol Company, Inc.	Buffalo, N. Y.
Diaprotein Company	Columbus, Ohio
Druggists Appliance Mfg. Company	Port Richmond, N. Y.
Dry Milk Company	New York, N. Y.
Eastman Kodak Company	Rochester, N. Y.
Fairchild Bros. and Foster	New York, N. Y.
Fritsche Bros., Inc.	New York, N. Y.
General Chemical Company	New York, N. Y.
Gilliland Laboratories, Inc.	Marietta, Pa.
Gradwohl Laboratories	St. Louis, Mo.

Hart, E. J., and Company, Ltd. ..... New Orleans, La.
Heilkraft Medical Company ..... Boston, Mass.
Heyden Chemical Company of America ..... Garfield, N. J.
Hoffmann-LaRoche Chemical Works ..... New York, N. Y.
Hoos, Louis ..... Chicago, Ill.
Howard-Holt Company ..... Cedar Rapids, Iowa
Hynson, Westcott and Dunning ..... Baltimore, Md.

Intarvin Company, Inc. ..... Long Island City, N. Y.
Interstate Chemical Company, 23 East 26th Street ..... New York, N. Y.
Intra Products Company ..... Denver, Colo.

Jensen-Salsberg Laboratories, Inc. ..... Kansas City, Mo.
Johnson and Johnson ..... New Brunswick, N. J.

Kasanof, D. R., and Company, 25 West 42nd Street ..... New York, N. Y.

Lederle Antitoxin Laboratories ..... New York, N. Y.
Lehn and Fink, Inc. ..... New York, N. Y.
Leich, Chas., and Company ..... Evansville, Ind.
Lilly, Eli and Company ..... Indianapolis, Ind.
Lister Bros., Inc ..... New York, N. Y.
Lumiere, A., Laboratories ..... New York, N. Y.

McCourt Label Cabinet Company ..... Bradford, Pa.
McNeil, Robert ..... Philadelphia, Pa.
Mallinckrodt Chemical Works ..... St. Louis, Mo.
Maltbie Chemical Company ..... Newark, N. J.
Maltine Company ..... Brooklyn, N. Y.
Manhattan Eye Salve Company ..... Louisville, Ky.
Mead Johnson and Company ..... Evansville, Ind.
Meadows Chemical Company ..... New York, N. Y.
Medical Laboratories, Inc ..... New York, N. Y.
Merck and Company ..... New York, N. Y.
Merrell-Soule Company ..... Syracuse, N. Y.
Merrell, Wm. S., Company ..... Cincinnati, Ohio
Metz, H. A., Laboratories, Inc ..... New York, N. Y.
Modern Office Devices, Inc., 675 Hudson Street ..... New York, N. Y.
Monsanto Chemical Works ..... St. Louis, Mo.
Morgenstern and Company ..... New York, N. Y.
Mulford, H. K., Company ..... Philadelphia, Pa.

National Aniline and Chemical Company ..... New York, N. Y.
National Homogenizer Corporation ..... Frankfort, N. Y.
National Pathological Laboratories ..... Chicago, Ill.
National Pharmacy Company ..... Oakland, Calif.
National Radium Products Company ..... New York, N. Y.
New York Intravenous Laboratory ..... New York, N. Y.
New York Quinine and Chemical Works ..... New York, N. Y.
North, Horace ..... Brooklyn, N. Y.
Northwestern Steel and Iron Works ..... Eau Claire, Wis.
Norton, John, Company ..... Columbus, Ohio
Nutrivoid Diabetic Flour Company ..... New York, N. Y.

Ohio Chemical and Manufacturing Company ..... Cleveland, Ohio

Parke, Davis and Company ..... Detroit, Mich.
Parmele Pharmacal Company ..... New York, N. Y.
Pasteur Institute of St. Louis ..... St. Louis, Mo.
Patch, E. L., Company ..... Boston, Mass.
Pfandler Chemical Company ..... Rochester, N. Y.
Pitman-Moore Company ..... Indianapolis, Ind.
Powers-Weightman-Rosengarten Company ..... Philadelphia, Pa.
Pure Gluten Food Company ..... Brooklyn, N. Y.

Radium Chemical Company ..... Pittsburgh, Pa.
Radium Emanation Corporation ..... New York, N. Y.
Radium Limited, U. S. A. ..... New York, N. Y.

Read Machinery Company ..... York, Pa.
Reinschild Chemical Company ..... New York, N. Y.
Reynolds and Reynolds ..... Dayton, Ohio
Riedel and Company ..... New York, N. Y.
Roessler and Hasslacher Chemical Company ..... New York, N. Y.

Schering and Glatz, Inc. ..... New York, N. Y.
Schiefflin and Company ..... New York, N. Y.
Schultz, O'Neil Company ..... Minneapolis, Minn.
Scott, Henry L., and Company ..... Providence, R. I.
Seydel Manufacturing Company ..... Jersey City, N. J.
Sharpe and Dohme ..... Baltimore, Md.
Sherman, G. H. ..... Detroit, Mich.
Shriver, T., and Company ..... Harrison, N. J.
Squibb, E. R., and Sons ..... New York, N. Y.
Standard Oil Company (Indiana) ..... Chicago, Ill.
Stearns Frederick and Company ..... Detroit, Mich.
Straub, A. W., Company ..... Philadelphia, Pa.
Sullivan, James F., 829 N. 5th Street ..... Camden, N. J.
Synthetic Drug Company ..... Toronto, Canada

Takamine Laboratory, Inc ..... Clifton, N. J.
Tappan Zee Surgical Company ..... Nyack, N. Y.

United States Industrial Chemical Company ..... New York, N. Y.
United States Radium Corporation ..... New York, N. Y.
United States Standard Products Company ..... Woodworth, Wis.
United Synthetic Chemical Corporation ..... New York, N. Y.

Vallez Rotary Filters Company ..... Bay City, Mich.
Van Dyk, L. A. ..... New York, N. Y.
Vitalait Laboratory of California ..... Pasadena, Calif.

Wallace and Tiernan Company, 233 Broadway ..... New York, N. Y.
Wallau, George J., Inc ..... New York, N. Y.
Waukesha Health Products Company ..... Waukesha, Wis.
Welty Company ..... Chicago, Ill.
Werner Drug and Chemical Company ..... Cincinnati, Ohio
West Disinfecting Company ..... New York, N. Y.
Western Chemical Company, Inc. ..... Hutchinson, Minn.
White Chemical Company ..... Wilmington, N. C.
Wilson Laboratories ..... Chicago, Ill.
Winthrop Chemical Company, Inc. ..... New York, N. Y.

INDEX

HEAVY BLACK FIGURES INDICATE THE PAGES UPON WHICH WORKING PROCESSES OR STANDARDS WILL BE FOUND

A

Abasier, 1965
Abbe refractometer, 1525
Abbreviated title, 17
Abbreviations, 19, 1595
Abbreviations, Latin, 1596
Abercrombie's lotion, 1965
Abies balsamea, 985, 1030, 1531
  canadensis, 985, 1030
  excelsa, 985, 1030
  pectinata, 985
Abietic acid, 1021
  anhydride, 1021
Abnormal constituents of urine, 1435
Abortifacients, 1249
Abrastol, 932
Abric, 1965
Absinthium, 1016
  oil, 985
Absolute acids, 553
  alcohol, 904, 1529
  specific gravity, 55
Absolutes and concretes, 952, 1210
Absorbable sutures, 1766
Absorbed menstruum, 239
Absorbent cotton, 795
Absorption of a gas in a solvent, 1482
Abstracts, 454
Acacia, 885
  and morphine, syrup, **284**
  bark, decoction, **363**
  blossoms, 1225
  farnesiana, 1221
  incompatibility, 1645
  mucilage of, 286
  Senegal, 885
  syrup, **283**
Acceptances, trade or bank, 1281
Accident insurance, 1288
Accounting, 1391
  columnar system, 1411
Accounts, 1391
  information from, 1421
  of credit customers, 1392
  payable, 1414
  personal, 1407
  speculative, 1407
  to control business, 1395
  value of, 1426
A. C. E. mixture, 1965
Acer spicatum, 1014
Acerrimum acetum, 1965
Aceta, 449
Acetal, 932
Acetaldehyde, 786, 932
Acet-amido-ethyl-salicylic acid, 932
Acetanilid, **829**
  ammoniated, 830
Acetanilid and sodium salicylate tablets, compound, 1712
  incompatibility, 1645
  methyl, incompatibility, 1646
  powder, compound, **481**
  tablets, 1712
    compound, 1582
Acetanilide, **829**
Acetanilidum, **829**
Acetannin, 1093
Acetate, aluminum, 703
  aluminum, solution, **702**
    assay, 1478
    diluted, assay, 1478
  ammonium and iron, solution, assay, 1467
    solution, **652**
    assay, 1457
  amyl, 175, 932, 1214
  barium, 687
  benzyl, 1214, 1226
  borneol, 1211
  bornyl, 963, 1022, 1215, 1226
  butyl, 175
  cellulose, 795
  cupric, 744, 1532
  ethyl, 175, 786, **927**, 1215, 1533
  ferric, 732
  geranyl, 1215, 1226
  iron and ammonium, solution assay, 1457
  isobutyl, 1216
  lead, **737**, 1535
    antidote, 1943
    assay, 1473
    incompatibility, 1647
  linalyl, 961, 1216, 1226
  magnesium, 670
  mercuric, 759
  methyl, 175, 937
  naphthylamine (beta), 1537
  phenylethyl, 1216
  potassium, **600**, 1538
  potassium and buchu, elixir, **320**
    assay, 1456
    buchu and juniper, elixir, **320**
  rhodinol, 1217
  rosaniline, 1534
  silver, 747
  sodium, **619**, 1540
    anhydrous, 1540
    assay, 1456
  strychnine, solution, **1129**
  tannyl, 1093
  terpinyl, 1217, 1226
  test, 800
  uranyl, 734
  zinc, **691**
  zinc, assay, 1478
Acetbromalid, 932
Aceteugenol, 973
Acetic acid, 786, 799, **800**, 1528
    assay, 1453
    diluted, **801**, 1528
      assay, 1453
    glacial, **802**, 1528
      assay, 1453
  aldehyde, 903, 968
  anhydride, 1528
  ether, **927**, 1215
  fluidextracts, 406
  turpentine liniment, **349**
Acetoacetate, ethyl, 175
Acetoarsenite, copper, 769
Acetone, 175, 786, **799**, **803**, 1529
  as a solvent, 174
  assay, 1469
  bromoform, 861
  chloroform, incompatibility, 1646
  in urine, 1443
    Lange's test, 1443
  reaction, 1568
Acetonitrile, 811
Acetonum, **803**
Acetophenone, 936, 1214
  methyl, 1214
Acetosalicylate, phenetidin, 938
Acetous liquids made by percolation or maceration, 449
Acetozone, incompatibility, 1645
Acetphenetidin, 828
  incompatibility, 1645, 1648
Acetphenetidinum, 828
Acetum acerrimum, 1965
Acetum aromaticum, **449**
  bezoardicum, 1965
  cantharidini, 450
  opii, 450
  Saturni, 1965
  scillæ, **449**
  Theriacale, 1965
  urgineæ, **450**
Acetvanillic acid, 973
Acetyl-choline, 1130
Acetylene, 780, 799
  series, 787
Acetylized methylene diguaiacol, 935
Acetylphenyl hydrazine, 932
Acetylsalicylic acid, 827
    assay, 1454
    incompatibility, 1645
Acetyltannic acid, 1093
Achillea, 1016
  millefolium, 1016
Achilleine, 1016
Achroodextrin, 903
Acid, abietic, 1021
  acet-amido-ethyl-salicylic, 932

Acid, acetic, 786, 799, **800**, 1528
  assay, 1453
  diluted, **801**, 1528
    assay, 1453
  glacial, **802**, 1528
    assay, 1453
acetvanillic, 973
acetylsalicylic, 827
  assay, 1454
  incompatibility, 1645
acetyltannic, 1093
aconitic, 1143
amorphous, 1007
anisic, 968
anthemic, 1012, 1016
apple, 1965
arsenous, **764**
  solution, 257, **765**
    assay, 1471
artanthic, 1003
aspartic, 1170
azotic, 1965
battery, 1965
benzoic, **832**, 1024, 1025, 1063, 1211
  assay, 1456
  English, 833
  German, 833
  troches, 499
betanaphtholhydroxytoluic, 934
  incompatibility, 1646
boracic, **590**
boric, **590**
  assay, 1453
  ointment, **502**
boroboracic, 1965
borussic, 1965
bromauric, 777
bromic, **568**
butyric, 799, 1203
cacodylic, 933
caffeic, 1157
camphor mixture, 297
camphoric, 988, 994
capronic, 799
caprylic, esters, 954
carbazotic, 1965
carbolic, **816**
  antidote, 1942
  crude, 813
  glycerite, **301**
  liquefied, **819**
  ointment, **506**
  suppositories, 523
  troches, 499
carbonic, 588
carminic, 842
catechutannic, 1096
cathartic, 1084
catholicon, 1965
cerotic, 1191
cetylacetic, 1965
chelidonic, 1163
chlorauric, 1534
chlorazotic, 1965
chloric, **568**, **733**
chloroplatinic, 1538
chrysophanic, 1083, 1084
cinnamic, 1024, 1025, 1211
citric, 787, **943**
  assay, 1453
  syrup, **264**
Cleve's, 811
coca-tannic, 1163
commercial, quality, 553
Acid, convolvulinic, 1063
  copaivic, 996
  cornic, 1075
  cresotic, 811
  cresotinic, 811
  cresylic, 813
  crotonic, 799
  cubebic, 995
  diacetyltannic, 1093
  diazobenzenesulphonic, 792
  dibromgallic, 936
  diethylbarbituric, **923**
    incompatibility, 1645
  dimethylarsenic, 933
  dioxysuccinic, 1965
  dipping, 1965
  dipropylbarbituric, 934
  disalicylic, 940
  dropper, 553
  dyes, 841
  electrolyte, 1965
  ellagic, incompatibility, 1646
  ethanoic, 786
  ethylsulphuric, 935
  euonic, 1088
  ferric albuminate, 1205
  filicic, 1007
  flavaspidic, 1007
  formic, 799, 1192
    spirit, **311**
  frangulic, 1089
  fuchsin, 853
  fumaric, 1158
  gallic, 1094, 1534
    anilide, 1100
  gallotannic, 1092
  gambogic, 1085
  gamma, 811
  gentisic, 1064, 1079
  glutamic, 1170
  glycyrrhizic, 900
  guaiacic, 1027
  guaiaconic, 1027
  guaiaretic, 1027
  H, 811
  hippuric, 1029
  homosalicylic, 811
  hydriodic, 577
    diluted, **555**
      assay, 1462
    incompatibility, 1647
    syrup, **265**, **577**
      assay, 1462
  hydrobromic, diluted, 556, **566**
    incompatibility, 1647
  hydrochloric, **553**, 1534
    antidote, 1940
    assay, 1453
    concentrated, 1534
    diluted, **555**, 1535
    diluted, assay, 1453
    incompatibility, 1647
  hydrocyanic, 1063
    antidote, 1943
    diluted, **991**
    Scheele's, 992
  hydrofluoric, 579
  hydropicrotoxic, 1157
  hydrosulphuric, 580
  hypochlorous, **568**
  hypophosphorous, **564**, 585
    assay, 1453
  hyposulphurous, 580, **581**
  igasuric, 1126
  ilicic, 1079
Acid, inorganic, 552
  incompatibility, 1647
  unofficial, 566
  insoluble ash in vegetable drugs, 1522
  iodic, **568**
  ipecacuanhic, 1147
  isoanemonic, 1013
  jervic, 1142
  juglandic, 1089
  kinic, 1114
  kinotannic, 1096
  kinovic, 1114
  krameria tannic, 1095
  krameric, 1095
  lactic, 786, 1183
    assay, 1454
  lactucic, 1017
  Laurent's, 811
  lithic, 1965
  lobelic, 1156
  lumenolsulphonic, 1965
  magenta, 853
  magnesium citrate, 669
  maizenic, 1016
  malic, 787, 946
  mandelic, 1135
  marine, 1972
  meconic, 1104, 1164
  meta-arsenic, 764
  metaboric, **590**
  metapectic, 945
  metaphosphoric, **581**, 585
  metarsenous, 764
  methyl-ethyl-acetic, 1063
  methyl formic, 786
  methylene-citryl-salicylic, 828, 938
  mineral, antidotes, 1940
  molybdic, 1537
  mucic, 885
  muriatic, 554
  nancic, 1965
  Neville and Winter's, 811
  nitric, **557**, 1537
    antidote, 1940
    assay, 1453
    diluted, 558, 1537
    fuming, 1537
    incompatibility, 1648
  nitrohydrochloric, **565**
    diluted, **566**
  nitromuriatic, **565**
    diluted, **566**
  nitrosylsulphuric, 559
  nitrous, 557
  "No. 8," 800
  number, 1512
  official strength, 553
  oleic, 1046
  ortho-arsenic, 764
  ortho-boric, 590
  orthohydroxy benzoic, **824**
  orthophenolsulphonic, 939
  orthophosphoric, 585
  ortho-sulphamide benzoic, 833
  oxalic, **798**, 885, 1537
    antidote, 1941
  palmitic, 1191
  perchloric, **568**
  periodic, **568**
  phenic, 1965
  phenolsulphonic, 938
  phenylacetic, 1211
  phenylformic, 1965

Acid, phenylglycolic, 1135
phenylhydrazin-levulinic, 932
phenyl-quinoline-carboxylic, 1125
phosphoric, **562**, 1538
antidote, 1940
assay, 1463
diluted, **563**
assay, 1463
syrupy, **562**
phosphorous, **581**, 585
phosphotungstic, 1538
phthalic, 832, 938
phytolaccic, 1078
pickling, 1965
picric, 811, **822**, 1538
piperic, 1004
piperonylic, 1017
podophyllinic, 1086
polygalic, 1072
propionic, 799
prussic, antidote, 1944
diluted, **991**
pyroarsenic, 764
pyroboric, **590**
pyrogallic, 1095
pyroligneous, 800
pyrophosphoric, **581**, 585
pyruvic, 903
quercitannic, 1097, 1099
quinic, 1114, 1157
quinotannic, 1114
quinovic, 1063, 1114
rheotannic, 1083
rosolic, 939
rubin, 853
saccharic, 885
saccharine fruits, 945
salicylic, 811, **824**, 1540
and cannabis indica, plaster, 521
assay, 1456
glycerogelatin, **515**
incompatibility, 1649
mull, **522**
ointment, 511
pencils, **524**
plaster, 521
salts, 536
santalic, 844
selenous, 1540
sodium phosphate tablets, 1714
solution, mercuric nitrate, 260
phosphates, 258, **682**
sozoiodolic, 1965
sozolic, 939, 1965
stannic, 736
stearophanic, 1965
succinic, 786, 940
sugar, 1965
sulphanilic, 811, 940, 1542
sulphhydric, 1965
sulphite, sodium, 1540
sulphocarbolic, 938
sulphophenic, 938
sulphosalicylic, 1542
sulphovinic, 935
sulphuric, **558**, 580, 1542
antidote, 1940
aromatic, **561**
assay, 1454
assay, 1453
concentrated, 1542
Acid, sulphuric, diluted, **562**, 1542
assay, 1453
evaporating, 128
fuming, 1543
incompatibility, 1650
Nordhausen, 560
sulphurous, 580, 1543
tannic, 1092, 1543
derivatives, official, 1092
unofficial, 1094
glycerite, **300**
incompatibility, 1650
ointment, **503**
suppositories, 523
troches, **498**
tartaric, 787, **942**, 1543
assay, 1453
thiolinic, 1965
thiosulphuric, 580
toluic, 811
toxicodendric, 1079
trichloracetic, **802**
assay, 1453
urine, sediments, 1447
vinegar, 1965
white, 1965
xanthoproteic, 558
zoötic, 1978
Acids, 534, 786, 1211
absolute, 553
antidotes, 1940
assay for (alkalimetric), 1514
diluted, 553
organic, assay of alkali salts, 1514
incompatibilities, 1647
strong, handling, 552
Acidum aceticum, **800**
dilutum, **801**
glaciale, **802**
acetylsalicylicum, 827
acetyltannicum, 1093
benzoicum, **832**
boricum, **590**
bromauricum, **777**
bromicum, **568**
butyricum, 1203
carbolicum iodatum, **820**
chloricum, **568**
chloronitrosum, 1965
citricum, **943**
cœruleum, 1965
formicum, 1192
gallicum, 1094
hydriodicum dilutum, **555**
hydrobromicum dilutum, **566**
hydrochloricum, **553**
dilutum, **555**
hydrocyanicum dilutum, **991** P. I., **991**
hypochlorosum, **568**
hypophosphorosum, **564**
hyposulphurosum, **581**
iodicum, **568**
lacticum, 1183
metaboricum, **590**
metaphosphoricum, **581**
muriaticum, 1965
nitrico-nitrosum, 1965
nitricum, **557**
nitrohydrochloricum, **565**
dilutum, **566**
oleicum, 1046
ossium, 1965
oxalicum, 798
Acidum perchloricum, **568**
periodicum, **568**
phenylcinchoninicum, 1125
phosphoricum, **562**
dilutum, **563**
phosphorosum, **581**
pyroboricum, **590**
pyrophosphoricum, **581**
salicylicum, **824**
scytodepsicum, 1965
stannicum, 736
stearicum, 1047
sulphuricum, **558**
aromaticum, **561**
dilutum, **562**
tannicum, 1092
tartaricum, **942**
trichloraceticum, **802**
Acipenser huso, 1205
Acme prescription book, 1619
Acne bacillus vaccine, 1918
bacterin, 1918
serobacterin, 1921
Aconine, 1143
Aconite, 1143
and chloroform liniment, **347**
and iodine dental liniment, compound, **341**
antidote, 1941
assay, 1506
dental liniment, compound, **341**
extract, **470**
fluidextract, **417**
liniment, **349**
root, 1143
tincture, **366**
tincture, assay, 1506
Aconiti tinctura P. I., **366**
tuber P. I., 1143
Aconitic acid, 1143
Aconitina, 1143
Aconitine, 1143
crystallized, 1144
ointment, 511
oleate, **351**, 1047
Aconitum, 1143
Acorn, 883
Acorus calamus, 985
Acridine dyes, 850, **851**
Acridines, 841
Acriflavina, 851
neutra, 851
Acriflavine, 851
neutral, 851
solution, 1775
Acrinyl isothiocyanate, 993
Acrolein, 1032
Acrylic aldehyde, 1032
Act, Food and Drugs, Federal, 1262
Actinium, 704
Active immunity, 1892, 1893
biological products for, 1912
Actol, 1965
Acusto, 1965
Adalin, 925
Adansonia digitata, 891
Adapter, use of, 137
Adapters, 137
Adding machine, 1411
Adeps, 1040
anserinus, 1965
benzoinatus, **1041**
gadi, 1965
lanæ, 1042

Adeps, lanæ, hydrosus, 1043
ovillus, 1965
Adhesive plaster, 518, 1751
elastic, 520
rubber, 518, 1751
surgeons', 1751
Adiantum capillus-veneris, 892
Adipsos, 1965
Adjustable Bunsen burner, 100
Adnephrin, 1196
incompatibilities, 1646
Adonidin, 1063, 1072
Adonin, 1072
Adonis, 1072
fluidextract, **418**
vernalis, 1063, 1072
Adragante, 1965
Adrenalin, 1195, 1196
incompatibility, 1645
Adrenamine, 1196
Advertisements, 1249
Advertising, 1357
agencies, 1362
allowance, 1363
appeal, 1373
copy, 1360
institutional, 1359
mediums, 1363
paid, 1359
per cent, 1272
to public, 1366
writing, 1372
Ægle marmelos, 891, 1016
Ænin, 840
Ænothera biennis, 891
Ær fixus, 1965
Ærosus lapis, 1965
Ærugo, 1965
Æs, 1965
æratus, 1965
Æsculapius, 3
Æsculatin, 1063
Æsculin, 1063
Æsculus hippocastanum, 1045, 1063, 1100
Æther, **917**
aceticus, **927**
vegetabilis, 1965
sulphuricus, 917
Ætherolea, 948
Æthiops antimonialis, 1965
martialis, 1965
mineralis, 1965
per se, 1965
vegetabilis, 1965
Æthylenum pro narcosi, 935
Æthylis aminobenzoas, 834
chaulmoogras, 921
chloridum, **920**
salicylas, 828
Æthylmorphinæ hydrochloridum, 1111
Afenil, 683
Affium, 1965
African bird pepper, 996
chillies, 996
ginger, 984
pepper, 996
saffron, 1965
Afsol, 940
After-damp, 1965
Agar, 887
Agar-agar, 887
glucose, 1576
glycerin, 1576
lactose-litmus, 1576
Agar-agar, plain, 1575
Agar emulsion, 1058
petrolatum, **1058**
compound, 1058
petrolatum emulsions, 887
phenolphthalein, 887
preparation, unofficial, 887
Agaric, 1026
larch, 1026
white, 1026
Agaricus, 1026
Agate, 591
Agate-ware evaporating dish, 125
Agencies, advertising, 1362
commercial, 1276
exclusive, 1377
Agglutinins, 1906
Agitator, portable, 172
Agmatine, 1130
Agnus castus, 1039
Agrimonia, 1100
eupatoria, 1100
Agrimony, 1100
Agropyron repens, 901
Aid from banks, 1275
Aids to filtration, 204
Air bath, 114
electrically heated and regulated, 114
gas-heated, water jacketed, 114
Air, inflammable, 1971
Airol, 775
incompatibility, 1645
Aitkin tonic pills, **496**
Ajacine, 1159
Ajacol, 936
Ajaconine, 1159
Akazga, 1163
Alabastic, 1965
Alabastine, 1965
Alanine, 1170
Alanin-mercury, 1965
Albaspidin, 1007
Albertus Magnus, 560
Albocarbon, 1965
Albolene, 1059
Album græcum, 1966
nigrum, 1966
Albumen cholicum, 1185
egg, fresh, 1186
assay, 1456
Albumin in urine, tests for, 1438
milk, Hoos, 1822
reaction, 1568
tannate, 1094
incompatibility, 1645
test solution, 1544
Albuminate, ferric, acid, 1205
ichthyol, 936
iron, **724**
solution, **724**
Albumini tannas, 1094
Albuminized iron, **724**
assay, 1468
solution, **724**
Albuminoids, 1170
Albuminometer, 1440
Albumins, 1170
Albutannin, 1094
Alcohol, 94, 905, 1529
absolute, 904, 1529
absolutum, 904
amyl, 175, 932, 1529
as a solvent, 174
Alcohol, benzyl, 175, 837, 1211, 1226
blast lamp, 95
butyl, 175
C_8, 1211
C_9, 1211
C_{10}, 1211
C_{11}, 1211
C_{12}, 1211
cinnamic, 1211, 1226
coniferyl, 1063
content, 12
decyl, 1211
dehydrated, 904, 1529
denatured, 94, 907
deodorized, 905
determination, 908
diacetone, 175
diluted, **906**
duodecylic, 1211
ethyl, 94, 781
anhydrous, 175
glyceric, 1048
grain, 94
incompatibility, 1645
isopropyl, 175
methyl, 94, 799, 809, 937
antidote, 1943
methylic, 809
myricyl, 1191
neutralized, 1529
nonyl, 954, 1211
octyl, 1211
perfumery, 1227
phenylethyl, 1212, 1226
phenylpropylic, 1226
solidified, 95
soluble extractive, 1523
stove, 95
pocket, 95
styrolene, 1222
sulphuris, 1966
trichlor-tertiary-butyl, 861
undecylic, 1211
wood, 809
antidote, 1943
Alcoholic ammonia test solution, 1544
liquors, prescriptions for, 1248
percentages of fluidextracts, 406
solutions, 305
Alcoholized iron, 711, 906
Alcoholometer, 63
centesimal, Gay-Lussac's, 64
Alcoholometers, 63
Alcoholometric table, 907
temperature corrections, 912
Alcohols, 1211
and derivatives, 902
aromatic, 791
dihydric, 786
hexatomic, 899
primary, 786
secondary, 786
tertiary, 786
Alcoolat, 1966
Alcoolature, 1966
Alcoolé, 1966
Alcosol, 186
Alcresta ipecac, 1148
Aldehyde, 781, 782, 903, 932
acetic, 903, 968
acrylic, 1032

Aldehyde and its derivatives, 929
anisic, 968, 1213
C_8, 1212
C_9, 1212
C_{10}, 1213
C_{11}, 1213
C_{12}, 1213
cinnamic, 972, 1213, 1226
decyl, 954, 1213
ethyl, 786
glyceric, 903
hydrocinnamic, 1214
lauric, 1213
methylnonylacetic, 1213
nonyl, 955, 1212
octyl, 955, 1212
phenylacetic, 1213
phenylpropylic, 1214
salicyl, 1063, 1214
undecylic, 1213
Aldehydes, 786, 1212
Alder, black, 1079
Alefol, 1214
Alegar, 1966
Alembic, 131
Aleppo galls, 1091
Aletris, 1073
elixir, compound, **316**
farinosa, 1073
fluidextract, **418**
Aleurites triloba, 1045
Alexandria senna, 1083
Algarobia glandulosa, 892
Algaroth, powder, 1966, 1974
Aliphatic hydrocarbons, 783
Aliquot part method, 1486
Alisma, 1005
plantago, 1005
Alizarin, 845
solution, 1571
Alkali, animal, 618
benzoates and salicylates, assay, 1514
fossil, 1970
metals and their compounds, 595
mineral, 618
residual titrations with excess of, 1454
salicylates and benzoates, assay, 1514
salts of organic acids, assay, 1455, 1514
vegetable, 618, 1966
volatile, 1966
Alkalies, antidotes, 1941
Alkalimetric assay for acids, 1514
Alkaline antiseptic solution, 340
tablets, 1715
aromatic solution, 257, **340**
cupric tartrate, 1554
elixir, **330**
mixture of rhubarb, **296**
sulphur ointment, **510**
tar solution, 260, **804**
urine, sediments from, 1447
Alkaloidal assays, 1485
type processes, 1494
calisaya elixir, **323**
ferrated, **323**
with iron and bismuth, 324
and strychnine, 324
drugs, unofficial, 1163
tablets, assaying, 1501
Alkaloids, 1101
and their salts, unofficial, 1165
automatic extraction apparatus for, 1487
cadaveric, 1204
cinchona and iron elixir, **323**
elixir, **323**
iron and bismuth elixir, **324**
and strychnine elixir, **324**
bismuth and strychnine elixir, **324**
estimation, 1490
extraction, 1493
purification, 1489
Alkanet, 845
Al-kohl, 906
Alkyl halides, 786
Alkyls, 785
Allergens, 1925
animal, 1930
bacterial, 1931
food, 1929
miscellaneous, 1930
pollen, 1927
used in diagnosis, 1933
Alliaria officinalis, 994
Alligation, 86
alternate, 87
medial, 86
Allium, 994
sativum, 994
Allowance for advertising, 1363
Allspice, 975
oil, 975
Allyl, 787
iodide, 993
isothiocyanate, 992, 993, 1063
sulphide, 994
-sulpho-carbamide, 994
sulphocyanide, 993
-sulpho-urea, 994
thiocarbamide, 993
tribromide, 994
Almond, bitter, spirit, **312**
water, **256**
compound powder, 484
cream, **1237**, **1238**
elixir, compound, **317**
emulsion, **290**
flavoring extract, 976
oil, bitter, 988, 1063
antidote, 1943
assay, 1460, 1464
expressed, 1034
sweet, 1034
sweet, 1034
syrup, **283**
Alnus, rubra, 1030
Aloe, 1080
and asafetida pills, **491**
and canella powder, 481
and iron pills, **492**
and mastic pills, **492**
and myrrh pills, **492**
tincture, **383**
and podophyllum pills, compound, **492**
assay, 1081
Barbadoes, 1081
Cape, 1080
Curaçao, 1080
decoction compound, 363
extract, **470**
ferox, 1080
incompatibility, 1645
Aloe, mercury and podophyllum pills, **493**
mercury and scammony compound pills, 497
perryi, 1080
pills, **490**
quinine, iron and nux vomica pills, **495**
socotrine, 1080
tincture, **383**
vera, 1080
Aloin, 1080, 1081
belladonna, strychnine and cascara tablets, 1716
incompatibility, 1645
pills, compound, **493**
strychnine and belladonna pills, **493**
compound, **493**
Aloinum, 1081
Alosa menhaden, 1205
Aloxite, 1966
Alpers' ointment filler, 1750
Alpha lactone, 858
naphthol, 792
rays, 684
Alphanaphthol salicylate, 932
Alphanaphthylamine, 811
Alphanitronaphthalene, 811
Alphol, 932
Alphozone, 932
Alpinia officinarum, 985
Alsop's infusion jar, 358
Alstonia constricta, 1163, 1165
infusion, **361**
scholaris, 1164
tincture, 400
Alstonine, 1163, 1165
Alternate alligation, 87
Althæa, 887
folia, 888
officinalis, 887, 888
Althæin, 840
Althea, 887
leaves, 888
syrup of, **272**
Alum, **698**
ammonium, **698**
assay, 1477
burnt, **700**
cake, 1966
concentrated, 1966
cube, 1966
dried, **700**
exsiccated, **700**
assay, 1478
-hematoxylin solution, **1573**
patent, 1966
porous, 1966
potassium, **698**
rock, 1966
Roman, 1966
root, 1100
Alumen, **698**
exsiccatum, **700**
plumosum, 1966
rubrum, 1966
ustum, **700**
Alumini acetas, 703
bromidum, 703
chloridum, **700**
hydroxidum, 703
iodidum, 703
naphtholsulphonas, 703
nitras, 703
oxidum, 703

Alumini, phosphas, 703
sulphas, **701**
Aluminum, 531, 690, 698
acetate, 703
gauze, **1761**
solution, 258, 702
assay, 1478
diluted, assay, 1478
acetico-tartrate solution, 259
and sodium fluoride, 579
betanaphthol-disulphonate, 703, 932
bromide, 703
chloride, **700**
assay, 1478
grain weights, 50
hydroxide, 703
iodide, 703
metallic, 1529
nitrate, 703
oleate, 1047
oxide, 703
paraphenol-sulphonate, 939
phosphate, 703
salts, tests, 698
unofficial, 703
subacetate solution, 258, 703
sulphate, **701**
assay, 1478
wire weights, 50
Alumnol, 703, 932
incompatibility, 1645
Alundum, 1966
filters, 204
Alypin, 837
Amadou, 1966
Amandin, 1034
Amanita muscaria, 1167
Amaranth, 841
Amber, 1030
oil, 938
petrolatum, 1058
Ambergris, 1203, 1219
Ambra grisea, 1203
Ambrene, 1060
Ambretta seeds, 1966
Ambrette, musk, 1217
American centaury, 1080
columbo, 1079
elm, 887
hellebore, 1142
Indian hemp, 999
oil, 1973
pennyroyal, 964
saffron, 845, 1016, 1975
senna, 1079
spikenard, 1002
wormseed, 1005
oil, 1000
Amianthus, 1966
Amid, 783
Amide, 783
Amidon, 1966
Amidopyrina, 830
Amidopyrine, 830
Amin, 783
Amine, 783
primary, 783
secondary, 783
tertiary, 783
Amino, 783
Aminobenzoate, ethyl, 834
Aminoform, 931
Amino-mercuric-chloride, 1966
-oxybenzoate, methyl, 937
Ammi copticum, 963
Ammonia, antidote, 1941
aromatic spirit, **307**
bakers', 656, 1967
liniment, **347**
solution, anisated, **312**
spirit, **314**
anisated, **312**
aromatic, **651**
test solution, 1544
alcoholic, 1544
stronger, 1544
water, **649**
assay, 1455
stronger, **651**
assay, 1455
Ammoniac, 1029
emulsion, 290
sal, 656
Ammoniacum, 1029
Ammoniated acetanilid, 830
camphor wash, **298**
glycyrrhizin, 901
mercury, **751**
assay, 1479
ointment, **504**
tincture ergot, 401
guaiac, **391**
opium, 401
quinine, 401
valerian, **382**
Ammonii arsenas, 659
benzoas, **653**
bicarbonas, 659
boras, 660
bromidum, **654**
carbonas, **655**
chloridum, **656**
citras, 660
dichromas, 660
et ferri chloridum, 660
et potassii tartras, 660
fluoridum, 660
formas, 660
hypophosphis, **658**
iodidum, 660
nitras, 660
nitris, 660
phosphas, **658**
salicylas, **657**
sulphas, 660
sulphis, 660
sulphocyanidum, 660
valeras, **659**, 660
Ammonio-ferric citrate, **716**
Ammonium, 649
acetate and iron, solution, **722**
assay, 1467
solution, 257, **652**
assay, 1457
alum, **698**
and iron chloride, 660
and potassium tartrate, 660
arsenate, 659
benzoate, **653**
assay, 1456
bicarbonate, 659
borate, 660
bromide, **654**
assay, 1462
elixir, **316**
carbonate, **655**, 1529
assay, 1455
T. S., 1544
carbonicum pyro-oleosum, 1966
Ammonium, chloride, 656, 1529
assay, 1463
lozenges, compound, 1717
mixture, 297
T. S., 1544
troches, **498**
citrate, 660
and iron, assay, **1467**
solution, 259
dichromate, 660
fluoride, 660
formate, 660
hypophosphite, 658
assay, 1464
syrup, **272**
ichthyol, 867
iodide liniment, **349**
metavanadate, 1529
molybdate T. S., 1544
nitrate, 660, 1529
nitrite, 660
oxalate, 798, 1529
T. S., 1544
phosphate, **658**
assay, 1457
polysulphide T. S., 1544
salicylate, **657**
assay, 1456
tablets, compound, 1713
salts, tests, 649
unofficial, 659
sulphate, 660, 1529
sulphide T. S., 1544
sulphite, 660
sulphocyanide, 660
sulpho-ichthyolate, 1966
valerate, **659**, 660
elixir, **317**
valerianate, **659**
vanadate, 1529
Amorphous acid, 1007
Ampelopsis quinquefolia, 1030
Amphion, 1966
Amphotropin, 931
Amplosia, 1966
Ampula, 260
Ampule vials, 1790
Ampullæ caffeinæ sodio-benzoatis, **1796**
camphoræ, **1796**
emetinæ hydrochloridi, **1796**
iodi, **1797**
quininæ dihydrochloridi, **1797**
et ureæ hydrochloridi, **1797**
sodii cacodylatis, **1798**
Ampuls, 260, 1790
caffeine sodio-benzoate, **1796**
camphor, **1796**
emetine hydrochloride, **1796**
filling, 1791
iodine, **1797**
quinine and urea hydrochloride, 1797
dihydrochloride, **1797**
sodium cacodylate, **1798**
sterilizing, 1794
Amydophenin, 932
Amygdala dulcis, 1034
Amygdalate, phenetidin, 932
Amygdalin, 1063
Amygdalus communis, 988, 1034
Persica, 947
Amyl acetate, 175, 932, 1214
alcohol, 175, 932, 1529

Amyl benzoate, 1214
butyrate, 932, 1214
chloride, 932
iodide, 932
nitrite, **926**
assay, 1481
salicylate, 1214, 1226
valerate, 932, 1215
Amylaceous principles, 882
substances and derivatives, unofficial, 883
Amylase, 902
Amylene, 932
-chloral solution, 932
Amylhydride, 938, 1966
Amylic compounds, 916
Amylis nitris, **926**
Amylit, 1966
Amyloclastic enzymes, 902
Amylodextrin, 903, 1966
Amylolytic enzymes, 902
Amylopsin, 1175
Amylum, **882**
iodatum, **568**
Anacardium occidentale, 891
Anacyclus, 1017
pyrethrum, 1008
Anagyrine, 1165
Anagyris fœtida, 1165
Analgen, 1165
Analgesine, 1966
Analysis, 528
and sampling, vegetable drugs, 1520
gravimetric methods, 1475
of sales, 1382
proximate, 528
ultimate, 528, 780
Analyst, the pharmacist as an, 1427
Analytical balance, 44
chainomatic, 1431
Troemner's, 1430
laboratory, 1578
weights, Troemner's, 1431
Anamirta cocculus, 1157
paniculata, 1079
Ananas sativa, 947
Anaphromeli, 1966
Anaphylaxis, 1895
Anchusa tinctoria, 845
Andropogon citratis, 986
nardus, 985
Schœnanthus, 985
Anemone Ludoviciana, 1013
prairie, 1013
pratensis, 1013
pulsatilla, 1013
Anemonin, 1013
Anesthesin, 834
incompatibility, 1645
Anesthetic solution, dental, **836**
Anethol, 966, 968, 969, 1217
solid, 968
Anethum graveolens, 970
Angelica archangelica, 969
fruit, 969
root, 969
fluidextract, **418**
garden, 969
seed, 969
European, 969
Angelicæ fructus, 969
radix, 969
Angioneurosin, 1966
Angustura, 1016
Angustura bark, 1016
oil, 985, 1016
Anhydride, abietic, 1021
acetic, 1528
chromic, **733**
sulphuric, 580
sulphurous, 580
Anhydrous cupric sulphate, 1532
ethyl alcohol, 175
lanolin, 1042
potassium carbonate, 1539
sodium acetate, 1540
carbonate, 1541
Anilide, gallic acid, 1100
sulphate, 1530
test solution, 1544
water, 1574
Aniline, 811, 1529
Anima articulorum, 1966
rhei, 1966
Animal allergens, 1930
alkali, 618
antigens, 1930
atopens, 1930
charcoal, 204
purified, 589
tablets, **500**
colors, official, 842
extracts, 1930
oil, 1973
organs, 1193
products, 1170, 1208
and derivatives, unofficial, 1203
substances, products from, 1170
Anisated powder rhubarb and magnesia, **484**
solution ammonia, **312**
spirit ammonia, **312**
Anise, 968
elixir, **317**
flavoring extract, 976
oil, 968
artificial, 969
synthetic, 969
powder, compound, **484**
seed, 968
spirit, **308**
water, **252**
Aniseed, 968
European, 968
Anisic acid, 968
aldehyde, 968, 1213
Anisum, 968
Annatto, 845
Annelida, class, 1205
Annidalin, 1966
Annuity insurance, 1287
Anode, 540
Anodyne, chloroform, **293**
Hoffmann's, **312**
Anodynin, 1966
Ant oil, artificial, 1966
Ant, red, 1205
Antacrid tincture, 1978
Anthemic acid, 1012, 1016
Anthemis, 1016
arvensis, 1012
nobilis, 985, 1016
oil, 985
Anthion, 1966
Anthocyanins, 840
Anthos (flores or herba), 1966
Anthoxanthins, 840
Anthracene, 811
Anthracite coal, 93
Anthrakokali, 1966
Anthranilate, methyl, 954, 1216
Anthraquinones, 841
Anthrarobine, 1966
Anthrasol, 932
Anthroglucosennin, 1084
Antiacid troches, 499
Anti-anthrax serum, 1907
-asthmatic elixir, **325**
Antibacterial immunity, 1894
serums, 1906
unofficial, 1907
Antibody solutions, 1897, 1911
solution pneumococcus, 1911
Antichlor, 635
Antidiphtheric globulins, 1900
serum purified, 1900
Antidote, arsenic, **717**
universal, 1940
Antidotes to poisons, 1939
Antidotum fuchsi, 1966
Antidysenteric serum, 1908
Antidyspeptic pills, 497
Antifebrin, **829**
Antifungin, 1966
Anti-gas-gangrene serum, 1906
Antigen-antibody combinations, 1920
pneumococcus, modified, 1919
Antigens, 1894, 1925
animal, 1930
bacterial, 1931
food, 1929
miscellaneous, 1930
pollen, 1927
used in diagnosis, 1933
Antigonococcic serum, 1910
Antihypo, 1966
Antimeningococcic serum, 1908
Antimonial powder, **481**
Antimonic oxide, 761
Antimonii bromidum, 763
chloridum, 763
et potassii tartras, **762**
fluoridum, 763
iodidum, 763
oxidum, **763**
oxysulphidum, 763
pentasulphidum, 763
sulphas, 763
sulphidum, 763
purificatum, 763
Antimonine, 1966
Antimonite, 761
Antimonium album, 1966
sulphuratum, 763
Antimonous oxide, 761
Antimony, 531, 761
and potassium tartrate, **762**
assay, 1470
antidote, 1941
bromide, 763
butter, 1967
compound pills, 497
compounds, unofficial, **874**
diaphoretic, 1966
flowers, 1970
fluoride, 763
glass, 1970
iodide, 763
needles, 1966
oxide, **763**
assay, **1470**
oxysulphide, **763**

Antimony pentasulphide, 763
pentoxide, 761
salts and preparations, unofficial, 763
tests for, 761
sodium thioglycollate, 874
sulphate, 763
sulphide, purified, 763
sulphurated, 763
tartrated, **762**
tetroxide, 761
thioglycollamide, 874
tincture, **384**
trichloride, 763
trioxide, 761
trisulphide, 763
Antimonyl potassium tartrate, **762**
Antiperiodic pills, **494**
without aloe, **494**
tincture, **384**, 1978
without aloe, **385**
Antipneumococcic serum, 1909
Antipyrina, 830
Antipyrine, 830
-caffeine citrate, 937
incompatibility, 1645
salicylacetate, 939
salicylate, 939
incompatibility, 1649
Antirabic vaccine, 1914
Antirachitic potency of cod liver oil, determination, 1188
Antisepsin, 932, 1966
Antiseptic dressing, 1761
pepsin solution, 258
powder, **481**
soluble, **481**
solution, 257, 339
alkaline, 340
pepsin, **1174**
Antiseptol, 1966
Antispasmin, 1165
Antistreptococcic serum, 1910
Antitetanic globulins, 1903
serum, 1904
crude, 1904
purified, 1903
Antithermin, 932
Antitoxic immunity, 1892
Antitoxin botulinus, 1906
diphtheria, 1900
concentrated, 1900
refined, 1900
super-concentrated, 1902
unofficial, 1902
perfringens, 1906
scarlatinal, 1904
scarlet fever, 1904
streptococcus, concentrated, 1904
Dochez method, 1906
tetanicum, 1903
tetanus, 1903
concentrated, 1903
crude, 1904
refined, 1903
unconcentrated, 1904
unrefined, 1904
Antitoxins, 1900
(new), 1897
unofficial, 1904
Antitoxinum diphthericum, 1900
tetanicum crudum, 1904
Antitussin, 932
Antlia gastrica, 1966
Ants, elimination, 1848
Ants, spirit, **311**
Apii fructus, 970
Apinol, 831
Apiol, 970, 994
Apis mellifera, 898, 1191
Apium graveolens, 970, 985
Apocynein, 1009
Apocynin, 1009
Apocynum, 1009
androsæmifolium, 1016, 1030, 1067
cannabinum, 1009, 1067
fluidextract, **419**
Apolysin, 932
Apomorphinæ hydrochloridum, 1111
Apomorphine chloride, 1111
hydrochloride, 1111
tablets, 1501
Apoquinamine, 1114
Aporetin, 1083
Apothecaries and metric weights, 77
fluid measure, 80
graduate, conical, 52
measure, U. S., 28
weight, 28
Apothem, 452
Apothesine, 837
Apparatus, elutriating, 154
for recovering alcohol from exhausted drugs, 127
Soxhlet, 133
subliming, 146
used in distillation, 131
vacuum, 126
Apparent specific gravity, 55
Apple, 947
acid, 1965
bitter, 1087
colocynth, 1087
extract, ferrated tincture, **390**
juice, fresh, 946
oil, 1966
Apples, extract, ferrated, **466**
Applicatio, 248, 524
Applications, 524
external, 345
Approach in sales, 1382
Approximate measures, 29
Apricot, 947
Apyonin, 1966
Apyrothium, 1966
Aqua, 545
acidi carbonici, 588
adstricta, 1966
ærata, 1966
æris fixi, 1966
ammoniæ, **649**
fortior, **651**
amygdalæ amaræ, **256**
anethi, **256**
anisi, **252**
aurantii florum, **252**
fortior, **252**
binelli, 1966
bullientis, 1966
camphoræ, **253**
carui, **256**
cerasorum, 1966
chloroformi, **253**
cinnamomi, **254**
coloniensis, **313**, 1966
communis, 1966
Aqua creosoti, **256**
crotonis, 1966
destillata, **254**, 547
sterilisata, 254, **1795**
flava, 1966
fluvialis, 1966
fœniculi, **254**
fœtida antihysterica, 1966
fontana, 1966
fortis, 558
gaseosa, 1966
gummosa, 1966
hamamelidis, **256**
hydrogenii dioxidi, **548**
hydrothionica, 1966
laurocerasi, **256**
laxativa Viennensis, 361, 1966
marina, 1966
artefacta, 1966
maris arte paranda, 1966
menthæ piperitæ, **255**
viridis, **255**
metallorum, 1966
mineralis, 1966
naphæ, **252**, 1966
nigra, 1966
nivalis, 1966
phagedænica, 1966
flava, **299**
nigra, **299**
phenolata, **256**
pluvialis, 1966
pura, 1966
reginæ Hungariæ, 962
rosæ, **255**
fortior, **255**
Saturnina, 1966
sedativa, **298**
vini, 906
vitæ, 906, 1966
Aquæ, 250
aromaticæ, **252**
Aqueous elixir glycyrrhiza, **329**
licorice, **329**
extract ergot, **465**
fluidextract cinchona, 442
solutions, 250
chemical, 257, 258
simple, 257, 258
tincture rhubarb, **397**
Aquila alba, 754, 1966
Arabic gum, 885
Arabin, 885
Arabinose, 885, 893
Arachis hypogœa, 1045
Aralia, 1002
fluidextract, **419**
racemosa, 1002
Aran's ether, 935
Arbor vitæ, 1005
Arbutin, 1063, 1079, 1097, 1098
Arbutus, trailing, 1100
Arcanum duplicatum, 1966
Archangel, 969
Archil, 845
Arctium lappa, 1077
minus, 1077
Arctostaphylos Uva-ursi, 1097
Areca nut, 1100, 1165
Arecoline hydrobromide, 1165
hypodermic tablets, assay, 1502
Argentamine, 932
Argenti acetas, 747
bromidum, 747
chloridum, 747

Argenti chloridum, colloidale saccharatum, 877
chromas, 747
citras, 747
cyanidum, 747
iodidum, 747
lactas, 747, 1203
nitras, **745**
fusus, **746**
mitigatus, 747
oxalas, 747
oxidum, 747
phosphas, 747
proteinas, 1204
sulphas, 747
Argentite, 744
Argento-proteinum forte, 874
mite, 876
Argentum, 744
arsphenamina, 873
colloidale, 877
credé, 877, 1204
fugitivum, 1966
musivum, 1966
vivum, 1966
Argilla, 1966
sulphurica alcalisata, 1966
Argol, 601
Argon, 531
Argonin, 1203
incompatibility, 1649
Argyn, 876
Argyrol, 876
incompatibility, 1649
Arheol, 998
capsules, 998
Aricine, 1114
Aristochin, 1122
Aristol, 578, 865
Aristolochia reticulata, 986, 999
serpentaria, 986, 999
Aristolochiaceæ product, 985
Arithmetic of pharmacy, 72
pharmaceutical, 72
Arithmetical problems, 74, 77, 79, 80, 81, 83, 91
proportion, 81
Arnica, 1009
extract, **470**
flowers, 1009
fluidextract, **419**
montana, 985, 1009, 1016
oil, 985
plaster, 521
root, 1016
fluidextract, 442
tincture, 400
tincture, **385**
Arnicæ radix, 1016
Arnicin, 1009
Arnold sterilizer, 1782
Aromatic alcohols, 791
camphor mixture, 297
castor oil, **356**
chemicals, solubility, 1226
used in perfumery, 1210
elixir, **315**
eriodictyon, **325**
glycyrrhiza, 338
red, **318**
yerba santa, **325**
fluidextract, 442
cascara sagrada, **408**
rhamnus purshiana, **408**
fluidglycerate cascara sagrada, **443**
Aromatic hydrocarbons, 788
oil spray, **354**
pepsin solution, 258
powder, **482**
chalk, **482**
and opium, **483**
solution, alkaline, **340**
pepsin, **1174**
spirit ammonia, **307**, **651**
sugars, 897
sulphuric acid, **561**
assay, 1454
syrup, **283**
cascara, **283**
eriodictyon, **276**
rhubarb, **269**
senna, **282**
yerba santa, **276**
tincture, **385**
rhubarb, **379**
umbelliferæ products, 965
vinegar, **449**
waters, **252**
type processes, **252**
Aromatol, **354**
Arquebusade, 1966
Arrack, 904
Arrangement of store, 1307
Arrowroot, 883
Arsanilate, sodium, 939
Arsenate, ammonium, 659
cupric, 744
ferrous, 732
manganese, 709
sodium, **635**, 769
assay, 1469
exsiccated, **636**
assay, 1469
solution, **637**, 769
assay, 1469
diluted, **637**, 769
assay, 1469
Arsenates, tests, 764
Arseni bromidum, 769
chloridum, 769
disulphidum, 769
iodidum, **767**
trioxidum, 764, 1530
trisulphidum, 769
Arsenic, 531, 761, 764
and arsenic compounds, 867
and mercuric iodides solution, 257
antidote, **717**, 1941
bromide, 769
and gold solution, **769**
chloride, 769
solution, **765**
compounds pentavalent, 867
trivalent, 867
unofficial, 769, 873
disulphide, 769
iodide, **767**
iron, quinine and strychnine pills, mild, **496**
stronger, **495**
oleate, 1047
solution, hydrochloric, **765**
Pearson's, **637**
test, 1512
Bettendorf's, 1513
tests, 764
tri-iodide, **767**
trioxide, **764**, 1530
assay, 1470
incompatibility, 1645
Arsenic, trisulphide, 769
white, **764**
yellow, 1978
Arsenite, copper, 769
potassium, solution, **766**
assay, 1471
incompatibility, 1650
Arsenobenzol, 869
Arsenopyrite, 764
Arsenous acid, 764
solution, 257, **765**
assay, 1471
tablets, 1713
and mercuric iodide solution, **678**
assay, 1462, 1471
incompatibility, 1649
compounds, 764
iodide, **767**
assay, 1462
oxide, **764**
Arsenphenolamine, sodium, 873
Arsphenamina, 868
Arsphenamine, 868
assay, 1466
incompatibility, 1645
silver, 873
sodium, 873
solutions, 869
Art metal, 1966
of perfumery, 1207
Artanthic acid, 1003
Artemisia, 1016
absinthium, 985, 986, 1016
maritima, 985
pauciflora, 1063, 1070
vulgaris, 1016
Artemisin, 1070
Artificial anise oil, 969
ant oil, 1966
calamine, 697
Carlsbad salt, **474**
effervescent, **477**
gum, 883, 889
Kissingen salt, **475**
effervescent, **477**
musk, 1219
oil cassia, 1973
wintergreen, 982
salts, 474
silk, 794
vert de violette, 1216
Vichy salt, **475**
effervescent, **477**
Asa dulcis, 1967
Asafetida, 994, 1022
and aloe pills, **491**
emulsion, **287**
gum, 1018, 1022
milk, **287**
oil, 994
opium and magnesia mixture, **294**
pills, **490**
tincture, **366**
Asafœtida, 1022
Asagræa officinalis, 1142
Asaprol, 932, 1967
incompatibility, 1646
Asarum, 985
canadense, 985
oil, 985
syrup compound, **273**
Asbestos, 591, 661, 1530
filters, 203

Asbolin, 1967
Ascaridol, 1001
  assay, 1483
Ascaris lumbricoides, 860
Asclepiadin, 1010
Asclepias, 1010
  tuberosa, 1010, 1030
Asclepin, 1010
Aseptol, 1967
Ash, 93
  acid, insoluble in vegetable drugs, 1522
  bark, white, 1080
  bone, 629, 1967
  in vegetable drugs, 1522
  or non-volatile matter in chemicals, 1513
  prickly, bark, 1015
    berries, 1015
Asparagin, 888
Aspartic acid, 1170
Aspidinol, 1007
Aspidium, 1007
  oleoresin, **446**
Aspidosamine, 1163
Aspidosperma, 1163
  fluidextract, 442
  Quebracho, 1165, 1167
    blanco, 1163
Aspidospermatine, 1163
Aspidospermine, 1163, 1165
Aspirin, 827
  incompatibility, 1645
  tablets, 1714
Assay, acetic acid, 1453
  acetic acid, diluted, 1453
    glacial, 1453
  acetone, 1469
  acetylsalicylic acid, 1454
  acids (alkalimetric), 1514
  aconite, 1506
  albuminized iron, 1467
  alkali benzoates and salicylates, 1514
  alkali salts of organic acids, 1455, 1514
  aloe, 1081
  alum, 1477
  aluminum chloride, 1478
    sulphate, 1478
  ammonia water, 1455
  ammoniated mercury, 1479
  ammonium benzoate, 1456
    bromide, 1462
    carbonate, 1455
    chloride, 1463
    hypophosphite, 1464
    phosphate, 1457
    salicylate, 1456
  amyl nitrite, 1481
  antimony and potassium tartrate, 1470
    oxide, 1470
  aromatic sulphuric acid, 1454
  arsenic trioxide, 1470
  arsenous iodide, 1462
  arsphenamine, 1466
  ascaridol, 1483
  barbital-sodium, 1476
  belladonna leaves, 1496
    root, 1497
  benzaldehyde, 1460
  benzoic acid, 1456
  biological, definition, 2
  bismuth magma, 1477
    subcarbonate, 1477
Assay, bismuth subgallate, 1477
    subnitrate, 1477
    subsalicylate, 1477
  black mustard, 1463
  boric acid, 1453
  bromides, 1514
  bromine, 1467
  caffeine sodio-benzoate, 1456, 1476
    salicylate, 1476
  calamine, prepared, 1458
  calcium bromide, 1462
    chloride, 1463
    glycerophosphate, 1478
    hypophosphite, 1464
    iodobehenas, 1465
    lactate, 1459
  calx, 1473
  cannabis, 1507
  chloral hydrate, 1460
  chloramine, 1465
  chlorides, 1514
  chlorinated lime, 1465
  chromium trioxide, 1466
  cinchona, 1497
  cinchophen, 1453
  citrated caffeine, 1476
  citric acid, 1453
  cocaine hydrochloride tablets, 1501
  codeine phosphate, 1458
    sulphate tablets, 1502
  coffee, roasted, 1500
  colchicum corm, 1497
    seed, 1497
  compound effervescing powder, 1456, 1457
    solution iodine, 1468, 1476
    tincture cinchona, 1499
  conium, 1501
  copper sulphate, 1466
  corrosive mercuric chloride, 1479
  dichloramine, 1465
  digitalis, 1504
  diluted solution aluminum acetate, 1478
    lead subacetate, 1473
    sodium arsenate, 1469
    sulphuric acid, 1453
  ergot, 1508
  ethereal tincture ferric chloride, 1467
  eucaine hydrochloride, 1453
  exsiccated, alum, 1478
    ferrous sulphate, 1474
    sodium arsenate, 1469
  extract belladonna, 1497
    colchicum, 1498
    conium, 1499
    hydrastis, 1500
    hyocyamus, 1498
    ignatia, 1500
    nux vomica, 1498
    stramonium, 1498
  ferric chloride, 1468
    citrate, 1468
    glycerophosphate, 1468
    hypophosphite, 1468
    oxide, 1468
    pyrophosphate, 1468
  ferrous lactate, 1468
    sulphate, 1474
  fluidextract belladonna leaves, 1498
Assay, fluidextract belladonna, root, 1498
    cinchona, 1498
    colchicum, 1498
      corm, 1500
    guarana, 1500
    hydrastis, 1498
    hyoscyamus, 1498
    ipecac, 1498
    kola, 1500
    nux vomica, 1500
  fused silver nitrate, 1462
  glacial acetic acid, 1453
  glycerite bismuth, 1477
  granulated opium, 1499
  guarana, 1501
  hydrastis, 1498
  hydriodic acid, diluted, 1462
  hydrochloric acid, 1453
    diluted, 1462
  hyoscyamus, 1498
  hypodermic tablets, 1501
  hypophosphorous acid, 1453
  ignatia, 1501
  iodides, 1514
  iodine, 1467
  ipecac, 1498
  iron, albuminized, 1468
  iron and ammonium citrate, 1467
  iron, peptonized, 1468
  kola, 1501
  lactic acid, 1454
  lead acetate, 1473
    iodide, 1463
    monoxide, 1473
  lime water, 1455
  liquefied phenol, 1468
  lithium benzoate, 1480
    bromide, 1462
    carbonate, 1458
    citrate, 1456
    salicylate, 1456
  magnesium carbonate, 1457
    chloride, 1463
    oxide, 1457
    sulphate, 1480
  mass ferrous carbonate, 1472
    mercury, 1462
  mercuric salicylate, 1461
  mercury, 1461
    with chalk, 1462, 1483
  methenamine, 1458
  methods based upon principles of neutralization, 1453
    chemical, 1449
    special, 1482
    volumetric, 1449
  methyl salicylate, 1461
  mild mercurial ointment, 1462
    mercurous chloride, 1471
    silver protein, 1462
  milk, magnesia, 1457
  morphine sulphate tablets, 1502
  neoarsphenamine, 1466
  nitric acid, 1453
  nux vomica, 1498
  oil bergamot, 1461
    bitter almond, 1460, 1464
    caraway, 1483
    chenopodium, 1483
    cinnamon, 1483
    clove, 1483

Assay, oil, dwarf pine needles, 1461
lavender, 1461
lemon, 1460
peppermint, 1461
pimenta, 1483
rosemary, 1461
santal, 1461
spearmint, 1483
thyme, 1483
opium, 1498
granulated, 1499
powdered, 1499
oxygen, 1482
peptonized iron, 1467
phenol, 1468
phosphoric acid, 1463
pills, ferrous carbonate, 1472
poison tablets, corrosive mercuric chloride, 1479
potassium acetate, 1456
and sodium tartrate, 1456
bicarbonate, 1455
bitartrate, 1453
bromide, 1462
carbonate, 1455
chlorate, 1475
chloride, 1463
hydroxide, 1459
hypophosphite, 1464
iodide, 1462
nitrate, 1463
sulphate, 1479
powdered opium, 1499
precipitated calcium carbonate, 1473
prepared calamine, 1458
chalk, 1473
processes, 22
quinine and urea hydrochloride, 1476
tannate, 1476
red lead oxide, 1469
mercuric iodide, 1483
oxide, 1461
reduced iron, 1474
resorcinol, 1468
saccharated ferrous carbonate, 1472
salicylic acid, 1456
silver nitrate, 1462
sodium acetate, 1456
arsenate, 1469
benzoate, 1457
bicarbonate, 1455
biphosphate, 1453, 1463
borate, 1459
bromide, 1462
cacodylate, 1459
chloride, 1463
citrate, 1456
glycero-phosphate, 1459
hydroxide, 1459
hypophosphite, 1464
iodide, 1462
nitrite, 1475
perborate, 1474
phosphate, 1463
exsiccated, 1463
salicylate, 1457
sulphate, 1479
thiosulphate, 1470
soluble ferric phosphate, 1467
manganese citrate, 1481
solution aluminum acetate, 1478
Assay, solution ammonium acetate, 1457
arsenous acid, 1471
and mercuric iodide, 1462, 1471
chlorinated soda, 1468
epinephrine hydrochloride, 1509
ferric chloride, 1467
citrate, 1467
subsulphate, 1468
formaldehyde, 1454
hydrogen dioxide, 1474
iron and ammonium acetate, 1457, 1467
iron tersulphate, 1467
lead subacetate, 1473
magnesium citrate, 1481
paraformaldehyde, 1454
pituitary, 1510
potassium arsenite, 1471
hydroxide, 1459
iodide, 1463
sodium arsenate, 1469
citrate, 1456
hydroxide, 1459
zinc chloride, 1463
spirit, camphor, 1482
ethyl nitrite, 1482
glyceryltrinitrate, 1476
squill, 1505
storax, 1476
stramonium, 1499
strong mercurial ointment, 1462
silver protein, 1462
stronger ammonia water, 1455
tincture iodine, 1469
strontium salicylate, 1456
strophanthus, 1505
strychnine nitrate tablets, 1502
sulphate tablets, 1502
sublimed sulphur, 1480
sucrose, 1484
sulphonated bitumen, 1457, 1480
sulphurated potassa, 1482
sulphuric acid, 1453
surgical solution, chlorinated soda, 1468
syrup ferrous iodide, 1462
hydriodic acid, 1462
tartaric acid, 1453
theobromine sodio-salicylate, 1456, 1477
thymol iodide, 1465
thyroid, 1465
thyroxin, 1465
tincture aconite, 1506
cinchona, 1499
compound, 1499
colchicum, 1499
corm, stronger, 1500
ferric chloride, 1467
hydrastis, 1500
hyoscyamus, 1499
ignatia, 1500
iodine, 1469, 1476
ipecac, 1500
nux vomica, 1499
opium, 1499
with saffron, 1500
stramonium, 1499
trichloracetic acid, 1453
Assay, volatile oil mustard, 1463
washed sulphur, 1480
yellow iodide mercury, 1472
mercuric oxide, 1461
zinc acetate, 1478
chloride, 1463
oxide, 1457
phenolsulphonate, 1479
stearate, 1458
sulphate, 1479
Assaying alkaloidal tablets, 1501
extracts, 454
Assays, alkaloidal, 1485
type processes for, 1494
biologic, 1503
by neutralization with barium hydroxide, 1456
hydrochloric acid, 1459
sulphuric acid, 1455
in which potassium thiocyanate is used, 1461
N. F. V., 1499
proximate, 1485
salts of organic acids with metals, 1455
Assets, 1273
and liability statement, 1410
Assignment of insurance, 1287
Assistants, selecting, 1271
Association, building and loan, 1285
Astragalus gummifer, 886
Astral oil, 1967, 1973
Astringent mixture, **292**
pyorrhea, **578**
substances, unofficial, 1100
Astrocaryum vulgare, 1046
Ater (Atra), 1967
Atmosphere of store, 1308
Atoms, 528
Atonone, 1214
Atopens, 1925
animal, 1930
bacterial, 1931
food, 1929
miscellaneous, 1930
pollen, 1927
used in diagnosis, 1933
Atoxyl, 939
Atramentum, 1967
Indicum, 1967
Atropa belladonna, 1132, 1133
Atropina, 1134
Atropinæ, sulphas, 1134
Atropine, 1134, 1138, 1164
and morphine hypodermic tablets, assay, 1502
antidote, 1941
derivatives, 1135
oleate, **351**, 1047
sulphate, 1134
solution, 259
sterile, **1798**
tablets, 1714
Attenuation, liquid, 1828
Aubepine, 1213, 1226
Auramin, 1967
Aurantii amari cortex, 953
dulcis cortex, 953
Aureoline, 1967
Auri bromidum, 778
chloridum, 778
et sodii chloridum, 778
iodidum, 778

Auristilla, 248, 524
Auristillation, 524
Aurum musivum, 1967
Australian fever bark, 1163
  sandalwood oil, 998
Autoclave, 1783
  horizontal, 1784
  vertical, 1784
Autogenous vaccines, 1922
Automatic extraction apparatus for alkaloids, 1487
  water still, Stokes', 142
Available chlorine, **568**
Ava-kava, 1006
Avena sativa, 888
  fluidextract, **419**
Aves, class, 1205
Avoirdupois weight, 28
  weights, 48
Axungia, 1967
Azedarach, 1079
Azines, 841
Azobenzene, 792
Azo compound, 792
Azo-dyes, 841, 850
Azotic apple, 1965
Azoxy compound, 792
Azoxybenzene, 792
Azulene, 949
Azur II, 853
  blue II, 853
  eosin, 853
Azurite, 1967

B

Baccæ spinæ cervinæ, 1090
Bacillen emulsion, 1923
Bacillula, 248, 1698, 1700
Bacillum, 248, 1733
Bacteriology, definition, 1
Bacillus acidophilus, 1179
  bulgaricus, 1179
    Squibb's, 1180
Bacterial allergens, 1931
  antigens, 1931
  atopens, 1931
  protein extracts, 1931
  vaccines, 1897, 1917
    mixed, 1920
    sensitized, 1897, 1920
Bacterin, acne, 1918
  cholera, 1918
  coli, 1918
  meningococcus, 1918
  Neisser, 1918
  pertusis, 1919
  plague, 1919
  pneumococcus, 1919
  stapylococcus, 1919
  streptococcus, 1919
  typhoid, 1919
Bacterins, 1897
Bacteriolisins, 1906
Bacteriotropins, 1906
Bael, 1016
  fruit, 891
  liquid extract, 442
Baker's ammonia, 656, 1967
Balance, analytical, 44
  cash, daily, 1414
  chainomatic, analytical, 1431
  specific gravity, Westphal's, 65
  tests, 43
  torsion prescription, 47
Balance, Troemner's, analytical, 1430
  Troemner's prescription, 46
Balances, care of, 47
  compound lever, 45
  double beam unequal arm, 45
  prescription, 44
  single beam, equal arm, 42
  single beam, unequal arm, 45
  torsion, 46
Balata, 1967
Baldwin's phosphorus, 1967
Ball or pebble mills, 158
  scale, 45
Balm, 964
  mountain, 1008
  of Gilead buds, 1005
Balneum, 248, 341
Baloena mysticetus, 1205
Balsam, Black, 1967
  canada, 1030
  capaiba, 996
  copaiba, 996
  copaiva, 996
  de maltha, 369
  fir, 1030
  gurjun, 985
  Hoffmann's, **295**
  Holy Victorious Knight, 369
  Hungarian, 1967
  Indian, 1074
  Jerusalem, 369
  of life, Turlington's, 369
  Peru, 1024, 1219
  Peruvian, 369
  poplar buds, 1005
  Riga, 1967
  Saint Victor's, 369
  sulphur, 1967
  Swedish, 369
  Thomas, 1977
  tolu, 1023
  vervain, 369
  Ward's, 369
Balsamic tincture, 369
Balsamodendron Mukul, 1029
Balsams, 1018
Balsamum arcaei, 1967
  catholicum, 369
  commendatoris, 369
  equitis sancti victoris, 369
  friari, 369
  Gileadense, 1967
  Judaicum, 1967
  nucistæ, 1967
  ophthalmicum rubrum,
  Persicum, 369
  Peruvianum, 1024
  saponaceum, 1967
  St. Yves, 1967
  succium, 369
  tolutanum, 1023
  tranquillans, **448**
  traumaticum, 369, 1967
  universale, 1967
  veranini, 369
  verum, 1967
  vitæ Hoffmanni, 1967
  vulnerarium, 369
Banana, 947
  oil, 1973
Bandages, 1759
  crêpe, 1759
  crinoline, 1759
  elastic, 1759
  flannel, 1759
Bandages, gauze, 1759
  plaster-of-Paris, 1759
  ribbon, 1759
  roller, 1759
  starch, 1759
  stockinette, 1760
  triangular, 1759
  water dressing, 1759
Bangue hemp, 999
Bank acceptances, 1281
  account, 1396
    opening, 1278
  book, 1279, 1413
  deposits, 1279
Banking, 1276
Banks, aid from, 1274
  federal reserve, 1282
  financing by, 1274
  national, 1281
  oil, 1967
  private, 1284
  savings, 1284
    postal, 1284
  state, 1284
Bannal, 1967
Baobab, 891
Baphia nitida, 845
Baptigenin, 1156
Baptin, 1156
Baptisia, 1156
  fluidextract, **420**
  tinctoria, 1030, 1156
Baptitoxine, 1156
Barbadoes aloe, 1081
Barbaloin, 1080
Barbital, **923**
  -Abbott, 923
  compounds, **923**
  incompatibility, 1645
  -M. C. W., 923
  -Merck, 923
  sodium, 924
    -Abbott, 924
    assay, 1476
    elixir, Abbott, 924
    -Merck, 924
  soluble, **924**
Barbitalis sodium, 924
Barbitalum, **923**
  solubile, 924
Barbitine, 1967
Barbitone, **923**
  sodium, **924**
Bardana, 1967
Barii acetas, 687
  benzoas, 687
  bromidum, 687
  carbonas, 688
  chloridum, 688
  chromas, 688
  dioxidum, 688
  hydroxidum, 688
  iodidum, 688
  nitras, 688
  sulphas, **686**
  sulphidum, 688
Barium, 531, 661, 686
  acetate, 687
  benzoate, 687
  bromide, 687
  carbonate, 688
  chloride, 688, 1530
    test solution, 1544
  chromate, 688
  dioxide, 688
  hydroxide, 688, 1530

Barium hydroxide, tenth-normal, 1554
test solution, 1545
iodide, 688
nitrate, 688, 1530
test solution, 1545
salts, tests for, 686
unofficial, 687
sulphate, **686**
sulphide, 688
antidote, 1941
Bark, acacia, decoction, **363**
Australian fever, 1163
bayberry, 1004
black oak, 1100
blackberry, 1099
calisaya, 1113
candleberry, 1004
cherry, wild black, 991
cotton root, 1076
dita, 1164
elm, 887
fringe tree, 1073
horsechestnut, 1100
Jesuit's, 1114
muawin, 1164
Peruvian, 1113
pomegranate, 1146
prickly ash, 1015
sassy, 1164, 1166
slippery elm, 887
soap-tree, 1078
tincture, **371**
wahoo, 1088
wax myrtle, 1004
white oak, 1099
yohimboa, 1165, 1167
Barley, 883
sugar, 897
Barm, 1967
Barnstead water still, 142
Barometer, mercurial, 122
paper, 736
Barosma betulina, 985, 998, 1030
crenulata, 985, 998
serratifolia, 985, 999
Barrel mill, 159
Barytes, 686
Bases, 534, 535
Basham's mixture, 257, **722**
Basic betanaphthol bismuth, 938
bismuth carbonate, **770**
gallate, **771**
nitrate, 772
salicylate, **773**
dyes, 841
ferric sulphate solution, **731**
fuchsin, 853, 1534
salts, 536
Basil oil, sweet, 986
wild, 964
Basilicon ointment, **513**
Basofor, 1967
Bassia longifolia, 1045
oil, 1045
Bassorin, 885
Bateman's pectoral drops, **395**
Bath, 341
air, 114
electrically and regulated, 114
gas heated water-jacketed, 114
glycerin, 113
Bath, oil, 113
salts, **1232**
sand, 112
steam, open, **115**
water, 113
brass, 362
Baths, 112
salt water, 113
steam, 114
Battery acid, 1965
manganese, 1972
Baudruche, 1967
Baumé de Vie, 1967
Baumé Tranquille, 448
Baumé's hydrometers, 58
Bay oil, 975, 1973
salt, 1967
Bayberry bark, 1004
oil, 1045
powder, compound, **483**
Bdellium, 1029
Beads, Lovi's, 65
specific gravity, 65
Bean, 883
Calabar, 1131
ordeal, 1131
Saint Ignatius, 1160
Bearberry, 1097
infusion, **362**
Bear's paw root, 1007
Bebeerine, 1161, 1165
sulphate, 1165
Beckmann type thermometer, 105
Beck's hydrometer, 64
Bedbugs, elimination, 1846
Beech-drop, 1100
Beech oil, 1045
Beef and iron elixir, **321**
extract, 1185
Beeswax, 1191
bleached, 1192
Beet sugar, **896**
Beetles, carpet, elimination of, 1846
Behen oil, 1045
Bela, 1016
Bell metal, 1967
Belladonna, 1941
aloin and strychnine pills, **493**
compound, **493**
and capsicum plaster, 521
extract, **455**
assay, 1497
pilular, **455**
powdered, **455**
leaves, 1133
assay, 1496
fluidextract, **406**
assay, 1498
liniment, **347**
ointment, **503**
plaster, 518, 520, 521, 1752
green, 520
root, 1133
assay, 1497
fluidextract, **407**
assay, 1498
suppositories, 523
tincture, **367**
Belladonnæ extractum P. I., **455**
folia, 1133
folium P. I., 1133
radix, 1133
tinctura P. I., **367**
Belladonnine, 1133
Bellows, foot, 110
Ben oil, 1045, 1973
Bending glass tubes, 134
Benedict's qualitative reagent, 1570
quantitative estimation of glucose in urine, 1441
reagent, 1570
Bengal isinglass, 1967
Benjamin flowers, 833, 1970
gum, 1024, 1970
Benne leaves, 891
oil, 1044
Bensamann's method of collecting fusible body, 107
Bent horn stirrer, 126
Benzacetin, 932
Benzaconine, 1143
Benzaldehyde, 978, 990, 1226
assay, 1460
Benzaldehydum, 990
Benzamine lactate, 932
Benzanilid, 932
Benzene, 96, 175, 788, 791, 811, 1530
blast lamp, 96
coal-tar, as a solvent, 174
medicinal, 831
Benzidin, 792
Benzidine, 811, 1530
test for blood in urine, 1447
Benzin, petroleum, 96, 785, 1531
as a solvent, 174
purified, **1061**
Benzinum purificatum, **1061**
Benzoate, ammonium, **653**
assay, 1456
amyl, 1214
barium, 687
benzyl, 837, 933, 1024, 1215, 1219, 1226
elixir, **837**
emulsion, **837**
betanaphthol, 933
incompatibility, 1645
calcium, 683
ethyl, 175, 934, 1215, 1226
ferric, 732
guaiacol, 809, 933
isobutyl, 1216
linalyl, 1216
lithium, **644**
assay, 1480
mercuric, 759, 878
methyl, 1216, 1226
naphthol, 933
sodium, **620**
assay, 1457
incompatibility, 1649
Benzoates, 833
and salicylates, alkali, assay, 1514
incompatibility, **1645**
Benzocaine, 834
Benzoic acid, **832**, 1024, 1025, 1063, 1211
assay, 1456
compounds and derivatives, 832
unofficial, 837
English, 833
German, 833
orthohydroxy, **824**
troches, 499

Benzoic ether, 1967
Benzoin, 1024, 1211, 1219
  flowers, 833
  lotion, 1211, **1236**
  Siam, 1024
  Sumatra, 1024
  tincture, 368
    compound, **368**
Benzoinated lard, **1041**
  suet, **1044**
Benzoinum, 1024
Benzol, 96, 1530
  crystallizable, 831
  medicinal, 831
  methyl, 1972
Benzolaconine, 1143
  methyl, 1143
Benzonaphthol, 933, 1967
Benzophenoneid, 1967
Benzosalin, 933
Benzosol, 933, 1967
  incompatibility, 1645
Benzosulphinidum, **833**
Benzoyl ecgonine, 1165
  glycocoll, 1029
  -guaiacol, 933
  -naphthol, 933
  -salicylic-acid methyl ester, 933
  tropeine, 1165
Benzoylanilid, 932
Benzyl acetate, 1215, 1226
  alcohol, 175, 837, 1211
  benzoas, 837
  benzoate, 837, 933, 1024, 1215, 1219, 1226
    elixir, **837**
    emulsion, **837**
  cinnamate, 1024, 1219
  fumarate-Abbott, 933
  succinate, 933
Benzylic alcohol, 1226
Benzylis benzoas, 933
  fumaras, 933
  succinas, 933
Berbamine, 1156
Berberine, 1064, 1144, 1158, 1164, 1165
Berberis, 1156
  fluidextract, **420**
  tincture, 400
  vulgaris, 1165, 1167
Berbine, 1156
Bergamot oil, 956
  assay, 1461
Beri-beri, 1168
Berlin blue, 1967
Berries, buckthorn, **1090**
  cubeb, 995
  horse, 1003
  horse-nettle, 1163
  jujube, 892
  juniper, 1003
    fluidextract, **431**
    oil, 1001
  poke, 1017
  prickly ash, 1015
  saw palmetto, **1013**
  sumac, 946
Berry, fish, 1157
  Indian, 1157
Bertholletia excelsa, 1045
Berzelius's blowpipe, 109
Bestuscheff's tincture, **389**
Beta rays, 684
Beta vulgaris, 896
Betaeucainæ hydrochloridum, 1150
Betaeucaine hydrochloride, incompatibility, 1645
  lactate, incompatibility, 1645
Betaine trimethyl-glycoll, 1165
Betanaphthol, 792, **812**, 1531
  benzoate, 933
    incompatibility, 1645
  bismuth, 775
    basic, 938
  -disulphonate, aluminum, 703, 932
  hydroxytoluic acid, 934
    incompatibility, 1646
  incompatibility, 1645
  paste, **516**
  petroxolin, **352**
  salicylate, 933
Betanaphtholsulphonate calcium, incompatibility, 1646
Betel nut, 1100, 1165, 1967
Beth root, 1015
Betol, 1967
  naphthalol, 933
Bettendorf's arsenic test, 1513
Betula alba, 805
  lenta, 982
  oil, 982
Betulaceæ products, 982
Bezoardicum, acetum, 1965
Bhang, 999
Bharg, 1967
Bial's reagent, 1570
Biancæa sappan, 845
Biborate, sodium, 622
Bicalcic phosphate, 1967
Bicarbonate, ammonium, 659
  potassium, **600**, 1538
    assay, 1455
  sodium, **620**, 1540
    assay, 1455
    tablets, **501**
Bicarbonates, tests, 621
Bichloride, mercury, **752**
  antidote, 1942, 1943
  as a disinfectant, 1873
  methylene, 937
  tablets, 500
Biebrich, 939
Bigarade orange, 952
Bile in urine, 1443
    Gmelin's test for, 1443
    Smith-Rosen test for, 1443
  reaction, 1568
  salts and compounds, unofficial, 1184
  salts, Fairchild, 1184
Bilein, 1184
Biliary color reactions, 1569
Bilis Bovinum, 1967
Billing ledger, 1403
Bills, list of, 1415
Binary compounds, 533
Binding prescriptions, 1619
Biniodide, mercury, **755**
  wool, **1762**
Binoxalate, potassium, 798
Bio-assay methods, 1504
Biologic assays, 1503
Biological assay, definition, 2
  products, 1891
    as diagnostic agents, 1932
    classification, 1798
    for active immunization, 1912
Biological products for passive immunization, 1900
    manufacturers of, 1936
Biologicals, classification (new), 1891
  dating, 1897
  dispensing, 1897
  preservation, 1897
Biology, definition, 1
Bi-palatinoid, 1967
Biphosphate, sodium, **631**
    assay, 1453, 1463
Birch oil, pyroligneous, rectified, 805
    sweet, 982
  tar oil, rectified, 805
Bird pepper, African, 996
Bismal, 775, 933
Bismosol, 776
Bismuth, 531, 761, 770
  and ammonium citrate, 775
  and iron citrate, 775
  and pepsin elixir, **332**
  and potassium tartrate, 775
  betanaphthol, 775
    basic, 938
  bromide, 775
  carbonate, basic, **770**
  chromate, 775
  citrate, 775
  colloidal, 188
  cream, **774**
  elixir, **318**
  emetine iodide, 1148
  gallate, basic, **771**
  glycerite, **302**, 775
    assay, 1477
  iodosubgallate, incompatibility, 1645
  iron and cinchona alkaloids, elixir, **324**
  iron, strychnine and cinchona alkaloids, elixir, **324**
  lactate, 775
  magma, **774**
    assay, 1477
  methylene-digallate, 933
  milk, **774**
  naphtholate, 938
  nitrate, basic, **772**
  oleate, 775, 1047
  oxalate, 775
  oxide, 775
  oxycarbonate, **770**
  oxychloride, 775
  oxygallate, **771**
  oxyiodogallate, 775
  oxyiodomethyl-gallol, 937
  oxynitrate, **772**
  pepsin and strychnine elixir, **331**
  phosphate, 775
  salicylate, basic, **773**
  salts, tests for, 770
    unofficial, 775
  solution, 258, **775**
  subcarbonate, **770**
    assay, 1477
  subgallate, **771**
    assay, 1477
  subnitrate, **772**
    assay, 1477
  subsalicylate, **773**
    assay, 1477
  tannate, **776**

Bismuth, tetra-iodo-phenolphthalein, 935
tribromocarbolate, 940
tribromphenate, 776
tribromphenol, 776, 940
incompatibility, 1645
troches, compound, 499
valerate, 776
Bismuthi betanaphtholas, 775
bromidum, 775
chromas, 775
citras, 775
et ammonii citras, 775
et ferri citras, 775
et potassii tartras, 777
iodosubgallas, 775
lactas, 775
methylene digallas, 775
oleas, 775
oxalas, 775
oxidum, 775
oxychloridum, 775
phosphas, 775
subcarbonas, **770**
subgallas, **771**
subnitras, **772**
subsalicylas, **773**
tannas, 776
tribromphenas, 776
valeras, 776
Bismuthinite, 770
Bistort, 1100
Bistorta, 1100
Bisulphate, potassium, 615, 1538
quinine, 1116
Bisulphite, potassium, 615
sodium, 642, 1540
Bitartrate, potassium, **601**
and sulphur tablets, **502**
assay, 1453
sodium, 1540
Bitter almond oil, 988, 1063
antidote, 1943
assay, 1460, 1464
spirit, **312**
water, **256**
apple, 1087
candytuft, 994
chips, 1967
earth, 1967
metallic pills, **495**
orange, 953
elixir, **318**
fluidextract, 442
infusion, 361
compound, **361**
oil, 956
peel, 953
tincture, **367**
root, 1967
salts, 1967
sticks, 1967
stomachic drops, **384**
tincture, **384**
zedoary, 401
wood, 1064, 1967
Bitterless syrup of quinidine, **281**
Bittersweet, 1159
fluidextract, **425**
Bitumen collodion, sulphonated, **344**
Judaicum, 1967
sulphonated, 866
assay, 1457, 1480
Bitumen sulphonated ointment, **507**
petroxolin, **352**
sulphonatum, 866
Bituminous coal, 93
Bixa orellana, 845
Black alder, 1079
balsam, 1967
basilicon ointment, 1973
blue, 1967
cherry bark, wild, 991
cohosh, 1009
fluidextract, **409**
draught, 361, 1967
drop, 361, 378, 1967
Quaker's, 1975
flux, 1967
gas, 1970
Germantown, 1970
ginger, 984
haw, 1014
elixir, **337**
hellebore, 1079, 1165
lotion, **299**
mercuric sulphide, 760
mustard, 992
assay, 1463
seed, 992
oak bark, 1100
Paris, 1974
pepper, 1004
pitch, 805
poplar buds, 1005
snakeroot, 1009
fluidextract, **409**
wash, **299**
Blackberry, 947
bark, 1099
cordial, 947
Black's blowpipe, 109
Bladder joints, 136
senna, 1090
Bladderwrack, 890
Blanc de Troyes, 1967
fixe, 686, 1967
Blancard's pills, 1967
Blankit, 1967
Blast lamp, alcohol, **95**
benzene, 96
Russian, 95
Blatta, 1205
orientalis, 1205
Blaud's mass tablets, 1719
pills, **490**
Bleached beeswax, 1192
Blennostasine, 1165
Blister plaster, 521
Blistering cerate, **513**
liquid, 259
Block metric weights, 49
-tin decoction vessel, 362
weights, 48, 49
Blood, 1204
-cell casts in urine, 1446
cells, red, in urine, 1447
examination, reagents for, 1572
in urine, benzidine test, 1447
chemical test for, 1447
guaiac test for, 1448
reaction, 1569
root, 1162
serum, 1576
Bloodroot tincture, **398**
Blossoms, acacia, 1225
May, 1225
Blossoms, red clover, 1078
Blotter, 1392
Blowpipe, Berzelius's, 109
Black's, 109
gas, 109
plain bulb, 109
Plattner's, 109
use, 109
Blue, Berlin, 1967
black, 1967
Chinese, 1967
cohosh, 1073
color, 841
copperas, 1967
flag, 1012
fluidextract, **430**
flame coal oil stove, wickless, 96
gauze, **1762**
gum leaves, 978
tree, 978
mass, **488**, **749**
methylene, 848
mono-nitro-methylene, 854
ointment, **505**
pill, **488**, **749**
Prussian, 1975
vervain, 1080
vitriol, 560, 743
wool, **1763**
Blueberry, 947
Bluestone, 743, 1967
Blue-weed, 891
Blush, Lady's, 1971
Boards of Pharmacy, National Association, 1250
reciprocity, 1250
Bogardus mill, 160
Boiler, gas heated, 117
steam, 117
Boiling, evaporation by, 124
point test, 122
points, 1524
determination of, 122
U. S. P. X method for determining, 120
Boldine, 1165
Boldo fluidextract, **420**
Bolus, 248, 1691
Alba, 1967
Armenia, 1967
Bone-ash, 629, 1967
char, 1967
oil, 1973
-phosphate, 629
Boneset, 1011
Bookkeeping, 1391
double entry, 1403
single entry, 1402
Book-lice, elimination of, 1853
Book of original entry, 1393
Bookoo, 998
Books on perfumery, 1243
pharmaceutical, 1625
Boracic acid, **590**
wool, **1762**
Borage, 891
Borago officinalis, 891
Borate, ammonium, 660
glyceryl, glycerite, **301**
sodium, **622**, 1540
assay, 1459
honey of, **285**
solution, compound, **641**
Borated gauze, 1758
talcum powder, white, 1235

Borates, 590
incompatibility, 1645
tests for, 590
Borax, 622
and honey, 285
-methylene blue solution, 1573
red, 1967
Borcherdt's dri-malt soup extract, 1821
with wheat flour, 1821
malt extract, 1821
sugar, 1821
Borers, cork, 135
Boric acid, 590
assay, 1453
gauze, 1761
ointment, 502
wool, 1762
gauze, 1761
wool, 1762
Borneol, 1211
acetate, 1211
Bornyl acetate, 963, 1022, 1215, 1226
Boroboracic acid, 1965
Borocitrate, lithium, 648
Boroglycerin, glycerite, 301
Boron, 531, 588, 590
compounds, unofficial, 590
trisulphide, 590
trisulphidum, 590
Borophenol, 933
Boro-salicylated powder of talc, 484
Borussic acid, 1965
Bos taurus, 1175, 1179, 1184, 1189, 1204
Boswellia, 1030
carterii, 986
Botanical name, 17, 20
Botany, definition, 1
Bottle brush, Lenox, 1662
capping machine, 668
fillers, 1666
graduated receiving, 245
Nicol's specific gravity, 66
poison, 1666
receiving for percolates, 245
specific gravity, 57
volume, 69
Woulff's, 182
Bottles, 1663
capping, 1670
for sealing cachets, 1686
prescription, 1603, 1662
receiving, 245
washing, 1666
Botulinus antitoxin, 1906
Bougie, 248, 1733
Bougie mold, 1743
Bougies, 1744
Bouillon filtrate, 1923
galactenzyme, 1181
glucose, 1575
plain, 1575
stock, 1574
Boulton's solution, 578
Bouncing Bet, 1080
Boundou, 1163
Box prescription scales, 46
Boxes, powder, 1676
B-oxybutyric acid in urine, 1443
Brady's suppository mold, 1739
Brain extract solution, 1203
lipoid, 1203
Brake, knotty, 1007
sweet, 1007
Bran oil, 1967
Brandy, 311, 903, 916
Branntwein, 903
Brasium, 1967
Brass, 1967
filter pump, 206
water bath, 362
Brassica campestris, 1046
juncea, 992, 993
nigra, 992, 993, 1045
Brassil, 1967
Brauneria angustifolia, 1028
pallida, 1028
Braunite, 706
Brayera, 1073
anthelmintica, 1073
infusion, 360
Brazil nut oil, 1045
wax, 1967
Brazilian cacao, 1967
rhatany, 1095
Brazilwood, 845
Bread sugar, 894
Breaker feeder, 165
Breast plaster, 521
tea, 486
British gum, 883, 889
oil, 1057
thermal units, 92
Brix's hydrometer, 64
Brom cresol purple, 543, 1450
test solution, 1450
phenol blue, 543
-strorolene, 1222
-styrol, 1217
Bromal, 933
Bromalin, 933
Bromamide, 933
Bromate, potassium, 1539
Bromates, tests for, 574
Bromauric acid, 777
Bromdiethyl acetylurea, 925
Bromeikon, 861
Bromela, 1216
Bromelin, 902
Bromethylate, hexamethylene tetramine, 933
Brometone, 861
Bromi chloridum, 568
Bromic acid, 568
Bromide, aluminum, 703
ammonium, 654
assay, 1462
elixir, 316
and chloral compound, 293
antimony, 763
arsenic, 769
arsenic and gold, solution, 769
barium, 687
bismuth, 775
cadmium, 705
calcium, 673
assay, 1462
elixir, 337
chromium, 734
cupric, 744
cuprous, 744
ethyl, 934
ethylene, 935
ferrous, 732
gold, 778
homatropine, 1135
hyoscyamine, 1137
Bromide, lead, 742
lithium, 645
assay, 1462
mercuric, 759, 1536
methyl codeine, 935
nickel, 735
potassium, 602
assay, 1462
effervescent salt, compound 603
elixir, 333
with caffeine, effervescent, 603
quinine, 1118
scopolamine, 1136
silver, 747
sodium, 623, 1540
assay, 1462
elixir, 334
strontium, 689
zinc, 697
Bromides, assay, 1514
elixir of five, 318
elixir of three, 319
incompatibility, 1646
soluble, incompatibility, 1647
syrup of, 273
tests for, 574
Bromine, 531, 567, 573, 1531
assay, 1467
chloride, 568
preparations, unofficial, 861
solution, 259, 575
Smith's, 575
tenth-normal, 1555
test solution, 1545
water, 1545
Brominized sesame oil, 861
Bromipin, 861
Bromodiethyl acetamide, 938
Bromoform, 861
-acetone, 861
Bromoformum, 861
Bromol, 940, 1967
Bromopyrine, 933
Bromsulphalein-H. W. and D., 848
Bromthymol blue, 543
Bromum, 573
Broom, infusion, 362
tops, 1163
Brown gum barbary, 1970
mixture, 291
mustard, 992
ointment, 508
plaster, camphorated, 520
Brownian movement, 186
Brucine, 1126
Brucite, 1967
Brunella, 964
vulgaris, 964
Brunfelsia Hopeana, 1161
Brush for show cards, 1384
lettering, 1384
Bryogenin, 1063
Bryonia, 1088
alba, 1063, 1088
dioica, 1063, 1087
tincture, 386
Bryonidin, 1088
Bryonin, 1063, 1088
Bryony, 1088
Bryoresin, 1088
Bryoretin, 1063
B. T. U., 92
Buchner funnel, 202

Buchu, 998
and potassium acetate, elixir, 320
elixir, 319
compound, 319
fluidextract, 407
compound, 420
infusion, 361
juniper and potassium acetate, elixir, 320
leaves, 998
long, 998
oil, 985
short, 998
tincture, 400
Buckbean, 1079
Buckthorn bark, 1089
berries, 1090
syrup, 281
Bufo cinereus, 1205
viridis, 1205
Buginarium, 248, 1733
Bugleweed, 964
Buhrstone mill, 159
Building and loan associations, 1285
Bulb blowpipe, plain, 109
trap, 134
Bulgara tablets, 1180
Bulgarian bacillus, liquid, 1181
rose perfume, 1224
Bulk containers, 1790
Bumping, 134
Bunsen burner, adjustable, 100
burners, 98
Burdock root, 1077
Bureau of Standards specifications for glass graduates, 52
Burette, dropping device for, 1451
glass-valved, 1451
ordinary, 1451
stand, 1452
Burglary insurance, 1288
Burgundy pitch, 1030
oil, 985
Burned wine, 903
Burner, adjustable Bunsen, 100
Fisher, 99
Fletcher's radial, 99
Meker, 99
micro, 99
Burners, Bunsen, 98
Burnett's disinfecting fluid, 693
Burnt alum, 700
sugar coloring, 844
Burow's solution, 702
Business administration, 1267, 1270
and profession, 1267
costs, census, 1422
facts must be known, 1269
laws, 1245
organization, 1269
requirements of pharmacy, 1267
training needed, 1268
transactions, outline, 1395
Butane, 785
normal, 781
Butea seed, powder, 484
Butene glycol, 787
Butesin, 839
picrate, 839
Butter, 1204
cacao, 1040
Butter, cocoa, 1040
color, 1967
of antimony, 1697
of tin, 1967
of zinc, 1967
orris, 1003
yellow, 853
Butterfly weed root, 1010
Butternut bark, 1089
Butyl acetate, 175
alcohol, 175
chloral, 933
hydrate, 933
Butylhypnal, 1967
Butyn, 838
Butyraldehyde, 979
Butyrate, amyl, 932, 1214
ethyl, 175, 934, 1215
geranyl, 1215
phenylethyl, 1216, 1217
rhodinol, 1217
Butyric acid, 799, 1203
ether, 1215
Butyrum, 1204
majoranæ, 1967
nucistæ, 1967
Buyer for drug store, 1328
price, 1366
service, 1366
Buying, coöperative, 1337
direct, 1338
in quantity, 1338
indirectly, 1338
merchandise, 1328
methods, 1329
Buxine, 1161, 1165
Buxus sempervirens, 1161, 1165
Byne (Bynin), 1968

C

Cabinet, laboratory, 1430
Cacao butter, 1040
præparatum, 1044
prepared, 1044
Cachet apparatus, dry seal, 1688
German, 1687
de pain, 1685
dry seal, 1688
funnel, 1686
sealing, 1686
wetter, 1686
Cachets, 1678, 1685
manufacture, 1685
Cacodylate, sodium, 624
assay, 1459
Cacodylic acid, 933
Cactus grandiflorus, 1157
tincture, 386
Cadaveric alkaloids, 1204
Cadaverine, 1204
Cade oil, 805
petroxolin, 352
Cadinene, 996, 1001, 1022,
Cadmii bromidum, 705
chloridum, 705
iodidum, 705
oxidum, 705
sulphas, 705
sulphidum, 705
Cadmium, 531, 690, 705
and potassium iodide, 1531
bromide, 705
chloride, 705, 1531
test solution, 1545
Cadmium, iodide, 705, 1531
oxide, 705
salts, tests for, 705
unofficial, 705
sulphate, 705
sulphide, 705
Cæsalpina, 845
bunducella, 1046
Cæsium, 595
Caffa, 1968
Caffeic acid, 1157
Caffeina, 1150
citrata, 1151
Caffeinæ sodio-benzoas, 1152
-salicylas, 1153
Caffeine, 1150, 1157, 1160, 1161
and sodium benzoate, hypodermic tablets, 1502
citrate, 1151
citrated, 1151
assay, 1476
effervescent, 1153
hypodermic tablets, assay, 1502
preparations, unofficial, 1153
sodio-benzoate, 1152
ampuls, 1796
assay, 1456, 1476
sodio-salicylate, 1153
assay, 1476
Cajeput oil, 978, 979
spirit, 315
Cajuputene, 978
hydrate, 978
Cajuputol, 978, 979
Cake, alum, 1966
nitre, 1973
salt, 1976
sublimates, 146
Calabar bean, 1131
antidote, 1942
Calamina præparata, 697
Calamine, 697
artificial, 697
liniment, 347
lotion, 298
compound, 299
ointment, 507
prepared, 697
assay, 1458
Calamintha, 964
clinopodium, 964
Calamus draco, 1030
oil, 985
Calbroben, 861
Calcii benzoas, 683
bromidum, 673
carbonas præcipitatus, 674
caseinas, 1820
chloridum, 676
glycerophosphas, 677
hydroxidum, 683
hypophosphis, 678
iodas, 683
iodidum, 683
iodobehenas, 862
lactas, 678
lactophosphas, 679
phenolsulphonas, 683
phosphas præcipitatus, 680
salicylas, 683
sulphas, 683
exsiccatus, 683
sulphidum, 683
crudum, 683
sulphis, 684

Calcii, sulphydras, 684
thiosulphas, 684
Calcination, 111
Calcined magnesia, **663**
plaster, 1968
Calcitea, 1968
Calcithos, 1968
Calcium, 531, 661, 670
and sodium glycerophosphates, elixir, **320**
hypophosphites, syrup, **274**
benzoate, 683
betanaphtholsulphonate, incompatibility, 1646
bromide, 673
assay, 1462
elixir, **337**
cacodylate, sterile solution, **1798**
carbonate, 1531
precipitated, **674**
assay, 1473
caseinate, 1820
chloride, **676**, 1531
assay, 1463
fused, 1531
solution, 1569
sterile solution, 1799
test solution, 1545
urea, 683
dibrombehenate, 861
fluoride, 579
glycerinophosphate, **677**
glycerophosphate, **677**
assay, 1478
hydrochlorophosphate syrup, **283**
hydroxide, 683
solution, 257, **672**
syrup, 283
test solution, 1545
hypophosphite, **678**
assay, 1464
elixir, **337**
syrup, **274**
iodate, 683
iodide, 683
syrup of, **274**
iodobehenate, 862
assay, 1465
lactate, **678**
assay, 1459
lactophosphate, **679**
and iron, syrup, **275**
elixir, **320**
syrup, **275**
monoiodobehenate, 862
oxide, **671**
antidote, 1941
oxysulphuret, solution, **681**
phenolsulphonate, 683
phosphate, precipitated, **680**
phosphide, 1968
salicylate, 683
salts, tests for, 671
unofficial, 683
sulphate, 683, 1531
exsiccated, 683
test solution, 1545
sulphide, 683
crude, 683
sulphite, 684
sulphydrate, 684
thiosulphate, 684
Calcreose, 809
Calculating inventory, 1354
Calculation of doses for children, 90
Calender of window displays, 1369
Calendula, 1010
fluidextract, **420**
officinalis, 1010
tincture, **386**
Calioben, 862
Calisaya bark, 1113
alkaloidal ferrated elixir, **323**
elixir, alkaloidal, **323**
alkaloidal, with iron and bismuth, 324
and strychnine, 324
Calmette test, 1935
Calomel, 188, **753**
and jalap, **483**
and santonin tablets, **501**
troches, 499
and soda tablets, 1718
colloidal, 881
incompatibility, 1646
incompatibility, 1648
ointment, **508**
pills, compound, **491**
tablets, **500**
Calomelanos, 1968
Calomelol, 881
incompatibility, 1646
Calorie, large, 92
small, 92
Calories, 92
Calumba, 1064
fluidextract, **421**
infusion, **361**
tincture, **369**
Calx, 670, **671**
assay, 1473
bismuthi, 1968
chlorinata, **568**, 673
sulphurata, 683
viva, 1968
Cambogia, 1085
Cambric, oiled, 1760
Camiofen ointment, 578
Camphene, 955
Camphol, 939
Camphor, 986
ampuls, **1796**
and menthol, **959**
opium pills, **496**
cerate, **514**
compressed, 987
cream, **988**
gum, 986
incompatibility, 1646
julep, 1968
juniper, 1001
lemon, 955
liniment, **345**
ammoniated, **350**
mixture, acid, 297
aromatic, 297
monobromated, 988
oil, 985
ointment, **507**
peppermint, 959
powdered, 986
preparations, unofficial, 988
salol, 939
spirit, **308**
assay, 1482
tonka bean, 1968
wash, ammoniated, **298**
water, **253**
Camphora, 986
monobromata, 988
Camphorate, hexamethylenetetramine, 931
Camphorated brown plaster, **520**
chloral, **858**
chloroform petroxolin, **352**
menthol, **959**
mother plaster, **520**
oil, **345**
phenol petroxolin, **353**
soap liniment, **348**
tincture opium, **378**
Camphoric acid, 988, 994
Camphors, 791, 948
Camwood, 845
Canada balsam, 1030
liniment, 348
pitch, 1030
snakeroot, 985
turpentine, 985, 1030, 1531
Canadian hemp, 1009
moonseed, 1164
Canadine, 1144
Canadol, 1968
Canangium odoratum, 986
Canarium commune, 985
Cancrorum Chelæ, 1968
lapilli, 1968
Candelæ fumales, 1968
Candies, selling, 1311
Candle nut oil, 1045
Candleberry bark, 1004
Candy rock, 896
Candytuft, bitter, 994
Cane sugar, **896**
Canella, 1002
alba, 985
and aloes powder, **481**
oil, 985
winterana, 1002
Canna, 883
edulis, 883
Cannabinine, 1000
Cannabinol, 1000
Cannabis, 999
antidote, 1942
assay, 1507
extract, **456**
fluidextract, **408**
assay, 1507
Indian oil, 986
indica, 999
sativa, 986, 999, 1045
tincture, 400
Cannarium commune, 1029
Cannon ball mill, 159
Cantharidal collodion, 344
Cantharides, 1190
antidote, 1942
cerate, **513**
plaster, **519**, 521, 1752
tincture, **369**
vinegar, 450
Cantharidin ointment, 511
plaster, 520
mild, 520
Cantharidis tinctura P.I., **369**
Cantharis, 1190
vesicatoria, 1190
Canton flannel strainers, 194
Capaiba, balsam, 996
Cape aloe, 1080
Capita papaveris, 1968
Capital, 1272, 1273

Capping bottles, 1670
varnish, pulp, **342**
Capronaldehyde, 979
Caproic acid, 799
Caprylic acid esters, 954
Capsaicin, 996
Capsella bursa-pastoris, 994
Capsicum, 996
and myrrh tincture, **386**
fastigiatum, 985
frutescens, 996
oil, 985
ointment, **507**, 511
oleoresin, **446**
plaster, 519, 520, 521, 1752
elastic, 520
tincture, **369**
wool, **1762**
Zanzibar, 996
Capsula, 248
amylacea, 248, 1685
Capsule filler, Colton, 1680
Ihrig, 1680
Sharp and Dohme, 1681
molds, 1682
Capsules, 1678
arheol, 998
enteric, 1683
filling, 1679
gelatin, 1678
glutoid, 1684
hard, 1678
poppy, 1164
soft, 1678
elastic, 1681
suppository, 1743
wafer, 1685
Caramel, 844, 897
tincture, 400
Carapa guianensis, 1045
Caraway, 965
fruit, 965
oil, 965
assay, 1483
seed, 965
Carbamate, ethyl, 934
incompatibility, 1646
Carbamide, urea, 1205
Carbasus, 248, 1759
acidi borici, 1761
carbolici, **1761**
picrici, **1761**
aluminii acetatis, **1761**
hydrargyri et zinci cyanidi, **1672**
perchloridi, **1761**
iodoformi, **1762**
cum glycerino, **1762**
salis alembroth, **1762**
styptica, **1762**
zinci sulphitis, **1762**
Carbazol, 811
Carbazotic acid, 1965
Carbo animalis purificatus, 589
ligni, **589**
Carbohydrases, 902
Carbohydrate foods, 1821
Carbohydrates, 787, 1168
Carbol methyl violet solution, 1573
Carbolated gauze, 1758
Carbolfuchsin solution, 1573
diluted, 1574
Carbolic acid, **816**
acid, antidote, 1942
as a disinfectant, 1875
Carbolic acid, crude, 813
gauze, **1761**
glycerite, **301**
liquefied, **819**
ointment, **506**
suppositories, 523
troches, 499
water, **256**
gauze, **1761**
Carbolized oil, **355**
solution of iodine, **578**
wool, **1761**
Carbon, 531, 588
black, 1968
dioxide, 588, 799
snow, 588
disulphide, 581, 811, 1532
as a solvent, 174
monoxide, 588, 799
antidote, 1942
tetrachloride, 785, 860, 1532
as a solvent, 174
Carbonate, ammonium, **655**, 1529
assay, 1455
barium, 688
bismuth, basic, **770**
calcium, 1531
precipitated, **674**
assay, 1473
creosote, 807
incompatibility, **1646**
diethyl, 175
ferrous, liquid, **713**
mass, **487**, 713
assay, 1472
nascent, **713**
pills, **490**
assay, 1472
saccharated, **712**
assay, 1472
guaiacol, **808**
lead, 742, 1535
lithium, **646**, 648
assay, 1458
magnesium, 205, **661**
assay, 1457
manganese, 709
mercurous, 759
methyl heptine, 1216
nickel, 735
potassium, **604**, 1539
anhydrous, 1539
assay, 1455
incompatibility, 1649
sodium, anhydrous, 1541
incompatibility, 1649
monohydrated, **624**, 1541
assay, 1455
strontium, 689
zinc, precipitated, 697
Carbonates, 589
incompatibility, 1646
tests, 589, 621
Carbonei disulphidum, **581**
tetrachloridum, 860
Carbonic acid, 588
Carbonization, 111
Carborundum, 1968
Carboxyl, 782
Carboy inclinator, 552
Carbromal, 925
Cardamom, 983
Ceylon, 983
elixir, compound, **321**
Malabar, 983
Cardamom oil, 983, 1045
seed, 983
spirit, compound, **313**
tincture, **370**
compound, **370**
Cardamomi semen, 983
Care of balances, 47
thermometers, 103
Cargentos, 876
incompatibility, 1646
Carlsbad salt, artificial, **474**
effervescent, **477**
Carminative, Dalby's, **292**
Dewees', **294**
mixture, **292**
Carmine, 843
chloral, 1968
indigo, **849**, 1535
-red, 842
solution, 258, **843**
Carminfibrin, 1572
Carminic acid, 842
Carminum, 843
Carnallite, 613, 661, 669
Carnation perfume, 1221
sachet, **1230**
Carnotite, 684, 734
Carota, 970
Carotin, 840
Carotinoids, 840
Carpaine, 1164
Carrageen, 889
Carrageenin, 889
Carrel-Dakin solution, **570**
Carron oil, **345**
Carrot fruit, 970
oil, 970, 985
Carrying charges, 1333
Carthamus, 845, 1016
tinctorius, 845
Cartier's hydrometer, 64
Carum, 965
Carvi, 965
Carvacrol, 963, 1217
Carvene, 965
Carvone, 1214
Caryophyllene, 973
Caryophyllin, 973
Caryophyllus, 973
aromaticus, 973
Cascara amarga, 1073
aromatic syrup of, **283**
sagrada, 1082
elixir, **321**
compound, **322**
extract, **457**
powdered, **457**
fluidextract, **408**
aromatic, **408**
fluidglycerate, **443**
aromatic, **443**
Cascarilla, 1005
infusion, **361**
oil, 985
tincture, **400**
Casec, 1820
Casein, 1532, 1820
diabetic flour, 1823
emulsions, 1660
iodine, 865
milk, 1204
saccharated, 1660
silver, 1203
incompatibility, 1649
Caseinate, calcium, 1820
Cases for display, 1316

Cash balance, daily, 1414
Cash discounts, 1334
register, 1391
Cashbook, 1404, 1406
Cashew-nut, 891
Cashoo, 1968
Cassava, 883
Casserole, 1736
Cassia angustifolia, 1083
fistula, 1088
flask, 1483
flavoring extract, 976
Marilandica, 1079
oil, artificial, 1973
synthetic, 972
purging, 1088
saigon, 971
Senna, 1083
Cassie perfume, 1221
Cassiterite, 736
Cassius's purple, 1968
Cast iron, 709
dish, enameled, 125
Castanea, 1097
dentata, 1097
fluidextract, 421
Castile soap, olive oil, 1054
Castor, 1204, 1219
fiber, 1204, 1218
oil, 1038
aromatic, **356**
emulsion of, **290**
jelly, **1039**
Castoreum, 1204
Casts, blood-cell, in urine, 1446
epithelial, in urine, 1446
fatty, in urine, 1446
granular, in urine, 1445
hyaline, in urine, 1445
in urine, 1445
pus, in urine, 1445
wax, in urine, 1446
Catalase, 902
Cataplasm, emollient, **485**
kaolin, **517**
linseed, 518
mustard, 518
slippery elm, 518
starch, 518
and boric acid, 518
Cataplasma amyli, **518**
et acidi borici, **518**
kaolini, **517**
lini, **518**
sinapis, **518**
ulmi fulvæ, **518**
Cataplasmæ, 517
Cataria, 964
Catarrh root, East India, 1002
Catechin, 1096
Catechol, 1096
Catechu, 845, 1100
compound powder, 484
incompatibility, 1646
pale, 1096
tincture, compound, **373**
tincture compound, 373
troches, 499
Catechutannic acid, 1096
Catgut, 1768
chromic, 1766
hardened, 1766, 1768
immersion, 1775
in envelopes, 1774
tubes, 1773
preparation, 1769
Catgut, sizes, 1770
softening, 1775
tanned, 1766
tensile strength, 1771
Cathartic acid, 1084
elixir, compound, **322**
pills, compound, **491**
vegetable, **494**
Cathartocarpus fistula, 1088
Cathetus, 248
Cathode, 540
Catholicon acid, 1965
Catmint, 964
Catnep, 964
and fennel elixir, **322**
fluidextract, **421**
oil, 985
Caulophylline, 1073
Caulophyllum, 1073
fluidextract, **421**
thallictroides, 1030, 1073
Caustic cone mold, 746
lunar, **746**
potash, **597**
antidote, 1941
soda, **617**, 618
antidote, 1941
Causticks, 746
Cayenne pepper, 996
Ceanothus americanus, 1030
Cedar oil, red, 986, 1005
red, 1005
white, 1005
wood oil, 1537
Cedrat oil, 985
Celandine, 1163
Celanese, 1968
Celery and guarana elixir, **329**
flavoring extract, 976
fruit, 970
fluidextract, **418**
oil, 985
seed, 970
Cellobiose, 893
Cellophane, 795
Cellu flour, 1823
Cellulin, 794
Celluloid, 797
Cellulose, 794
acetate silk, 795
acetates, 795
decomposition products, 796
flour, 1823
group, 794
mercerized, 794
wadding, 1758
Celluloses, 893
Census of business costs, 1422
Centaurium, 1074
Centaury, 1074
American, 1080
Centesimal alcoholometer, Gay-Lussac's, 64
Centigrade thermometer, 102
Centigram, 31
Centimeter, 31
cubic, 31
Centipedes, elimination of, 1851
Centrifugal filter, Sharples, 210
filtration, 208
machines, 229
Centrifuge, covered laboratory, 229
Gand laboratory, 229
self-balancing, 229
small, 229
Centrifuges, 229
Cephaëline, 1147
Cephaëlis acuminata, 1147
ipecacuanha, 1147
Cephalin, impure, 1203
Cera alba, 1192
flava, 1191
sigillata, 1968
Cerasin, 885
Cerasus serotina, 1031
virginiana, 1030
Cerata, 512
Cerate, **513**
blistering, **513**
camphor, **514**
compound, 1968
cantharides, **513**
Goulard's, **514**
lead subacetate, **514**
red, 1975
rosin, **513**,
compound, **514**
simple, **513**
Turner's, **507**
Cerates, 512, 1745
dispensing, 1746
preserving, 1746
Ceratum, **513**
calaminæ, 507
calaminare, 507
camphoræ, **514**
cantharidis, **513**
citrini, 1968
de lapide calaminari, 507
epulaticum, 1968
Galeni, 1968
labiale, 1968
lithargyri acetati compositum, 1968
plumbi subacetatis, **514**
refrigerans, 503
resinæ, **513**
compositum, **514**
Cerebrospinal meningitis disinfection, 1884
Cerelose, 894
Cereolus, 248, 1733
Ceresin, 1968
Cereus, night blooming, 1157
Cerevisiæ fermentum compressum, 904
Ceric oxide, 704, 705
Cerii chloridum, 705
nitras, 705
oxalas, 705
oxidum, 705
sulphas, 705
Cerin, 1191
Cerite, 704
Cerium, 531, 690, 704
chloride, 705
compounds, tests for, **704**
nitrate, 705
oxalate, 705
salts, unofficial, 705
sulphate, 705
Cerolein, 1191
Cerotic acid, 1191
Cerous oxide, 704
Certified colors, 841
Céruléine, **849**
Ceruse, 1968
Cerussa acetata, 1968
Cesium, 531
Cetaceum, 1186
Cetin, 1186

Cetin, elain, 1186
Cetraria decoction, **363**
Cetylacetic, acid, 1965
Cevadilline, 1142, 1164
Cevadine, 1142, 1164
Ceylon cardamom, 983
  cinnamon oil, 972
Chainomatic analytical balance, 1431
Chalcanthum, 1968
Chalk, 205
  and opium powder, aromatic, **483**
  drop, **675**
  French, 592
  mercury with, **750**
    assay, 1462, 1483
  mixture, **291**
  pink, 1234
  powder, aromatic, **482**
    compound, **478**
  precipitated, **674**
  prepared, **675**
Chalybeate pills, **490**
Chamæliretin, 1076
Chamælirin, 1076, 1079
Chamælirium, 1079
  luteum, 1076, 1079
Chamisso, 1164
Chamomile, German, 1012
  wild, 1012
Chapman's dinner pills, **497**
  mixture, **294**
  pump, 206
Char, bone, 1967
Charas, 999
Charcoal, 93, **589**, 799, 1532
  animal, 204
    purified, 589
    tablets, **500**
  tablets, **500**
  troches, 499
  wood, 204, **589**
Charge accounts, 1414
  slip, 1393
Charging retorts, 137, 138
Charlton white, 1968
Charpie, 1968
Charta potassii nitratis, **523**
Chartæ, 522, 1755
Chartula, 248
  amylacea, 248, 1685
Chaser mills, 160
Chasers, 160
Chaulmestrol, 921
Chaulmoogra oil, 1035
  ointment, 511
Chaulmoograte, ethyl, 921
Chavicol, methyl, 968
Check book, 1279
  stub, 1279
Checking prescriptions, 1614
Checks, voucher type, 1280
Cheiranthus annuus, 994
Chekan, 1016
Cheken, 1016
Chelen (kelene), 1968
Chelerythrine, 1162, 1163, 1165
Chelidonic acid, 1163
Chelidonine, 1163
Chelidonium, 1163
  majus, 1163, 1165
Chelidoxanthin, 1163
Chelone glabra, 1030
Chemical assay methods, 1449
  compounds, inorganic, 527
Chemical constituents of urine, 1438
  equations, 537
  food, **279**
  incompatibility, 1627
  reactions, 537
  solution, 171
    (aqueous), 257, 258
  symbol, 529
  test for blood in urine, 1447
Chemicals, aromatic, solubility, 1226
    used in perfumery, 1210
  ash or non-volatile matter in, 1513
  heavy metals test, 1519
  organic, 779
  solubility, 173
Chemick, 1968
Chemistry, 527
  colloidal, 184
  definition, 1
  inorganic theory, 527
  organic, 779
Chenopodium, 1005
  ambrosioides, 1000, 1005
  oil, 1000
    assay, 1483
Cheplin's bacillus acidophilus milk, 1181
Cherry, 947
  bark, wild black, 991
  laurel, 1006
    water, **256**
  wild, 991
    fluidextract, **434**
    infusion, **362**
    syrup, **268**
Chestnut leaves, 1097
    fluidextract, **421**
Chicken pox disinfection, 1883
Children's doses, calculation of, 90
  remedies, 12
Chili saltpetre, 557
Chillies, 996
  African, 996
  Mombassa, 996
  Zanzibar, 996
Chimaphila, 1098
  fluidextract, **422**
  umbellata, 1030, 1098
Chimaphilin, 1098
China clay, 593
  oil, 1968
Chinese blue, 1967
  cinnamon oil, 972
  gelatin, 887
  red, 1968
  white, 1968
Chinium, 1968
Chinoidin, 1122
Chinoidine, 1165
Chinol, 1165
Chinoline, 933, 1165
Chinosol, 933
Chionanthus, 1074
  fluidextract, **422**
  virginica, 1074
Chips, bitter, 1967
Chirata, 1074
  fluidextract, **422**
  tincture, 400
Chiratin, 1074
Chiretta, infusion, **361**
Chloral, **857**
Chloral and bromide compound, **293**
    potassium bromide mixture, compound, **293**
  butyl, 933
    hydrate, 933
  camphorated, **858**
  camphoratum, **858**
  carmine, 1968
  hydrate, **857**, 1532
    antidote, 1942
    assay, 1460
  hydrated, **857**, 1532
  menthol, 933
  mentholated, 933
  phenol, 933
  syrup of, **283**
  test solution, 1545
Chloralamide, 933
  incompatibility, 1646
Chloralformamide, 933
  incompatibility, 1646
Chloralhydrate, croton, 933
Chloralimide, 933
Chloralis hydras, **857**
Chloralose, 933
Chloralum, 701
  hydratum, **857**
Chloramide, mercury
Chloramina, **855**
Chloramine, **855**
  assay, 1465
  -T, **855**
Chlorate, mercuric, 759
  potassium, **604**, 1539
    assay, 1475
  sodium, 642
Chlorates, 568
  incompatibility, 1646
  tests for, 567
Chlorauric acid, 1534
Chlorazotic acid, 1965
Chlorbutanol, 934
Chlorcosane, 1060
Chloretone, incompatibility, 1646
Chloric acid, **568**
  ether, **309**
Chloride, aluminum, **700**
    assay, 1478
  amino-mercuric, 1966
  ammonium, **656**, 1529
    and iron, 660
    assay, 1463
    mixture, **297**
    troches, **498**
  amyl, 932
  apomorphine, 1111
  arsenic, 769
    solution, **765**
  barium, 688, 1530
  bromine, **568**
  cadmium, 705, 1531
  calcium, **676**, 1531
    fused, 1531
  cerium, 705
  chromium, 734
  cobalt, 1532
  cobaltous, 1532
  cocaine, 1149
  corrosive mercuric, mull, **522**
  cotarnine, 1112
  cupric, 744
  cuprous, 744
  ethydene, 935
  ethyl, 786, **920**

Chloride, ethylidene, 935
ethylmorphine, 1111
ferric, **714**, 1533
solution, **714**
assay, 1468
tincture, **373**, **716**
assay, 1468
ethereal, 389, 1467
tasteless, **389**
gold, 778, 1534
and sodium, 778
incompatibility, 1647
hydrastine, 1145
iron and ammonium, 660
lead, 742
lime, **568**
lithium, 648
magnesium, **669**, 1536
assay, 1463
manganous, 709
mercurammonium, **751**
mercuric, **752**, 1536
corrosive, **752**
assay, 1479
poison tablets, assay, 1479
incompatibility, 1647
mercurous, **753**, 1536
incompatibility, 1648
mild, **753**
assay, 1471
tablets, **500**
methene, 785
methenyl, 785
methyl, 785, 937
methylthionine, 848
mild mercurous, compound pills, **491**
ointment, **508**
morphine, 1107
nickel, 735
palladous, 1538
pilocarpine, 1139
platinic, 1538
platinum and sodium, 643
potassium, **613**, 1539
assay, 1463
quinine and urea, 1121
silver, 747
sodium, **626**, 1541
and platinum, 643
assay, 1463
solution, physiological, 627
stannous, 736, 1542
strontium, 689
tetramethylthionine, 848
zinc, **692**
assay, 1463
solution, **692**
assay, 1463
Chlorides, assay, 1514
elixir, **323**
of four, **323**
in urine, 1443
soluble, incompatibility, 1647
tests for, 567
Chlorinated lime, **568**, **673**, 1532
as a disinfectant, 1876
assay, 1465
solution, 1569
paraffin, 1060
potassa solution, 260
soda solution, 257, **569**
assay, 1468
Chlorinated soda solution, surgical, **570**
assay, 1468
test solution, 1545
Chlorine, 531, 567
as a disinfectant, 1873
available, **568**
solution compound, 258, **573**
test solution, 1545
water, **573**, 1545
Chlormethylmenthyl ester, 933
Chlorobutanol, 861
Chloroform, 785, **858**, 1532
acetone, incompatibility, 1646
and aconite liniment, **347**
morphine mixture, compound, **293**
tincture compound, 400
opium mixture, compound, **295**
anodyne, **293**
antidote, 1942
as a solvent, 174
emulsion, **290**
liniment, **346**
petroxolin, camphorated, **352**
solutions, 342
spirit, **309**
water, **253**
Chloroformic solution of mastic compound, **342**
rosin, **342**
Chloroformum, **858**
Chlorogenine, 1165
Chloronitrosum acid, 1965
Chlorophora tinctoria, 845
Chlorophyll, 840
-a, 840
-b, 840
Chloroplasts, 840
Chloroplatinic acid, 1538
Chloroxyl, 1125
Chlorphenol, 937
Chocolate coating, extemporaneous, 1721
Choice of thermometers, 103
Choke-damp, 1968
Choleate, sodium, 1205
Cholera bacterin, 1918
disinfection, 1880
mixture, **295**
serobacterin, 1921
vaccine, 1918
Cholesterol, 1042, 1184, 1187
Cholines, 1204
Chondodendron tomentosum, 1161, 1167
Chondrin, 1171
Chondrus, 889
crispus, 889
emulsions, 1661
mucilage, **286**
Chopping, 156
Chrisma, 248
Christia, 1968
Chromate, barium, 688
bismuth, 775
lead, 742
mercuric, 759
potassium, 616, 1539
silver, 747
Chromates, incompatibility, 1646
Chrome yellow, 1968
Chromic acid, **733**
Chromic acid, solution, 259
anhydride, **733**
oxide, 734
sulphate, 734
Chromii bromidum, **734**
chloridum, 734
dichloridum, 734
fluoridum, 734
oxidum, 734
sulphas, 734
trioxidum, **733**
Chromium, 531, 706, 732
bromide, 734
chloride, 734
dichloride, 734
fluoride, 734
salts, tests for, 733
unofficial, 734
trioxide, **733**, 1532
assay, 1466
incompatibility, 1646
Chromogene, 1076
Chrysarobin, 1084
ointment, **504**
Chrysarobinum, 1084
Chrysene, 799
Chrysin, 840
Chrysophanic acid, 1083, 1084
Chrysophyllum glycyphlœum, 1100
Chrysotile, 1968
Churchill's tincture iodine, **393**
Chymosin, 1968
Chypre perfume, 1227
Cibus deorum, 1968
Cicely oil, sweet, 986
Cicuta, 970
virosa, 970, 1165
Cicutine, 1165
Cider, 946, 947
Cigars, 1311
Cimicifuga, 1009
compound syrup of, **283**
extract, **470**
fluidextract, **409**
racemosa, 1009, 1030
resin, 1030
tincture, **387**
Cina flores, 1968
Cineres clavellati, 1968
Cinchona, 1113
assay, 1497
alkaloids and iron, elixir, **323**
elixir, **323**
iron and bismuth, elixir, **324**
calcium lactophosphate, elixir, 337
pepsin, elixir, 337
strychnine, elixir, **324**
bismuth and strychnine elixir, **324**
with hypophosphites elixir, 337
calisaya, 1113
extract, **470**
febrifuge, 1122
fluidextract, **409**
aqueous, 442
assay, 1498
infusion, **361**
ledgeriana, 1113
micrantha, 1123
red, 1113
succirubra, 1113
tincture, **370**

Cinchona, tincture, assay, 1499
compound, assay, 1499
yellow, 1113
Cinchonamine, 1114
Cinchonicine, 1114
Cinchonic-red, 1114
Cinchonidinæ salicylas, 1165
sulphas, 1124
Cinchonidine, 1114
salicylate, 1165
sulphate, 1124
Cinchoninæ sulphas, 1123
Cinchonine, 1114, 1165
sulphate, 1123
Cinchophen, 1125
assay, 1453
derivatives, unofficial, 1125
Cinchotine, 1114
Cincophenum, 1125
Cineol, 961, 978, 979
Cinnabar, 747, 1968
Cinnamate, benzyl, 1024, 1219
ethyl, 1026, 1215, 1226
guaiacol, 936
incompatibility, 1650
linalyl, 1216
meta cresol, 936
methyl, 1216, 1226
phenyl-propyl, 1026
Cinnamic acid, 1024, 1025, 1211
alcohol, 1211, 1226
aldehyde, 972, 1213, 1226
Cinnamomum, 971
camphor, 986
Cassia, 971
Loureirii, 971
saigonicum, 971
Cinnamon, 971
compound powder, 484
flavoring extract, 976
oil, 971
assay, 1483
Ceylon, 972
Chinese, 972
Saigon, 971
spirit, **309**
syrup, **275**
tincture, **387**
true, 971
water, **254**
white, 1002, 1978
wild, 1002
Cinquefoil, 1100
Circulatory maceration, 231
solution, 173
Citral, 955, 1213, 1226
Citraptene, 955
Citrate, 669
ammonio-ferric, **716**
ammonium, 660
and iron, assay, 1467
antipyrin caffeine, 937
bismuth, 775
and ammonium, 775
iron, 775
bottle, metal top, 667
patent top, 667
caffeine, **1151**
cornutine, 1166
cupric, 744
ergotinine, 1130
ferric, assay, 1468
soluble, **716**
solution, **725**
assay, 1467
Citrate, iron and ammonium, **716**
quinine, 732
strychnine, 732
green, **717**
lithium, **647**
assay, 1456
effervescent salt, **647**
magnesia, 257, 669
magnesium, acid, 669
solution, **666**
assay, 1481
manganese, 709
and sodium, **706**
soluble, 706
assay, 1481
monophenetidin, 932
potassium, **606**, 1539
assay, 1456
effervescent, **607**
solution, **607**
silver, 747
sodium, **627**
assay, 1456
solution, **641**
assay, 1456
thorium-sodium, 704
Citrated caffeine, **1151**
assay, 1476
effervescent, 1153
Citrates, tests, 944
Citresia, 669
Citric acid, 787, **943**
assay, 1453
syrup, **264**
Citrine ointment, **509**
Citrochloride, ferric, tincture, **389**
Citronella oil, 985
Citronellal, 955, 1213, 1226
Citronellol, 1212, 1226
hydroxy, 1226
Citrophen, 934
Citrullus colocynthis, 1063, 1087
Citrus aurantium, 947, 953, 954
amara, 956
bergamia, 956
bigaradia, 956
limonum, 947
medica, 955, 985
acida, 947
vulgaris, 956
Civet, 1219
Civetta, 1204
Clamp extension, 139
holder, 139
ring retort, 138
Clarification, 211
and decoloration, 211
Clarified honey, 898
Class annelida, 1205
aves, 1205
insecta, 1205
mammalia, 1203
pisces, 1205
reptilia, 1205
Claviceps purpurea, 1045, 1129
Clay, 698
China, 593
porcelain, 593
Clays, 204
Cleaners, 1061
Clearing house, 1283
Clematis, 1016
Clemen's solution of arsenic 259
Clerks, employing, 1295
Cleve's acid, 811
Clinical tests, 1568
thermometer, 105
Clipper emulsifier, 1659
Closed chain hydrocarbons, 788
Closet, drying (gas heat), 149
fume, 129, 130
Closets, drying, 128, 129
Closing a sale, 1382
Clove, 973
flavoring extract, 976
infusion, **361**
oil, 973
assay, 1483
Clover, 1225
blossoms, red, 1078
yellow, sweet, 1077
Cloves, 973
oil, 973
synthetic, 974
Coagulated mercury, 1972
Coagulating enzymes, 902
Coagulation, 186
Coal, 93, 810
anthracite, 93
bituminous, 93
hard, 93
oil, 96
stove, 96
wickless blue flame, 96
soft, 93
tar, 810, 811
benzene as a solvent, 174
colorless, 932
creosote, 806
derivatives, 811
dyes, 846, 853
unofficial, 849
fractions, 811
intermediates, 811
naphtha, 1968
product, 811
purified, 932
solution, 258, **812**
Coarse powder, 170
Coating and polishing plant, 1723
chocolate, extemporaneous, 1721
colored, 1729
gold, 1721
keratin, 1732
pans, 1722
pearl, 1721
pills, 1720
salol, 1731
silver, 1721
solution gelatin, 1721
stearic acid, 1722
sugar, extemporaneous, 1721
sugarless, 1730
syrup, 1727
tablets, 1720
tolu, 1722
white, 1729
Cobalt, 531, 735, 736
chloride, 1532
salts, tests for, 736
Cobaltite, 736
Cobaltous chloride, 1532
test solution, 1545
Cobweb, 1205
Coca, 1163

Coca, Huanuco, 1163
-tannic acid, 1163
Cocaina, 1148
Cocainæ hydrochloridum, 1149
Cocaine, 1148, 1163
antidote, 1942
chloride, 1149
hydrochloride, 1149
hypodermic tablets, assay, 1502
ointment, 511
oleate, **351**, 1047
Cocainum hydrochloricum P. I., 1149
Cocculus, 1157
indicus, 1167
antidote, 1942
tincture, **387**
Coccus, 842
cacti, 842
lacca, 845
Cochin ginger, 984
Cochineal, 842
color, **842**
solution, 258
test solution, 1450
tincture, 400
Cochlearia armoracia, 994
officinalis, 994
Cocillana, 1074
fluidextract, **422**
Cockroach, 1205
Cockroaches, elimination, 1849
Cocoa, 1044
butter, 1040
powder, 1044
powdered, 1044
syrup, **273**
Cocoanut oil, 1045
Cocus nucifera, 1045
Cod liver oil, 1187
emulsion of, **288**
phosphatic, 291
with calcium lactophosphate, 291
with egg, **289**
with hypophosphites, **289**
with malt, **289**
with wild cherry, 291
Codamine, 1105, 1106
Code of ethics, 9
Codeina, 1109
Codeinæ phosphas, 1110
sulphas, 1110
Codeine, 1105, 1109, 1164
and terpin hydrate, elixir, **335**
antidote, 1942
phosphate, 1110
phosphate, assay, 1458
hypodermic tablets, assay, 1502
sulphate tablets, assay, 1502
sulphate, 1110
syrup, **283**
Codes for pricing, 1332
Codoil, 1968
Coefficient, phenol, 813, 818
Cœrulein, 949
Cœruleum, acidum, 1965
Cœrulignol, 804
Coffea arabica, 1150, 1157
liberica, 1157
tosta, 1157
Coffee, 1157, 1968
fluidextract, **422**
Coffee, roasted, 1157
assay, 1500
Cognac, 1968
oil, 916
Cohobation, 951
Cohosh, black, 1009
fluidextract, **409**
blue, 1073
Coke, 93
Cola, 1161
nitida, 1161
Colation, 193
in small operations, 194
Colchiceine, 1141
Colchici cormus, 1140
flores, 1164
semen, 1140
P. I., 1140
tinctura P. I., 372
Colchicina, 1141
Colchicine, 1141, 1164
Colchicum, antidote, 1942
autumnale, 1140, 1164
corm, 1140
assay, 1497
fluidextract, **423**
assay, 1500
tincture, stronger, **388**
assay, 1500
extract, **457**, **470**
assay, 1498
powdered, **457**
flowers, 1164
fluidextract, **410**
assay, 1498
root, 1140
seed, 1140
assay, 1497
wine, **372**
tincture, **372**
assay, 1499
Colcothar, 1968
Cold cream, 1240
theatrical, **1240**
toilet, 1240
Cole's dinner pills, **497**
Coli bacterin, 1918
serobacterin, 1921
Colla piscium, 1968
Collagens, 1171
Collapsible tubes, 1747
Collargol, 877
incompatibility, 1646
ointment, 877
Collargolum, 877, 1204
Collaurin, 1968
Collidine, 1204
Collinsonia, 964
canadensis, 964, 1030
Collodia, 343
Collodion, **343**
flexible, **343**
of sulphonated bitumen, **344**
salicylic, compound, **344**
styptic, **344**
Collodions, 343
unofficial, 344
Collodium, **343**
bituminis sulphonati, **344**
cantharidatum, **344**
flexile, **343**
iodi, **344**
iodoformi, **344**, 864
salicylicum compositum, **344**
stypticum, **344**
tiglii, **344**
Colloidal bismuth, 188
calomel, 881
incompatibility, 1646
chemistry, 184
iron, 188
mercury, incompatibility, 1648
silver, 188, 877
compounds, 877
incompatibility, 1646
solution, 171
Colloids, 171
and dialysis, 184
protective, 186
Collunarium, 248, 341
Collutorium, 248, 341
Collyria, 260
Collyrium, 248, 341
Colocynth, 1087
and hyoscyamus pills, 497
and podophyllum pills, 497
antidote, 1942
apple, 1087
extract, **458**
compound, **459**
powdered, **458**
compound, **459**
pills, compound, 497
pulp, 1087
Colocynthein, 1063
Colocynthin, 1063, 1087
Colocynthis, 1087
Colocynthitin, 1087
Cologne, headache, **1228**, **1229**
spirits, 906
water, **1228**, **1229**
Colombo, 1064
Colon bacillus vaccine, 1918
Colonial spirit, 94, 809
Colophony, 471, 1021
Color, blue, 841
butter, 1967
cochineal, **842**
green, 841
orange, 841
Coloring, burnt sugar, **844**
chalk, 1233
face powders, 1233
principles, 840
solutions for syrup, 1726
talc, 1233
tooth powders, 1233
Colorless coal tar, 932
hydrastine solution, **1145**
Colors, animal, 842
certified, 841
permitted, 841
red, 841
vegetable, 842
unofficial, 845
yellow, 841
Colton capsule filler, 1680
Colton's automatic triturate machine, 1703
glycerin suppository mold, 1739
granulation moistener, 1706
granulator, 1708
lozenge cutting machine, 1700
mass mixer, 1691
modern pill plant, 1696
pearl or globule leaf making machine, 1684
suppository machine, 1742
triturate machine, 1702, 1703

Coltsfoot, 1076
leaves, 1076
Columba, 1064
Columbian spirit, 94, 809
Columbin, 1064
Columbium, 531
Columbo, 1064
American, 1079
Columnar accounting, 1411
Colutea, 1090
arborescens, 1090
Colza oil, 1973
Combustion, 92
Comfrey-root, 891
Comitissæ palmæ, 1968
Commanders' balsam, 369
Commercial acids, quality, 553
agencies, 1276
law, 1245
paper, 1247
Comminution, 151, 235
Commiphora myrrh, 986, 1023
Commissions, 1377
Commodities, exchanging, 1357
for sale, 1327
Common gin, 904
plaster, 519
scurvy grass,
Community relations, 1298
Companion sales, 1381
Compensation insurance, 1289, 1398
Composition of urine, 1434
powder, 387, 483
Compound acetanilid powder, 481
agar emulsion of petrolatum, 1058
anise powder, 484
bismuth troches, 499
bromide and chloral, 293
calamine lotion, 299
calomel pills, 491
camphor cerate, 1968
catechu powder, 484
cathartic, elixir, 322
cathartic pills, 491
chalk powder, 478
chloroformic solution of mastic, 342
cinnamon powder, 484
confection guaiac, 489
cresol solution, 257
decoction of aloes, 363
of sarsaparilla, 363
milder, 363
stronger, 363
dental liniment of aconite, 341
and iodine, 341
digestive elixir, 331
powder, 484
effervescent salt of potassium bromide, 603
effervescing powder, 478
assay, 1456, 1457
elixir, aletris, 316
almond, 317
buchu, 319
cardamom, 321
cascara sagrada, 322
corydalis, 325
euphorbia, 325
formates, 338
glycerophosphates, 328
helonias, 329
Compound elixir hydrastis, 330
manaca, 330
pepsin, 331
and rennin, 332
rubus, 338
sabal and sandalwood, 333
saw palmetto and sandalwood, 333
sodium salicylate, 334, 338
taraxacum, 335
terpin hydrate and creosote, 336
vanillin, 336
viburnum opulus, 337
emulsions, 1661
extract colocynth, 459
powdered, 459
gambir powder, 484
gargle guaiac, 297
infusion gentian, 360
orange, 361
rose, 361
senna, 361
iron mixture, 297
kaladana powder, 484
fluidextract, buchu, 420
sarsaparilla, 436
stillingia, 438
trifolium, 439
lanolin ointment, 512
laxative pills, 496
lead suppositories, 523
lever balances, 45
licorice powder, 479
liniment, croton oil, 350
mustard, 349
opium, 348
soft soap, 348
menthol inunction, 512
spray, 355
troches, 499
wool, 1763
mixture chloral and potassium bromide, 293
chloroform and morphine, 293
glycyrrhiza, 291
opium and chloroform, 295
rhubarb, 295
rhubarb, 296
senna, 297
oil, hyoscyamus, 448
ointment, mercury, 511
liniment, 348
pancreatin powder, 483, 1176
pills, aloe and podophyllum, 492
aloes, mercury and scammony, 497
aloin, 493
strychnine and belladonna, 493
antimony, 497
colocynth, 497
mild mercurous chloride, 491
rhubarb, 497
squill, 498
powder almond, 484
bayberry, 483
glycyrrhiza, 479
ipecac, 479
jalap, 480
kino and opium, 484
morphine, 484
opium, 484
Compound powder rhubarb, 480
talc, 484
resorcinol ointment, 510
rosin cerate, 514
salicylic collodion, 344
plaster, 521
scammony powder, 484
soap pills, 498
solution chlorine, 258, 573
cresol, 814
assay, 1484
crude, 815
glycerophosphates, 328
hydrastine, 258, 1145
hypophosphites, 258, 682
iodine, 257, 576
assay, 1468, 1476
phosphates, 683
sodium borate, 258, 641
phosphate, 258, 642
zinc and aluminum, 260
and iron, 260
spirit, cardamom, 313
ether, 312
horseradish, 315
juniper, 315
lavender, 375
myrcia, 313
orange, 308
vanillin, 314
sulphur ointment, 511
sulphurated petroxolin, 353
syrup asarum, 273
cimicifuga, 283
figs, 277
hypophosphites, 278
phosphates, 279
sarsaparilla, 269
senna, 284
squill, 270
stillingia, 282
thyme, 283
trifolium, 283
white pine, 280
with morphine, 280
senna, 284
tablets, santonin, 501
tar ointment, 508
tincture benzoin, 368
cardamom, 370
catechu, 373
chloroform and morphine, 400
cinchona, 371
assay, 1499
cudbear, 396
gambir, 373
gentian, 373
guaiac, 391
jalap, 394
kino and opium, 401
lavender, 375
opium and gambir, 395
pale catechu, 373
senna, 401
viburnum, 399
tragacanth powder, 484
troches of santonin, 499
urginea pills, 498
Compounding, definition, 1
extemporaneous solutions, 1651
prescriptions, 1614
Compressed camphor, 987
pills, 1704

Compressed suppositories, 1740
tablets, 1704
troches, 1704
yeast, 904, 1543
Compressing machines, 1709
Comptonia, 1100
asplenifolia, 1100
Concentrated alum, 1966
diphtheria antitoxin, 1900
hydrochloric acid, 1534
perfume extracts, 1227
preparations, infusions from, 359
sulphuric acid, 1542
tetanus antitoxin, 1903
Conchinine, 1968
Concretes, 952
and absolutes, 1210
Concusconine, 1114
Condensation, 131
Condensed milk emulsions, 1661
Condenser, glass, special form, 133
metallic worm, 141
Condensers, Liebig, 139
Condensing worm, 140
Condurangin, 1075
Condurango, 1075
fluidextract, **423**
Conduransterin, 1075
Condy's fluid, 1968
Cone mold, 746
Cones, medicated, 1831
Confectio aromatica, 482
cardiaca, 482, 1968
Damocratis, 1968
guaiaci composita, **489**
piperis, **489**
Raleighana, 482
rosæ, **489**
sennæ, **489**
sulphuris, **489**
Confection, guaiac, compound, **489**
pepper, 489
rose, **489**
senna, **489**
sulphur, 489
Confectioner's granulated sugar, 896
Confectionery, 1346
Confectiones, 488
Confections, unofficial, 489
Congealing points, 108, 1524
U. S. P. X method for determining, 108
Conglutin, 1034
Congo red test paper, 1571
Conhydrine, 1158, 1165
Conical apothecaries' graduate 52
metric graduate, 52
percolator, 235
Coniferin, 1029, 1063
Coniferous woods, 1063
Coniferyl alcohol, 1063
Coniine, 1158, 1165
hydrobromide, 1165
Conium, 1158
antidote, 1942
assay, 1501
extract, **465**
assay, 1499
fluidextract, 442
maculatum, 1165
Conjugated proteins, 1170
Conjunctival test, tuberculin disks, 1936
tuberculin test, 1935
Connecticut lead, 1968
Conquinamine, 1114
Conquinine, 1122
Conserva, 248
Conserves, 488
Constant white, 1968
Constants, physical, 1524
Constituents of urine, abnormal, 1435
chemical, 1438
normal, 1434
Consumptives' weed, 1008
Containers, bulk, 1790
Content, alcohol, 12
of habit-forming narcotic drugs, 12
Continental method for emulsions, 1657, 1658
Continuous extraction apparatus, 445
filtration, 202
phase, 184, 1655
washing, 189
apparatus, 190
Contracts, 1245
Contributary negligence, 1288
Control of business by accounts, 1395
in manufacturing pharmacy, 1577
Contusion, 155
Convallamaretin, 1063
Convallamarin, 1063, 1075
Convallaretin, 1063, 1075
Convallaria, antidote, 1942
flowers, 1079
fluidextract, 442
majalis, 986, 1063, 1075, 1079
root, 1075
fluidextract, **423**
Convallariæ radix, 1075
Convallarin, 1063, 1075
Convolvulin, 1063, 1083
Convolvulinic acid, 1063
Convolvulus batatas, 883
scammonia, 1086
scoparius, 986
Coöperative buying, 1337
Copaiba, 996
and opium mixture, **294**
balsam, 996
mass, **488**
mixture, **293**
oil, 997
solidified, **488**
Copaiva, 996
balsam, 996
Copaivic acid, 996
Copal, 1029
Copper, 188, 531, 737, 742, 1532
acetoarsenite, 769
arsenite, 769
compounds, tests for, 743
fluorescein, 852
funnel, tinned, 201
funnels, 201
measure, special, 51
with outlet, 51
measures, 51
oleate, 1047
orthoarsenite, 769
percolator, 243
salts, unofficial, 744
Copper sulphate, **743**
antidote, 1942
assay, 1466
solution, 1570
Copperas, 720
blue, 1967
white, 1978
Copra, 1968
oil, 1973
Coptine, 1158
Coptis, 1158
fluidextract, **424**
teeta, 1164
trifolia, 1158
Copy for advertising, 1360
Corallin, 939
Cordial, blackberry, 947
elixir, Stoughton's great, **373**
neutralizing, **296**
Cordialia, 339
Cordiale, 248
Cordials, 339
Coriander, 967
oil, 967
seed, 967
Coriandrol, 967
Coriandrum, 967
sativum, 967
Corinthian raisins, 1975
Cork borers, 135
fitting, 135
notched, 237
press, 1668
French, 1669
Lochmann's, 1669
Corks, pressing, 1669
Corm, colchicum, 1140
assay, 1497
fluidextract, **423**
assay, 1500
tincture, stronger, **388**
assay, 1500
Corn silk, 1016
smut, 1080
squirrel, 1158
starch, **882**
sugar, 894, 1968
syrup, **894**
turkey, 1158
Cornic acid, 1075
Cornin, 1075
Cornu cervi, 1968
ustum nigrum, 1968
Cornus, 1075
florida, 1030, 1075
fluidextract, **424**
Cornutine citrate, 1166
Coronilla scorpioides, 1079
Corpora lutea soluble extract, Wilson, 1202
Corporation, 1247, 1274
Corpus luteum, desiccated, Armour, 1202
Wilson, 1202
extract, Lederle, 1202
L and F., desiccated, 1202
Lederle, 1201
Corrosive mercuric chloride, **752**
assay, 1479
mull, **522**
poison tablets, 500
assay, 1479
sublimate, **752**
antidote, 1942
gauze, 1758

Corrosive subliminate incompatibility, 1647
tablets, 500
Corydaline, 1158, 1166
Corydalis, 1158
elixir, compound, 325
fluidextract, **424**
Corylopsis, 1227
Corylus avellana, 1045
Corynanthe, Yohimbi, 1167
Cosmetics and perfumery, 1207
Cosmoline, 1059
Cost comparisons, 1423
Costs, census, 1422
Cotarninæ chloridum, 1112
hydrochloridum, 1112
Cotarnine chloride, 1112
phthalate, 939
Cotoin, 1017
Cotton, absorbent, 795, 1756
cloth strainers, 194
filters, 203
flannel strainers, 194
non-absorbent, 795, 1756
purified, 795
root bark, 1076
decoction, **363**
fluidextracts, **428**
styptic, **796**
Cottonseed oil, 1037
Couch grass, 901
decoction, **363**
Coumarin, 977, 1217, 1219
Coumarinum, 977
Counter for efficiency, 1312
scales, 45
in glass box, 44
wrapping, 1312
Counterirritant refrigerant, **341**
Covered laboratory centrifuge, 229
Cow parsnip, 970
Cow's milk, 1179
Coxe's hive syrup, **270**
Crab oil, 1045
orchard salt, 666, 670
Cranberry, 947
bark, high bush, 1014
Crane's prescription file, 1619
Cranesbill, 1098
Cratægus, 1225
Cream, 297
almond, **1237**, 1238
bismuth, **774**
camphor, **988**
cold, 1239
theatrical, **1240**
toilet, 1240
massage or rolling, **1242**
rolling or massage, **1242**
tartar, **601**
and sulphur tablets, **502**
toilet, **1236**, **1237**
tragacanth, 1236
vanishing, **1241**
Creams and lotions, hand, 1235
disappearing, 1241
face and hand, 1236
fatty, 1239
rolling, 1239, 1242
skin, 1239
toilet, 1237
vanishing, 1239, 1241
Creasatin, 816
Creasote, **806**
Credit customers' accounts, 1392, 1414
form, 1394
memorandum, 1394
personal, 1275
rating, 1276
slip, 1393
Cremor, 248, 297
Cremor tartari, 1968
Creolin, 814, 934
Creosol, 799, 804, 806
Creosotal, 807
Creosote, 799, 806
and terpin hydrate elixir, compound, **336**
carbonate, **807**
incompatibility, 1646
coal tar, 806
compounds, unofficial, 809
incompatibility, 1646
methylene, 939
mull, salicylated, **522**
ointment, 511
water, **256**
Creosoted lumber, 811
Creosoti carbonas, **807**
Creosotum, **806**
Cresol, 799, 804, **813**
crude, solution, compound, **815**
iodide, 934
red, 543
solution compound, 257, **814**
assay, 1484
Cresolal, incompatibility, 1646
Cresolated formaldehyde, **815**
Cresols, 811
three, purified, 816
Cresotic acid, 811
Cresotinic acid, 811
Cress, 994
Cresylic acid, 813
Creta præparata, 675
Crisco, 1033
Crocetin, 1063
Crocin, 1063, 1076
Crocus, 1076
martis, 1968
metallorum, 1968
sativus, 845, 986, 1063, 1076
saturin, 1968
Crotalus, 1205
horridus, 1205
Croton chloral hydrate, 933
eluteria, 985, 1005
liniment, **350**
compound, **350**
oil, 1039
antidote, 1942
collodion, 344
resin, 1039
tiglium, 1039
Crotonic acid, 799
Crow fig, 1968
Crowfoot, 1017
Crucible furnace, electric, 110
Fletcher's gas, 110
Hessian, 110
operations, 110
platinum, 110
tongs, 111
Crude antitetanic serum, 1904
calcium sulphide, 683
carbolic acid, 813
cresol solution, compound, **815**
Crude digitalein, 1065, 1066
drug, extraction, 1486
fiber, 794, 1522
malate of iron, **466**
tincture, **390**
oil, 1973
petroleum, 1056
tetanus antitoxin, 1904
thyroxin, 1200
Cryogenine, 816
Cryolite, 579
Cryptolytes, 902
Cryptopine, 1105, 1106
Cryst alba, 1968
Crystal, rock, 1975
sublimates, 147
Crystalli tartari, 1968
Crystallization, 218
fractional, 223
intermediate, 223
Crystallized aconitine, 1144
ouabain, 1068
strophanthin, 1068
veratrine, 1142
Crystallography, 218
systems in, 218
Crystalloid, 184
Crystallose, 1968
Crystals, headache, 959
methods of obtaining, 221
of Venus, 1968, 1978
peppermint, 959
vanilla, 977
Cube, alum, 1966
Cubeb, 995
berries, 995
fluidextract, **424**
oil, 995
oleoresin, **447**
tincture, **388**
troches, 499
Cubeba, 995
Cubebic acid, 995
Cubebin, 995
Cubebs, tailed, 995
Cubic centimeter, 31
Cuca, 1968
Cucumber seed oil, 1045
Cucumis melo, 1046
prophetarum, 1063
sativus, 1045
Cucurbit, 131
Cucurbita citrullus, **1046**
pepo, 1038, 1146
Cudbear, 844
tincture, **396**
compound, **396**
Cullet, 1968
Culture bacillus acidophilus, 1181
Bulgaricus, 1181
media, 1574
Culver's root, 1089
Cumarin, 977, 1077
Cumene, 811
Cumin, 970
oil, 970
Cuminum, 970
cyminum, 970
Cumol, 799
Cunila, 1005
mariana, 1005
Cup troy weights, 49
Cupreine, 1114
Cupri sulphas, **743**
Cupric acetate, 744, 1532

Cupric acetate, test solution, 1545
ammonium sulphate, 744
test solution, 1545
arsenate, 744
bromide, 744
chloride, 744
citrate, 744
fluoride, 744
nitrate, 744
oxide, 744
test solution, 1546
subacetate, 744
sulphate, 743, 1532
anhydrous, 1532
test solution, 1546
tartrate, 744
volumetric solution, alkaline, 1554
Cupricsticks, 744
Cuprous bromide, 744
chloride, 744
iodide, 744
Cuprum, 742
scoriatum, 1968
Curaçao aloe, 1080
orange peel, 953
Curare, 1164, 1166, 1533
Curarine, 1164, 1166
Curassao elixir, 318
Curatio paraffini, 1060
Curcas purgans, 1046
Curcuma, 883
longa, 845, 883, 985
oil, 985
zedoaria, 984, 986
Curd soap, 1052
Curies, 685
Curled dock, 1099
Currant, 947
Cusconidine, 1114
Cusconine, 1114
Cusso, 1073
fluidextract, 442
Cutaneous test, 1936
tuberculin test, 1935
Cutch, 1968
Cutter, rotary, 157
tobacco, 157
Cutting, 156
glass tubes, 134
Cyanegg, 1968
Cyanfran, 1968
Cyanide, ethyl, 934
mercuric, 759, 878
nickel, 735
potassium, 616
antidote, 1944
incompatibility, 1648
silver, 747
sodium, 643, 1541
zinc, 697
and potassium, 697
Cyanides, antidote, 1942
incompatibility, 1646
Cyanin, 840
Cyclamen perfume, 1221
persicum, 1221
Cyclic hydrocarbons, 788
Cyclopropane, 788
Cydonia vulgaris, 891
Cydonium, 891
Cylindrical graduate, 52
weights, 49
Cylindroids in urine, 1446
Cymarin, 1067
Cymene, 948, 963
Cymogene, 785
Cyna oil, 985
Cynoglossum, officinale, 892
Cynosbatæ, 1968
Cynotoxin, 1009
Cypripedium, 1010
fluidextract, 424
hirsutum, 1010
parviflorum, 1010
pubescens, 1010, 1030
Cystamine, 931
Cysteine, 1170
Cystine, 1170
Cystogen, 931
Cystography, thorium solution for, 704
Cytase, 902
Cytisine, 1156, 1164, 1166
Cytisus laburnum, 1164, 1166
scoparius, 1163, 1167

D

Dactyli, 1968
Daggett oil, 1973
Dagutt, 1968
Dahlia oil, 985
pinnata, 985
Daily cash balance, 1414
records, 1412, 1413
Dakin-Dunham tablets, 936
Dakin's solution, 257
modified, 570
Dalby's carminative, 292
Damiana, 1011
fluidextract, 425
Dandelion, 1079
Daphne Gnidium, 1008
Laureola, 1008
mezereum, 1008, 1063
Daphnetin, 1063
Daphnin, 1008, 1063
Dating machine, rubber, 1610
Datisca cannabina, 1063
Datiscetin, 840, 1063
Datiscin, 1063
Datura metal, 1132, 1133
Datura seeds tincture, 400
stramonium, 1046, 1132, 1138, 1164
Daturine, 1138, 1166
Daucus carota, 970, 985
Daybook, 1392, 1402
Deadly nightshade root, 1133
leaves, 1133
poisons, 1249
Decantation, 190
Decimal system, 30
Decocta, 362
Decoction, acacia bark, 363
aloes, compound, 363
cetraria, 363
cotton root bark, 363
couch grass, 363
hematoxylon, 363
ispaghula, 363
sappan, 363
sarsaparilla compound, 363
milder, 363
stronger, 363
vessel, block-tin, 362
Zittmann's, milder, 363
stronger, 363
Decoctions, 362
official general process for, 362
Decoctions, unofficial, 361
Decoctum acaciæ corticis, 363
agropyri, 363
album, 1968
aloes composition, 363
cetrariæ, 363
diaphoreticum, 1968
gossypii radicis corticis, 363
hæmatoxyli, 363
ispaghulæ, 363
lignorum, 1968
sappan, 363
sarsaparillæ compositum, 363
fortius, 363
mitius, 363
Zittmanni, 1968
Decoloration, 211, 213
and clarification, 211
Decolorization, 213
Decolorized tincture iodine, 392
Decyl alcohol, 1211
aldehyde, 1213
Decylic aldehyde, 954
Definition, official, 21
Deflagration, 112
Degras, 1968
Dehydrated alcohol, 904, 1529
ethanol, 904
ether, 1533
Dehydration, 120, 150
Dekanormal potassium hydroxide, 598, 1558
sodium hydroxide, 1561
DeLaval separator, 210
Deliquescence, 223
Delivery service, 1382
Delphinin, 840
Delphinine, 1166
Delphinium, 1159
ajacis, 1159
consolida, 1045, 1159
Staphisagria, 1046, 1165–1167
Delphinus Phoccena, 1205
Demonstration of sales, 1382
Denarcotized tincture opium, 377
Denatured alcohol, 94, 907
Dengue, prevention, 1889
Denigé's reagent, 1546, 1548
Densimeter, Rousseau's, 66
Density, maximum, 122
of solutions, 172
Dental anesthetic solution, 836
liniment of aconite and iodine compound, 341
compound, 341
liniments, 341
wax, 356
Dentifrice, 486
Dentifrices, 486
Dentifricia, 486
Dentifricium, 486
Dentilinimenta, 341
Dentilinimentum aconiti compositum, 341
et iodi compositum, 341
Denver mud, 1968
Deodorants, 701
Deodorized alcohol, 905
kerosene, 1061
opium, 1112
tincture, 377
Deodorolina, 1059
Departments in drug store, 1327
Depilatories, 1242, 1243
Depositing in bank, 1279

Depreciation, 1420
Derivatives of atropine, 1135
Derived proteins, 1170
Dermatol, **771**
Dermatologic pastes, 516
Derosne's salt, 1968
Description, official, 21
Deshler's salve, **514**
Desiccated corpus luteum, Armour, 1202
Wilson, 1202
parathyroid gland, 1202
substance, 1202
pineal gland, 1203
pituitary body, 1195
substance, 1195
suprarenal glands, 1197
thymus gland, 1203
thyroid glands, 1198
Desiccation, 120, 148
Desiccator, 149
Destructive distillation, 145
Detailing physicians, 1365
Determination boiling points, 122
invert sugar by Fehling's solution, 1484
Determinations, electrolytic, 1483
Detre differential test, 1936
Dewees' carminative, **294**
tincture, guaiac, **391**
Dextri-maltose, 1821
Dextrin, 883, 893
paste, 1623
white, 889
Dextrinated paste, **516**
Dextrins, 903
Dextrinum album, 889
Dextro-glucose, 895
-limonene, 955, 1016
-terpineol, 954
Dextrose, 787, 893, 895, 1533, 1821
sterile solution, 1799
Dextrosum, 895
Dhurrin, 1063
Diabenzene, 1204
Diabetic flour, casein, 1823
Diabetics, foods for, 1822
Diabolus metallorum, 1969
Diacetic acid in urine, 1443
Gerhardt's test for, 1443
reaction, 1569
Diacetone alcohol, 175
Diacetylmorphine, 1166
hydrochloride, 1166
Diacetyltannic acid, 1093
Diacetyl tannin, incompatibility, 1650
Diachylon ointment, **506**
plaster, 519, 1974
Diacodion, 1103
Diacodium, **1969**
Diagnostic agents, biological products for, 1932
reagents, 1897
coal-tar dyes, 853
Diagnostical reagents, 1568
Diagram, metric, 32
Diagrydium, **1969**
Dialysis and colloids, 184
Dialyzate, 187
Dialyzed iron, 188
Dialyzer, 187
glass, 188
127
Diamine ethylene, 935
incompatibility, **1646**
Diamylphthlate, 175
Diana, **1969**
Dianthine, 1221
Dianthus, 1221
Diapente, **1969**
Diaphoretic powder, 480
Diaphtherin, 938
Diaprotein prepared casein flour, 1823
Diarrhea mixture, Squibb's, **295**
Diarsenol, 869
Diasinidine, 811
Diaspirin, 940
Diastase, 884, 902
Diastasum, 884
Diazo compound, 792
reaction, Ehrlich, 1569
Diazobenzenesulphonic acid, 792
Diazyme essence, 1178
incompatibility, **1648**
glycerole, 1178
Dibenzyl fumarate, 933
succinate, 933
Dibrombehenate, calcium, 861
Dibromgallic acid, 936
Dibromin, 861
Dibromobarbituric acid, 861
Dibromo-orthocresol-sulphonphthalein, 1450
Dibutylphthlate, 175
Dibutyltartrate, 175
Dica's hydrometer, 64
Dicentra canadensis, 1030, 1158, 1166
Cucullaria, 1158
Dichloramine, **856**, 1533
assay, 1465
-T, 856
Dichloride, chromium, 734
methylene, 937
Dichlormethane, 785
Dichloromethane, 937
Dichromate, ammonium, 660
potassium, 616, **1539**
incompatibility, **1648**
Dichromates, incompatibility, **1646**
Dick test, 1935
Dicotoin, 1017
Didymium, 704
Diethylacetal, 932
Diethylaldehyde, 932
Diethylbarbiturate, sodium, 924
Diethylbarbituric acid, **923**
incompatibility, 1645
Diethylcarbonate, 175
Diethylendiamine, 939
Diethylglycocollguaiacol hydrochloride, 936
Diethylketone, 935
Diethylmalonylurea, sodium, **924**
Diethyl oxalate, 175
Diethylphthlate, 175
Diethyltartrate, 175
Differential thermometers, 105
Diffusate, 187
Di-fluor-di-phenyl, 932
Digalen, 1066
Digestion, 231, 232
Digestive elixir, compound, **331**
enzymes, unofficial, 1176
powder, 1974
Digestive powder compound, 484
Digger pine, 948
Digipoten, 1068
Digitalein, 1065
crude, 1065, 1066
Digitaleinum crudum, 1066
Digitaligenin, 1063
Digitalin, 1063, 1065
French, 1065, 1067
German, 1065, 1067
Homolle's, 1065, 1067
Schmiedeberg's, 1065
true, 1065, 1066
Digitaline amorphe, 1067
chloroformique, 1067
cristallisés, 1067
Digitalinum Germanicum, 1067
verum Kiliani, 1065, 1066
Digitalis, 1065
antidote, 1942
assay, 1504
fluidextract, **425**
folium, P. I., 1065
infusion, **360**
opium and quinine pills, **496**
principles, 1066
related, 1067
purpurea, 1063, 1065
squill and mercury pills, **494**
tinctura P. I., **372**
tincture No. 111, 1068
Digitalose, 1063
Digitan, 1068
Digitin, 1065
Digitoflavin, 1065
Digitogenin, 1062
Digitol, 1068
Digitonin, 1065
Digitophyllin, 1065
Digitoxin, 1065, 1067
Digitoxinum, **1067**
Dihydric alcohols, 786
Dihydrochloride, quinine, 1118
Dihydrogen phosphate sodium, **631**
Dihydroxyacetone, 903
Dihydroxy-methyl-benzene, 854
Dihydroxytoluene, 938
Dilapsus, 1969
Dill, 970
oil, 970
water, **256**
Diluted acetic acid, **801**, 1528
assay, 1453
acids, 553
alcohol, **906**
-soluble extractive, 1523
ethanol, **906**
hydriodic acid, **555**
assay, 1462
hydrochromic acid, **566**
hydrochloric acid, **555**, 1535
assay, 1453
hydrocyanic acid, **991**
iodine petroxolin, **353**
mercurial ointment, **505**
nitric acid, 558, 1537
nitrohydrochloric acid, **566**
nitromuriatic acid, **566**
ointment mercuric nitrate, 511
phosphoric acid, **563**
assay, 1463
prussic acid, **991**

Diluted solution aluminum acetate, assay, 1478
lead subacetate, 257, 258, 742
assay, 1473
sodium arsenate, **258**, **637**, 769
assay, 1469
sulphuric acid, **562**, 1542
assay, 1453
Dilutions, 1828
Dimazon, 850
Dimethylamine, 1204
Dimethylamino-antipyrin, 830
incompatibility, 1649
Dimethylaminoazobenzene, 853
Dimethylaniline, 811
orange, 1450
Di-methylanthranilate, 1216
Dimethylarsenic acid, 933
Dimethylbenzene, 791
Dimethyl ketone, 786, **803**
-piperazine tartrate, incompatibility, **1647**
Dimethylxanthine, 1154, 1155
Dimyricyl, 784
Dinaphthalene, 811
Dinitrobenzene, 811
Dinitrochlorobenzene, 811
Dinitrophenol, 811
Dinitrotoluol, 811
Dinner pills, Chapman's, **497**
Coles', **497**
Hall's, **497**
Lady Webster, **492**
Dionin, incompatibility, 1646
Dioscorea, 1027
fluidextract, **425**
villosa, 1027, 1030
Diosphenol, 999
Diospyros, 1100
virginiana, 1100
Dioxide, barium, 688
carbon, 588, 799
snow, 588
hydrogen, solution, **548**
assay, 1474
incompatibility, 1649
lead, 742, 1535
manganese, 1536
silicon, 591
succinic, 932
sulphur, 580
zinc, 697
Dioxides, incompatibility, 1648
Dioxysuccinic acid, 1965
Dioxytoluene, 1969
Dip, sheep, 814, **816**
Diphenyl, 792, 811
Diphenylamine, 811, 1533
test solution, 1546
Diphenylmethane, 1217
Diphenyl-oxide, 1217
Diphtheria antitoxin, 1900
concentrated, 1900
refined, 1900
super-concentrated, 1902
unofficial, 1902
disinfection, 1884
immunity test, 1934
toxin-antitoxin mixture, 1916
toxoid, 1916
Dippel's oil, 1973
Dipping, acid, 1965
Dipropyl barbituric acid, 934
Dipterix, 1969
Dipterix odorata, 1046
Dipterocorpus turbinatus, 985, 1029
Diquinidine, 1114
Diquinine carbonic ester, 1122
Direct buying, **1338**
dyes, 841
heat evaporation, 128
titration with iodine, 1470
silver nitrate, 1464
potassium permangante, 1474
Disaccharides, 893
Disalicylate, pyrogallol, 1100
Disalicylic acid, 940
Disappearing creams, 1241
Discounts, 1334
Dish, agate ware evaporating, 125
cast iron enameled, **125**
evaporating, graduated, 129
glass, 1490
evaporating, 125
platinum, 1490
porcelain evaporating, 125
Dishonor, notice of, 1248
Disinfectant powder, Izal, **816**
soaps, 1052
testing by Hygienic Laboratory method, 818
Disinfectants, gaseous, 1866
Disinfecting fluid, Burnett's, 693
Disinfection, 1865
Disintegration products of radium, 684
Disintegrator, Mead's, 167
Disks, 1831
Dispensatories, 24
Dispensing cerates, 1746
course, 1945
definition, 1
equipment, 1600
ligatures and sutures, 1777
Dispensing liquids, 1662
ointments, 1746
pills, 1697
plasters, 1753
powders and solids, 1672
solids, 1672
suppositories, 1744
Disperse phase, 184
Dispersed phase, 1655
Dispersing medium, 1655
Dispersion, 184
medium, 1655
Displacement, 233
washing, 189
Display cases, 1316
fixtures, 1312
windows, 1368, 1370
Dissociation, ionic, 539
determination, 541
Disterin-glycero-phosphoric cholin ester, 1205
Distillate, flask, 140
Distillation, 120, 131, 914
apparatus used in, 131
destructive, 145
flask, 132
fractional, 143
reflux, 133
steam, 133
vacuum, 144
volatile oils, 951
Distilled extract of witchhazel, **256**
water, **254**, 547
sterilized, 254, **1795**
Distilling flask, 132
flasks, tubulated, 133
points, 1524
U. S. P. X method for determining, 120
Distributor, steam, 115
Disulphate, quinine, 1116
Disulphide, arsenic, 769
carbon, 581, 811, 1532
a solvent, 174
ethyl, 934
iodine, 584
Dita, 1164
bark, 1164
Ditain, 1164
Ditamine, 1164
Diterpenes, 791
Dithiocarbonate, sodium cellulose, 794
Dittany, 1005
Diuretin, 1154
incompatibility, 1646, 1650
Diversity of laws, 1245
Divided percolation, 404
Dividing powders, 1675
Dobell's solution, 641
Dochez method, scarlet fever streptococcus antitoxin, 1906
Dock, curled, 1099
yellow, 1099
Documentary metrology, 27
Dog grass, 901
Doganoff and Moro test, 1935
Dogsbane, 1016
Dogwood bark, 1075
Jamaica, 1079
Dofomite, 661, 665
Donovan's solution, 257, **768**
incompatibility, 1649
Dorema ammoniacum, 1029
Dose, minimum lethal, 1506
Doses, 22
for children, calculation of, 90
unusual, 1590
Double beam, unequal arm balances, 45
cyanide gauze, **1762**
wool, **1762**
entry bookkeeping, 1391, 1403
jar mill, 158
-normal sodium hydroxide, 1562
solution, 1453
plain filter, 197
salts, 536
screw press, 226, 227
stirrer, 126
tube percolator, 241
Doundaké, 1029
Dover's powder, **479**
syrup of, **279**
tincture, **394**
Draco mitigatus, **754**, 1969
Drafts, 1281
Dragon gum, 1970
Dragon's blood, 1030
Drastics, antidotes, 1942
Draught, black, 361, 1967
Dressing, paraffin, **1060**
Dressings, antiseptic, 1761

Dressings, first aid, 1764
surgical, 1756
Dried alum, **700**
ferrous sulphate, **720**
smallpox vaccine, 1914
suprarenals, 1197
Drimys winteri, 1006
Drink mixer for emulsions, 1659
Drinking water, 546
Drop, black, 361, 378, 1967
chalk, **675**
Dropper, acid, 553
normal, 54
Dropping bottle, 1668
device for burette, 1451
Drops, dutch, 1969
Drops, eye, 341
Hoffmann's, **312**
hot, **383**
Lamotte's, 389, 1971
palsy, 376
pectoral, **395**
Bateman's, **395**
steel, 1977
stomach, 384
stomachic bitter, **384**
toothache, 356
Wade's, 369
Drosera, 1027
angelica, 1027
fluidextract, **425**
longifolia, 1027
rotundifolia, 1027
Drug business, make up, 1327
crude, extraction, 1486
mills, 159
store label, 1620
stores, typical, 1319
Druggist, wholesale, 1337
Druggist's financial statement, 1426
standard sugar, 896
Drugless drug store, 1268
Drugs and Food Act, Federal, 1262
containing astringent principles, 1090
fresh, tinctures, **400**
green, fluidextracts from, 406
power moistener for, 236
solanaceous, 1132
vegetable, sampling and analysis, 1520
Drum filter, U. S., 208
Drumstick, 1969
Dry cleaners, 1061
-cleaning soaps, 1052
protein milk, 1822
seal cachet, 1688
apparatus, 1688
Dryer, vacuum, 127
Drying closet (gas heat), 149
closets, 128, 129
liniment, 350
medicinal substances, loss in, 149
Dryopteris filix-mas, 1007
Duboisia, 1164, 1166
Hopwoodii, 1167
myoporoides, 1164
Duboisine, 1164, 1166
Dugong oil, 1205
Dulcamara, 1159, 1167
fluidextract, 425
Dulcified mercury, 754
Dulcin, 1969
Duodecylic alcohol, 1211
Dusting powder, brown, 1725
chocolate, 1725
iodine, 578
white, 1725
powders, 1695
Dutch drops, 1969
liquid, 1969
oil, 1969
metal, 1969
tea, 1969
white, 1969
Duties of pharmacist to physician, 10
profession, 11
public, 9
Dwarf pine needles oil, 1021
assay, 1461
oil, 1021
Dye, lac, 845
Dyers' broom, 1016
Dyes, acid, 841
acridine, 850, 851
azo, 850
basic, 841
coal-tar, 846, 853
unofficial, 849
direct, 841
fluorescein pyronine, 852
fluoresceine, 850
medicinal, 850
mordant, 841
phenolphthalein, 846, 850
rosaniline, 850, 852
suitable for perfumes, 1219
triphenylmethane, 850, 852
unofficial phenolphthalein, 846
Dysentery, disinfection, 1880
Dysprosium, 531

E

Ear, Judas's, 1971
Earth, bitter, 1967
Fuller's, 698
infusorial, purified, 593
Japan, 1969
nut, 1969
siliceous, purified, 593
wax, 1969
Earths, siliceous, 204
East India catarrh root, 1002
root, 1002
Indian goldthread, 1164
Easton's syrup, 276
Eau de broccherai, 1969
luce, 1969
rabel, 1969
medicinale, Husson's, 1142
sedative de Raspail, **298**
Ebers' papyrus, 3
Ebner's fluid, 1574
Ebullition, 120
Ebur ustum, 1969
Ecballium elaterium, 1087
Ecgonine, benzoyl, 1165
Echinacea, 1028
fluidextract, **426**
Echium vulgare, 891
Eclectic resinoids, 1030
Economical surface evaporation, 127
Effervescent artificial Carlsbad salt, **477**
Effervescent artificial Kissingen salt, **477**
Vichy salt, **477**
with lithium, 478
citrated caffeine, 1153
granules, 476
magnesium sulphate, **670**
mixtures, 1708
potassium bromide with caffeine, **603**
citrate, **607**
salt of lithium citrate, **647**
potassium bromide, 478
compound, **603**
salts granular, 475
sodium phosphate, **630**
solution of magnesium sulphate, 260, 670
sodium citro tartrate, 260
Effervescing powder, compound, **478**
assay, 1456, 1457
Efficiency counter, 1312
Efflorescence, 223
Egg albumen, fresh, 1186
fresh, 1186
yolk, fresh, 1187
glycerite, **303**
Eggs, oil, 1973
Egyptian privet, 1969
Ehrlich's diazo reaction, 1569
solution, 1569
triacid plain, 1572
Eighty per cent clause, 1286
Eikonogen, 1969
Eisenzucker, **727**
Eisner-Wolff test, 1935
Elæosacchara, 484
Elastic adhesive plaster, 520
capsicum plaster, 520
salicylic plaster, 521
Elastica, 1029
Elaterin, 1063, 1087
antidotes, 1942
Elaterinum, 1087
Elaterium, 1063, 1088
Elder flower water, 1005
flowers, 1005
oil, European, 985
Elecampane, 1012
Electric crucible furnace, 110
muffle furnace, 111, 112
stove, 101
Electrical properties of elements, 539
Electrically heated and regulated air bath, 114
Electricity as source of heat, 101
Electrolon, 1969
Electrolysis, determinations by, 1483
Electrolyte, acid, 1965
Electrolytes, 540
Electrolytic determinations, 1515
Electrum, 1969
Electuaries, 488
Electuarium, 248, 1969
dentifricium, 1969
Elements, 528
electrical properties of, 539
Elemi, 1029
oil, 985
Eleometer, 63
Eleoptene, 948
Elephant louse, 1969

Electtaria cardamomum, 983
repens, 1045
Elimination of household pests, 1833
Elixir ad longam vitam, 1969
adjuvans, 316, 1969
aletridis compositum, 316
aletris compound, 316
alkaline, 330
almond compound, 317
ammonii bromidi, 316
valeratis, 317
valerianatis, 317
ammonium bromide, 316
valerate, 317
amygdalæ compositum, 317
anise, 317
anisi, 317, 1969
anti-asthmatic, 325
aperitivum, 1969
aromatic, 315
aromaticum, 315
rubrum, 318
asthmaticum, 379
aurantii amari, 318
compositum, 318
aurantiorum compositum, 1969
barbital sodium, Abbott, 924
beef and iron, 321
benzyl benzoate, 837
bismuth, 318
bismuthi, 318
bitter orange, 318
black haw, 337
bromidorum quinque, 318
trium, 319
buchu, 319
and potassium acetate, 320
compositum, 319
compound, 319
et potassii acetatis, 320
juniper and potassium acetate, 320
juniperi et potassii acetatis, 320
calcii bromidi, 337
et sodii glycerophosphatum, 320
hypophosphitis, 337
lactophosphatis, 320
calcium and sodium glycerophosphates, 320
bromide, 337
hypophosphite, 337
lactophosphate, 320
calisaya alkaloidal, 323
ferrated, 323
with iron and bismuth, 324
and strychnine, 324
cardamom compound, 321
cardamomi compositum, 321
carnis et ferri, 321
cascara sagrada, 321
compound, 322
cascaræ sagradæ, 321
compositum, 322
catariæ et fœniculi, 322
cathartic compound, 322
cathartici compositum, 322
catnep and fennel, 322
chlorides, 323
chloridorum, 323
cinchona alkaloids, 323
and hypophosphites, 337
Elixir cinchona, hypophosphites and iron, 323
bismuth, 324
calcium lactophosphate, 337
pepsin, 337
strychnine, 324
bismuth and strychnine, 224
cinchonæ alkaloidorum, 323
et ferri, 323
hypophosphitum, 337
ferri, bismuthi et strychninæ, 324
et bismuthi, 324
calcii lactophosphatis, 337
strychninæ, 324
pepsini, 337
ferri, bismuthi et strychninæ, 324
cordial, Stoughton's great, 373
corrigens, 325, 1969
corydalis compositum, 325
compound, 325
curassao, 318
Daffy's, 1969
digestive compound, 331
enzymes, 1177
eriodictyi aromaticum, 325
eriodictyon, aromatic, 325
euphorbia compound, 325
euphorbiæ compositum. 325
ferri hypophosphitis, 337
phosphatis, 337
pyrophosphatis, 338
quininæ et strychninæ, 326
lactatis, 337
quininæ et strychninæ, 326
phosphatum, 338
ferric hypophosphite, 337
lactate, 337
pyrophosphate, 338
pyrophosphate, quinine and strychnine, 326
five bromides, 318
formates, 338
compound, 338
formatum, 338
compositum, 338
four chlorides, 323
Garus, 1969
gentian, 327
and ferric phosphate, 327
iron, 327
glycerinated, 328
with tincture of ferric citrochloride, 327
gentianæ, 327
et ferri, 327
phosphatis, 327
ferratum, 327
glycerinatum, 328
glycerophosphates, compound, 328
glycerophosphatum, 320
compositum, 328
glycyrrhiza, 316
aqueous, 329
glycyrrhizæ, 316
aquosum, 329
aromaticum, 338
guarana, 329
and celery, 329
Elixir guaranæ, 329
et apii, 329
heloniadis compositum, 329
helonias compound, 329
Haller's, 1969
hops, 338
humuli, 338
hydrangea and lithium, 330
hydrangeæ et lithii, 330
hydrastis compound, 330
compositum, 330
hypophosphites, 338
and iron, 338
hypophosphitum, 338
et ferri, 338
iron hypophosphite, 337
lactate, 337
phosphate, 337
pyrophosphate, 338
quinine and strychnine, 326
phosphate, 338
lavativa Viennensis, 361
laxative, 322
licorice, 316
aqueous, 329
life, 7
lithii bromidi, 338
citratis, 338
salicylatis, 338
lithium, bromide, 338
citrate, 338
salicylate, 338
long life, 1969
manaca compound, 330
manacæ compositum, 330
paregoric, 378
paregoricum, 379
pectorale, 1969
pepsin, 331
and bismuth, 332
iron, 338
bismuth and strychnine, 331
pepsin, compound, 331, 332
pepsini, 331
bismuthi et strychninæ, 331
compositum, 331
et bismuthi, 332
ferri, 338
rennini compositum, 332
phosphori, 332
et nucis vomicæ, 333
phosphorus, 332
and nux vomica, 333
potassii acetati et juniperi, 338
acetatis, 338
bromidi, 333
potassium acetate, 338
and juniper, 338
bromide, 333
proprietatis, 383
(Paracelsi), 1969
purgans, 1969
Q., I., and S., 326
quininæ valeratis et strychninæ, 338
quinine valerate and strychnine, 338
red, 318
aromatic, 318
rhamni purshianæ compositum, 322
rhei alkalinum, 296

Elixir rhei darelii, 1969
roborans whyttii, 1969
rubus compound, 338
sabal and sandalwood, compound, 333
et santali compositum, 333
sacred, 1975
salutis, 1969
sandalwood and sabal, compound, 333
saw palmetto and sandalwood, compound, 333
simple, 315
sodii bromidi, 334
salicylatis, 334
compositum, 334
sodium bromide, 334
hypophosphite, 338
salicylate, 334
compound, 334, 338
stomachic, 1969
Stoughton's, 373, 1969
strychnine valerate, 338
taraxaci compositum, 335
taraxacum compound, 335
terpin hydrate, 335, 339
and codeine, 335
creosote, compound, 336
terpini hydratis, 335
cum codeine, 335
et codeinæ, 335
creosote compositum, 336
et diacetylmorphinæ, 339
three bromides, 319
tonga and salicylates, 336
tongæ et salicylatum, 336
trium bromidorum, 319
vanillin, compound, 336
vanillini compositum, 336
veronal, 923
viburni opuli compositum, 337
prunifolii, 337
viburnum opulus compound, 337
prunifolium, 337
viscerale, 1969
Hoffmannii, 318
vitriol, 561
Mynsichti, 561
vitrioli acidum, 561
Mynsichti, 1969
yerba santa aromatic, 325
zinc valerate, 339
zinci valeratis, 339
Elixiria, 315
Elixirs, 315
unofficial, 337
Ellagic acid, incompatibility, 1646
Elm, 887
American, 887
bark, 887
slippery, 887
Indian, 887
mucilage, 287
of, 287
red, 887
slippery, 887
sweet, 887
troches, 499
Elœis guineensis, 1046
Elutriating apparatus, 154
Elutriation, 154
Embrocatio, 248
Emerald green, 1969
Emetamine, 1147
Emetic, tartar, 762
antidote, 1941
Mynsicht's, 762
Emetics, 1939
Emetinæ bismutho-iodidum, 1148
hydrochloridum, 1147
Emetine, 1147
bismuth iodide, 1148
bismuthous iodide, 1148
hydrochloride, 1147
ampuls, 1796
Emodin, 1080, 1083, 1084, 1090
Emollient cataplasm, 485
poultice, 485
species, 485
Empiric formula, 530
Empirical formula, 530
solutions, use of, 1553
Empirin, 827
Emplastra, 518, 1751
Emplastrum adhæsivum, 518, 1751
elasticum, 520
aromaticum, 482
belladonnæ, 518, 520, 1752
viride, 520
calefaciens, 520
cantharidini, 520
mite, 520
cantharidis, 519, 1752
cantharidum perpetuum, 1969
capsici, 519, 520, 1752
elasticum, 520
commone, 519
elasticum, 518, 1751
fuscum, 1969
camphoratum, 520
gummosum, 1969
hydrargyri, 521
menthol, 521
plumbi, 519, 521
oleatis, 519, 1752
resinæ, 521
salicylicum compositum, 521
fortius, 521
elasticum, 521
saponis, 520, 521
sinapis, 520, 1753
zinci oxidi, 521
Employees, selecting, 1293
Employing help, 1295
Employment forms, 1294
Empyreumatic oils, 799
resins, 799
Emulsa, 287
Emulsifications and emulsions, 1655
Emulsifier, 1655, 1659
Emulsifiers, 1658
Emulsifying agent, 1655
powders, 1660
Emulsin, 268, 902, 1062
Emulsio communis, 1969
Emulsion, agar, 1058
almond, 290
ammoniac, 290
benzyl benzoate, 837
chloroform, 290
cod liver oil with calcium lactophosphate, 291
Emulsion, cod liver oil with calcium phosphate, 291
wild cherry, 291
almond, 290
asafetida, 287
castor oil, 290
chloroform, 290
cod liver oil, 288
with egg, 289
hypophosphites, 289
malt, 289
oil of turpentine, 288
petrolatum, 290
agar, 1058
compound, 1058
phosphatic, 291
Emulsions, 287
and emulsifications, 1655
casein, 1660
chondrus, 1661
compound, 1661
condensed milk, 1661
continental method, 1657, 1658
English method, 1657
flavors for, 287
gum resin, 1657
natural, 1657
oil-in-water, 1655
petrolatum-agar, 887
powdered milk, 1661
prepared, 1657
preservation, 1661
quillaja, 1661
seed, 1657
unofficial, 290
water-in-oil, 1655
Emulsoid, 186
Emulsum ammoniaci, 290
amygdalæ, 290
asafœtidæ, 287
chloroformi, 290
olei morrhuæ, 288
cum calcii lactophosphas, 291
phosphas, 291
extracto malti, 289
hypophosphitibus, 289
malto, 289
pruno virginiana, 291
vitello, 289
ricini, 290
terebinthinæ, 288
petrolati, 290
petrolei, 290
Enameled cast iron dish, 125
steam kettle, 118
Enclosed sifter, 168
Endocrins, 1170, 1193
Endorsing checks, 1280
Endosmosis, 184
Endowment life insurance, 1287
Enema, 248, 341
Enemata, 341
Energy, 539
Enfleurage, 952, 1209
Engler viscosimeter, 1526
English benzoic acid, 833
method for emulsions, 1657
prepared mustard, 993
title, official, 17, 18
weight systems, 74
white, 1969
Ens martis, 1969
Enteric capsules, 1683

Enteric pills, 826, 1731
Enterprise mill, 162
press, 226
Enzymes, 902
amyloclastic, 902
amylolytic, 902
coagulating, 902
digestive, unofficial, 1176
elixir, 1177
fermenting, 902
hydrolytic, 902
oxidizing, 902
proteoclastic, 902
Enzymol, 1177
Eosin, 934
A, 853
azur II, 853
yellowish, 853
Ephedra vulgaris, 1164
Ephedrine, 1164
Epicarin, 934
incompatibility, 1646
Epigæa, 1100
repens, 1100
Epilobium, 1100
angustifolium, 892, 1100
Epinephrina, 1195
Epinephrine, 1193, 1195, 1533
hydrochloride solution, 257, 1196
assay, 1509
incompatibility, 1646
Epiphegus, 1100
virginiana, 1100
Epipremnum pinnatum, 1163
Epirenan, 1196
Epithelial casts in urine, 1446
cells in urine, 1446
Epsom salt, **665**
Equal arm balances, single beam, 42
Equations, chemical, 537
Equivalents of linear measures, 39
weights and measures, 33
Equus, genus, 1900, 1903, 1904
Erbium, 531
Erepsin, 902
Ergot, 1129
ammoniated tincture, 401
antidote, 1942
aseptic, 1130
assay, 1508
extract, **470**
aqueous, **465**
purified, 1131
fluidextract, **410**
standard, 1509
infusion, **361**
oil, 1045
preparations, unofficial, 1130
rye, 1129
Ergota, 1129
Ergotin Bonjean, 1131
Merck, 1131
Wernich, 1131
Ergotine, 1130
P.I., **465**
Ergotininæ citras, 1130
Ergotinine, 1129
citrate, 1130
Ergotole, 1131
Ergotoxine, 1129, 1166
Ericinol, 1063
Ericolin, 1079, 1097, 1098
Erigeron, 1016
Erigeron canadensis, 1016
oil, 1016
Eriodictyon, 1008
californicum, 986, 1008
elixir aromatic, **325**
fluidextract, **411**
syrup, aromatic, **276**
Erysipelas disinfection, 1883
Erythrocytes in urine, 1447
Erythrodextrin, 903
Erythrœa centaurium, 1074
Erythrol tetranitrate, 934
Erythrophleine, 1164
hydrochloride, 1166
Erythrophlœm, 1164
guineense, 1164, 1166
Erythroretin, 1083
Erythrose, 893
Erythrosine, 841
Erythroxylon, 1163
Coca, 1148, 1163, 1166
truxillense, 1163
Esbach's reagent, 1568
Escharotica, 248
Eschscholtzia Californica, 1164
Eseramine, 1131
Eseridine, 1131
Eserine, 1131
antidote, 1942
salicylate, 1132
Essence, 1969
diazyme, 1178
mirbane, 1969
peppermint, **310**
pepsin, **332**, 1190
Fairchild, 1178
vinegar, 1969
Essences, 305, 948
Essentia, 249
Bina, 1969
Essential oils, 948
salt of lemons, 798
Ester number, 1517
Esterases, 902
Esters, 786, 1214
caprylic acid, 954
Estimation, aldehydes and ketones in volatile oils, 1483
alkaloids, 1490
phenol in a volatile oil, 1483
phenols in compound solution of cresol, 1484
Estragol, 968
Eternal pills, 1974
Ethane, 780, 785
Ethanoic acid, 786
Ethanol, 786, 905
dehydrated, 904
diluted, **906**
Ether, **917**
acetic, **927**, 1215
antidote, 1942
Aran's, 935
as a solvent, 174
butyric, 1215
chloric, **309**
dehydrated, 1533
ethylenediethyl, 932
formic, 934
hydrocyanic, 934
methylene-dimethyl, 937
methyl-ethyl, 937
methylic, 937
nitrous, spirit, **305**, **919**
œnanthic, 1973
petroleum, 1061
Ether pyroacetic, 1969
-soluble extractive, non-volatile, 1523
volatile, 1523
spirit, **312**
compound, **312**
stronger, **917**
sulphuric, **917**
Wigger's, 935
Ethereal oil, **918**
solutions, 343
tincture ferric chloride, **389**
assay, 1468
lobelia, 401
tinctures, **400**
Éthérolat, 1969
Éthérolaturé, 1969
Éthérolé, 1969
Ethers, 785
phenol, 1217
Ethics, code, 9
pharmaceutical, principles, 9
Ethiops mineral, 760
Ethydene chloride, 935
Ethyl acetate, 175, 786, **927**, 1215, 1533
acetoacetate, 175
alcohol, 94, 781
(anhydrous), 175
aldehyde, 786
aminobenzoate, 834
benzoate, 175, 934, 1215, 1226
bromide, 934
butyrate, 175, 934, 1215
carbamate, 934
incompatibility, 1646
chaulmoograte, 921
chloride, 786, **920**
cinnamate, 1026, 1215, 1226
cyanide, 934
disulphide, 934
formate, 934, 1215
hydrosulphide, 787
hydroxide, 786, 904
iodide, 934
lactate, 175
laurinate, 1215
mercaptan, 787
nitrite, pure, 919
spirit, **305**, **919**
assay, 1482
nonylate, 1215
oxide, 785, 904
pelargonate, 916, 935
phenylacetate, 1215
propionyl, 175
salicylate, 828, 935, 1215, 1226
sulphydrate, 787, 935
valerate, 935, 1215
Ethylate, sodium, 643, 939
Ethylcarbonate, quinine, 1120
incompatibility, 1649
Ethylene, 780, 799
bromide, 935
diamine, 935
silver nitrate, 932
incompatibility, 1646,1650
-ethenylamidine, incompatibility, 1647
for anesthesia, 935
Ethylenediethyl ether, 932
Ethylidene chloride, 935
Ethylmorphine chloride, 1111

Ethylmorphine hydrochloride, incompatibility, 1646
Ethyl-oxy-caffeine, 1166
Ethyl-piperidine, 1158
Ethylproprionyl, 935
Ethylsulphate, sodium, 643
Ethylsulphuric acid, 935
Eucainæ hydrochloridum, 1150
Eucaine hydrochloride, 1150
assay, 1453
Eucalypti gummi, 1026
Eucalyptol, 978, 979
petroxolin, 352
spray, **354**
Eucalyptus, 978
fluidextract, **411**
globulus, 978
gum, 1026
troches, **498**
kino, troches, 499
leaves, 978
oil, 979
ointment, 511
rostrata, 1026
Eucasin, 1969
Eucatropine, 1135
Eucerin, 1043
Eucodin, 935
Eudoxin, 935
Eugallol, 1100
Eugenia chekan, 1016
Eugenin, 973
Eugenol, 973, 974, 1217, 1226
Eugoform, 935
Eulachon oil, 1205
Eumydrin, 935
Euonic acid, 1088
Euonymus, 1088
atropurpureus, 1030, 1088
extract, **466**
powdered, **466**
fluidextract, **426**
Eupatorin, 1011, 1030
Eupatorium, 1011
fluidextract, **426**
perfoliatum, 1011, 1030
Euphorbia corollata, 1030
elixir, compound, **325**
fluidextract, **426**
herta, 1028
pilulifera, 1028
Euphorbium, 1029
resinifera, 1029
Euphorin, 935
Euphrasia, 1016
officinalis, 1016
Euphthalmine, 935, 1135
hydrochloride, 935
Eupion, 806
Eupyrine, 935
Euquinine, 1120
incompatibility, 1649
Eureka tablet machine, 1709
Euresol, 824, 935
European angelica seed, 969
aniseed, 968
elder oil, 985
goat's rue, 890
pennyroyal, 965
Europhen, 935
incompatibility, 1646
Europium, 531
Eutectic solution, 964, 987
Euxanthone, 840
Evaporating below boiling point, 124, 125
Evaporating dish, agate, 125
glass, 125
graduated, 129
porcelain, 125
kettle, glass-lined, 125
sulphuric acid, 128
Evaporation, 120, 121
by boiling, 124
direct heat, 128
economical surface, 127
flask, 128
of liquids by boiling, 124
solvent, 1476
measuring, 129
spontaneous, 127
to fixed volume, 129
Evening primrose, 891
Exalgin, 1969
incompatibility, 1646
Exalgine, 936, 937
Examination of urine, 1436
Exchanging commodities, 1357
Excipient bottle, 1693
for pills, general, 1693
Excipients, pill, 1692
Executive functions, 1293
Exempt narcotics, 1259
Exogonium Jalapa, 1085
purga, 1063
Expectorant mixture, 296
pectoral, **296**
Stokes', **296**, 1969
Expense relation to net profit, 1425
Expressed oil, almond, 1034
nutmeg, 980
Expression, 225
Exsiccated alum, **700**
assay, 1478
calcium sulphate, 683
ferrous sulphate, **720**
assay, 1474
sodium arsenate, **636**, 769
assay, 1469
phosphate, **631**
assay, 1463
sulphite, 643, 1542
Exsiccation, 120, 218, 223, 224
Extemporaneous chocolate coating, 1721
mixtures, 1651
powders, 1672
preparation of troches, 1700
solutions, 1651
compounding, 1651
sugar coating, 1721
Extension clamp, 139
External applications, 345
phase, 1655
Extra soda, 622
Extract, aconite, **470**
aloe, **470**
apple, ferrated, tincture, **390**
apples, ferrated, **466**
arnica, **470**
beef, 1185
belladonna, **455**
assay, 1497
pilular, **455**
powdered, **455**
brain, solution, 1203
cannabis, **456**
cascara sagrada, **457**
powdered, **457**
cimicifuga, **470**
cinchona, **470**
Extract, colchicum, 457, 470
assay, 1498
powdered, **457**
colocynth, **458**
compound, **459**
powdered, **458, 459**
conium, **465**
assay, 1499
ergot, **470**
aqueous, **465**
purified, 1131
euonymus, **466**
powdered, **466**
gelsemium, **470**
gentian, **466**
glycyrrhiza, **460**
pure, **460**
golden seal, **467**
Goulard's, **738**
hematoxylon, **467**
henbane, **460**
hydrastis, **467**
assay, 1500
powdered, **467**
hyoscyamus, **460**
assay, 1498
pilular, **460**
powdered, 461
ignatia, **467**
assay, 1500
powdered, **467**
jalap, **470**
krameria, **468**
powdered, **468**
leptandra, **468**
powdered, **468**
licorice root, **460**
pure, 460
malt, **462**, 1821
Borcherdt's, 1821
unmedicated, 1821
with cod liver oil, 1821
nux vomica, **462**
assay, 1498
powdered, **462**
opium, **469**
powdered, **469**
oxgall, **459**
powdered, **459**
physostigma, **470**
pituitary, 1194
solution, 1195
podophyllum, **470**
quassia, **470**
rhamnus purshiana, **457**
rhubarb, **463**
powdered, **463**
Saturn, 739
stramonium, **463**
assay, 1497
pilular, **463**
powdered, **464**
strophanthus, **470**
sumbul, **469**
taraxacum, **469**
viburnum prunifolium, **470**
white rose, 1224
witchhazel, distilled, **256**
Extracta, 451
Extraction, 231
alkaloids, 1493
apparatus, continuous, 445
Lewin's, 244
by maceration and digestion, 231
percolation, 233

Extraction, crude drug, 1486
galenicals, 1487
method, total, 1486
with hand shaking, 1501
Extractive, 451
alcohol-soluble, 1523
diluted alcohol-soluble, 1523
non-volatile ether-soluble, 1523
soluble in purified petroleum benzin, 1523
volatile, ether-soluble, 1523
water-soluble, 1523
Extractor, Lloyd, 213
Extracts, 451
animal, 1930
assaying, 454
flavoring, 976
food, 1929
protein, 1929
meat, 1824
perfume, concentrated, 1227
pilular, 453, 1487
pollen, 1927
powdered, 454, 1487
preparation, 453
preservation, 453
unofficial, 470
Extractum aconiti, **470**
aloes, 470
arnicæ, **470**
belladonnæ, **455**
foliorum, **455**
cannabis, **456**
carnis, 1185
cascaræ sagradæ, **457**
catholicum, 1969
cimicifugæ, **470**
cinchonæ, **470**
colchici, **457**, **470**
cormi, **457**
colocynthidis, **458**
compositum, **459**
conii, 465
Cusso fluidum, 442
ergotæ, **470**
aquosum, **465**
ergotæ liquidum, 1131
purificatum, 1131
ergoti, 1131
euonymi, **466**
fellis bovis, **459**
ferri pomatum, **466**
gelsemii, **470**
gentianæ, **466**
glycyrrhizæ, 460
purum, **460**
hæmatoxyli, **467**
hydrastis, **467**
hyoscyami, **460**
ignatiæ, **467**
jalapæ, **470**
krameriæ, **468**
leptandræ, **468**
malti, **462**
martis pomatum, 1969
menispermi fluidum, 442
nucis vomicæ, **462**
opii, 469
aquosum, **469**
liquidum, 442
panchymagogum Crollii, 1969
pancreaticum integrum, 1178
physostigmatis, **470**
picrorhizæ liquidum, 442
podophylli, **470**
Extractum, quassiæ, **470**
rhei, **463**
secalis cornuti, 1131
stramonii, **463**
strophanthi, **470**
sumbul, 469
taraxaci, **469**
viburnum prunifolium, **470**
Eye drops, 341
lotion, isotonic, 260
lotions, 260
wash, 341
washes, 260
Eyebright, 1016
Eyestones, 1969

F

Faba Porcina, 1969
Purgatrix, 1969
Suilla, 1969
vulgaris, 883
Face powder, flesh, **1234**
liquid, **1235**
naturelle, **1234**
white, **1234**
powders, 1233
Fæcula, 1969
Fagus sylvatica, 1045
Fahrenheit thermometer, 102
Fahrenheit's hydrometer, 64
Fairchild's essence of pepsin, 1178
False unicorn, 1076
Fancy goods, 1311
Farfara, 1076
Farina Hordei Præparata, 1969
Fat, mountain, 1973
soluble A, 1168
wool, 1042
hydrous, 1043
refined, 1042
Fats, 1032, 1168
and fatty acids, iodized, 865
unsaponifiable, 1056
Fatty casts in urine, 1446
creams, 1239
hydrocarbons, 783
Febrifuge, cinchona, 1122
Federal Food and Drugs Act, 1262
laws, 1292
reserve banks, 1282
Feeder, breaker, 165
vibrator, 165
Fehling's solution, 1554, 1571
Fel bovis, 1184
Feldspar, 698
Felt strainers, 193
Fenchone, **966**
Fennel, 966, 968
and catnep, elixir, **322**
oil, 966
seed, 966
water, **254**, 970
Fenugreek, 892
Ferioben, 865
Fermentation, 902, 914
products, unofficial, 941
tube, 1794
Fermented milk, **1182**
Fermenting enzymes, 902
Ferments, action upon saccharine fruits, 941
fibrin, 1202
Ferments, pancreatic, incompatibility, 1648
Fern, male, 1007
male, oleoresin, **446**
shield, 1007
sweet, 1100
Ferrated elixir of calisaya, alkaloidal, **323**
extract of apples, **466**
tincture, **390**
Ferratin, 1205
Ferri acetas, 732
arsenas, 732
benzoas, 732
bromidum, 732
carbonas saccharatus, **712**
chloridum, **714**
et ammonii citras, **716**
sulphas, 732
tartras, 732
potassii tartras, 732
quininæ citras, 732
sodii pyrophosphas, 732
strychninæ citras, 732
ferrocyanidum, 732
glycerophosphas, **725**
hydroxidum, 732
cum magnesii oxido, **717**
hypophosphis, **726**
iodidi syrupus P.I., **267**
lactas, **727**, 732
malas crudus, **466**
nitras, 732
oxalas, 732
oxidum magneticum, 732
rubrum, 732
saccharatum, **727**
phosphas, **719**
albus, 732
solubilis, **719**
pyrophosphas, **728**
salicylas, 732
scobs, 1969
subcarbonas, 732
sulphas, **719**
sulphas granulatus, **721**
exsiccatus, **720**
sulphidum, 732
valeras, 732
Ferric acetate, 732
solution, 259
acid albuminate, 1205
ammonium sulphate, 732, 1533
test solution, 1546
and ammonium acetate solution, 257
and potassium tartrate, 732
benzoate, 732
chloride, **714**, 1533
assay, 1468
ethereal tincture, assay, 1467
solution, 257, 259, **714**
assay, 1467
test solution, 1546
tincture, **373**, **716**
assay, 1468
ethereal, **389**
tasteless, **389**
wool, **1762**
citrate assay, 1468
soluble, **716**
solution, 258, **725**
assay, 1467
citrochloride tincture, **389**

Ferric ferrocyanide, 732
glycerinophosphate, **725**
glycerophosphate, **725**
assay, 1468
hydrate with magnesia, **717**
hydroxide, 732
magma, 732
with magnesium oxide, **717**
hypophosphite, **726**
assay, 1468
elixir, **337**
solution, 259
syrup, **284**
lactate elixir, **337**
nitrate, 732
solution, 259
oleate, 1047
oxide, saccharated, **727**
assay, 1467
assay, 1468
soluble, **727**
oxychloride solution, 259
oxyhydrate, 732
oxysulphate solution, 259
phosphate and gentian elixir, **327**
elixir, **337**
soluble, **719**
assay, 1467
white, 732
with sodium nitrate, **719**
pyrophosphate, **728**
assay, 1468
elixir, **338**
quinine and strychnine elixir, **326**
soluble, **728**
salicylate, 732
solution, 258, **730**
salts, 710
subsulphate solution, 258, **731**
assay, 1468
sulphate, basic, solution, **731**
solution, **723**
tersulphate solution, 257
valerate, 732
Ferricyanide, potassium, 616, 1539
Ferro Pagliari, 1969
silicon, 1969
Ferrocyanide, ferric, 732
potassium, 616, 1539
zinc, 697
Ferropyrine, incompatibility, 1646
Ferro-sajodin, 865
Ferrous arsenate, 732
bromide, 732
carbonate, liquid, **713**
mass, **487**, **713**
assay, 1472
nascent, **713**
pills, **490**
assay, 1472
saccharated, **712**
assay, 1472
chloride solution, 259
syrup, 284
iodide pills, **495**
syrup, **267**, **718**
assay, 1462
lactate, **727**, 732
assay, 1468
oxalate, 732
phosphate, syrup, 284
Ferrous salts, 710
sulphate, **719**, 1533
assay, 1474
dried, **720**
exsiccated, **720**
assay, 1474
granulated, **721**
precipitated, **721**
test solution, 1546
acid, 1546
sulphide, 732, 1533
Ferruginous pills, **490**
Ferrugo, 1969
Ferrum, 710
albuminatum, **724**
alcoholisatum, 1969
dialysatum, 188
limatum, 1969
oxydatum saccharatum,
peptonatum, **728**
pomatum, 1970
redactum, **710**
reductum, **710**
Fertility vitamin, 1169
Ferula asafœtida, 1022
fœtida, 1022
galbaniflua, 1029
persica, 994
sumbul, 967
Fetid spirit of ammonia, 314
Fetty, 1022
Fever bark, Australian, 1163
scarlet, antitoxin, 1904
streptococcus antitoxin, concentrated, 1904
Dochez method, 1906
toxin, 1916
tree, 978
Feverfew, 1017
oil, 985
Fiber, crude, 794, 1522
Fibrin, 1204
ferments, 1202
Ficus, 1089
carica, 947, 1089
Fidelity insurance, 1289
Fiftieth-normal hydrochloric acid, 1556
sodium hydroxide, 1563
solution, 1453
sulphuric acid, 1567
Fig, 1089
Figs, 947
compound syrup of, **277**
File and rasp, 135
rat tail, 135
Filicic acid, 1007
nigrine, 1007
Filing prescriptions, 1619
Filling the prescription, 1600
Filter, double plain, 197
international, 208
Kiefer glass tray, 202
monocell, 208
monopad, 203
multiple pulp, 210
paper, folding, 196
quantities, 1533
plain, 196, 197
plaited, 197
press, 209
presses, 229
pump, brass, 206
glass, 206
Rother's, 197
Sharpless centrifugal, 210
Filter, U. S. drum, 208
vacuum, 207
Vallez rotary, 210
Filter-cel, 204
Filtering apparatus, rapid, 206
media, 203
Filters, alundum, 204
asbestos, 203
cotton, 203
glass-wool, 203
paper, 196
sand, 204
stoneware, 204
Filtration, 196
aids, 204
centrifugal, 208
continuous, 202
hot, 205
stone crock, 208
under pressure, 208
vacuum, 206
volatile liquids, 202, 203
Financial statement for druggists, 1426
statements, 1420
Fine powder, 170
Fineness of powder, 169
powders, 1493
Fir balsam, 1030
Fire damp, 785, 1970
insurance, 1286, 1397
proofing, 1371
Firm zinc glycerogelatin, **515**
First aid dressings, 1764
costs, 1335
Fish berry, 1157
berries, antidote, 1942
Fisher burner, 99
Fitting corks, 135
Five bromides, elixir, **318**
Fixatives, 1209, 1218, 1220
from animal sources, 1218
synthetic chemicals, 1219
vegetable sources, 1219
Fixed air, 1970
oils, 1032
unofficial, 1045
volume, evaporation to, 128
Fixture depreciation, 1420
Fixtures, display, 1312
Flag, blue, 1012
fluidextract, **430**
Flake lead, 1970
tapioca, 883
white, 742, 1970, 1978
Flame, 92
gas, 98
Flask, cassia, 1483
distillate, 140
distillation, 132
distilling, 132
evaporation, 128
volumetric, 1552
Flasks, tubulated distilling, 133
Flavaspidic acid, 1007
Flavaspidin, 1007
Flavone, 840
Flavoring extracts, 976
Flavors for emulsions, 287
Flaxseed, 888
oil, 1037
Flea seeds, 1970
wort, 1970
Fleabane oil, 1016
Fleas, elimination of, 1854

Fletcher's gas crucible furnace, 110
radial burner, 99
Fleur de Lys, 1012
Flexible collodion, 343
Flies, elimination of, 1833
Russian, 1190
Spanish, 1190
Flint, 591
Floating soap, 1052
Flocculation, 186
Floor covering, 1315
Floors, 1315
Floral odors, 1221
Florence oil, 1970
Florentine orris, 1003
receiver, 215
Flores antimonii, 1970
benzoes, 1970
bismuthi, 1970
martis, 1970
zinci, 694, 1970
Florida water, 1229
Flos æruginis, 1970
salis, 1970
Flour, casein diabetic, 1823
cellu, 1823
cellulose, 1823
fossil, 1970
hepco, 1823
Hoyt's glutin special, 1823
nutrivoid, 1824
paste, 1622
soy bean gruel, 1824
sulphur, 582
Flower, passion, 1162
tincture, 396
wind, 1013
Flowers, antimony, 1970
arnica, 1009
Benjamin, 833, 1970
benzoin, 833
colchicum, 1164
lavender, 1225
mullein, 891
orange, oil, 956
perfume, 1223
perfumed, 1209
sulphur, 581
zinc, 1970
Fluid, Condy's, 1968
measure, 77
apothecaries, 80
Fluidextract, aconite, 417
adonis, 418
aletris, 418
angelica root, 418
apocynum, 419
aralia, 419
arnica, 419
root, 442
aromatic, 442
asclepias, 419
aspidosperma, 442
avena sativa, 419
bael, 442
baptisia, 420
belladonna leaves, 406
assay, 1498
root, 407
assay, 1498
berberis, 420
bitter orange, 442
bittersweet, 425
black cohosh, 409
snakeroot, 409
Fluidextract blue flag, 430
boldo, 420
buchu, 407
compound, 420
calendula, 420
calumba, 421
cannabis, 408
standard, 1507
cascara sagrada, 408
aromatic, 408
castanea, 421
catnep, 421
caulophyllum, 421
celery fruit, 418
chestnut leaves, 421
chimaphila, 422
chionanthus, 422
chirata, 422
cimicifuga, 409
cinchona, 409
aqueous, 442
assay, 1498
cocillana, 422
coffee, 422
colchicum, 410
assay, 1498
corm, 423
assay, 1500
condurango, 423
conium, 442
convallaria flower, 442
root, 423
coptis, 424
cornus, 424
corydalis, 424
cotton root bark, 428
cubeb, 424
cusso, 442
cypripedium, 424
damiana, 425
digitalis, 425
dioscorea, 425
drosera, 425
dulcamara, 425
echinacea, 426
ergot, 410
standard, 1509
eriodictyon, 411
eucalyptus, 411
euonymus, 426
eupatorium, 426
euphorbia, 426
frangula, 427
fucus, 427
galega, 427
gelsemium, 427
gentian, 428
geranium, 428
ginger, 417
glycyrrhiza, 412
golden seal, 412
grindelia, 428
guarana, 428
assay, 1500
hamamelis leaves, 429
helianthemus, 442
helonias, 429
henbane, 413
hop, 429
hydrangea, 430
hydrastis, 412
assay, 1498
hyoscyamus, 413
assay, 1498
ipecac, 413
assay, 1498
Fluidextract, jalap, 430
juglans, 430
juniper berries, 431
kava, 431
kola, 431
assay, 1500
krameria, 431
lappa, 432
leptandra, 432
licorice root, 412
lobelia, 432
lupulin, 432
manaca, 432
matico, 433
menispermum, 442
mezereum, 433
mitchella, 433
mullein leaves, 440
nux vomica, 433
assay, 1500
oat, 419
opium, 442
paracoto, 442
pareira, 434
parsley root, 442
phytolacca, 434
picrorhiza, 442
pilocarpus, 442
podophyllum, 442
pomegranate, 412
quassia, 434
quercus, 435
rhamnus cathartica, 435
purshiana, 408
aromatic, 408
rhubarb, 414
rhus glabra, 414, 442
rose, 414
rubus, 435
rumex, 435
sandalwood, 436
sanguinaria, 436
sarsaparilla, 415
compound, 436
scoparius, 436
scutellaria, 437
senecio, 437
senega, 416
senna, 417
serpentaria, 437
solanum, 437
spigelia, 442
squill, 415
staphisagria, 442
stillingia, 437
compound, 438
stramonium, 438
sumbul, 442
taraxacum, 438
thuja, 439
thyme, 439
tonga, 439
trifolium, 439
compound, 439
trillium, 440
triticum, 440
uva ursi, 417
valerian, 440
veratrum viridis, 442
verbena, 442
viburnum opulus, 441
prunifolium, 441
wild cherry, 434
xanthoxylum, 441
yerba santa, 411
zea, 441

Fluidextracta, 402
Fluidextracts, 402, 406
acetic, 406
alcoholic percentages, 406
from green drugs, 406
preservation, 405
unofficial, 442
Fluidextractum aconiti, 417
adonidis, 418
aletridis, 418
angelicæ radicis, 418
apii fructus, 418
apocyni, 419
araliæ, 419
arnicæ, 419
radicis, 442
aromaticæ, 442
asclepiadis, 419
aspidospermatis, 442
aurantii amari, 442
avenæ sativæ, 419
baptisiæ, 420
belæ liquidum, 442
belladonnæ foliorum, 406
radicis, 407
berberidis, 420
boldi, 420
buchu, 407
compositum, 420
calendulæ, 420
calumbæ, 421
cannabis, 408
cascaræ sagradæ, 408
aromaticum, 408
castaneæ, 421
catariæ, 421
caulophylli, 421
chimaphilæ, 422
chionanthi, 422
chiratæ, 422
cimicifugæ, 409
cinchonæ, 409
aquosum, 442
cocillanæ, 422
coffeæ, 422
colchici, 410
cormi, 423
seminis, 410
condurango, 423
conii, 442
convallariæ florum, 442
radicis, 423
coptis, 424
corni, 424
corydalis, 424
cubebæ, 424
cusso fluidum, 442
cypripedii, 424
damianæ, 425
digitalis, 425
dioscoreæ, 425
droseræ, 425
dulcamaræ, 425
echinaceæ, 426
ergotæ, 410
eriodictyi, 411
eucalypti, 411
euonymi, 426
eupatorii, 426
euphorbiæ, 426
frangulæ, 427
fuci, 427
galegæ, 427
gelsemii, 427
gentianæ, 428
geranii, 428
Fluidextractum glycyrrhizæ, 412
gossypii corticis, 428
granati, 412
grindeliæ, 428
guaranæ, 428
hamamelidis foliorum, 429
helianthemi, 442
heloniadis, 429
humuli, 429
hydrangeæ, 430
hydrastis, 412
hyoscyami, 413
ipecacuanhæ, 413
iridis versicoloris, 430
jalapæ, 430
juglandis, 430
juniperi, 431
kavæ, 431
kolæ, 431
krameriæ, 431
lappæ, 432
leptandræ, 432
lobeliæ, 432
lupulini, 432
manacæ, 432
matico, 433
menispermi, 442
mezerei, 433
mitchellæ, 433
nucis vomicæ, 433
opii liquidum, 442
paracoto, 442
pareiræ, 434
petroselini radicis, 442
phytolaccæ, 434
picrorhizæ liquidum, 442
pilocarpi, 442
podophylli, 442
pruni virginianæ, 434
quassiæ, 434
quercus, 435
rhamni catharticæ, 435
rhei, 414
rhois glabræ, 414
rosæ, 414
rubi, 435
rumicis, 435
sabal, 435
sanguinariæ, 436
santali albi, 436
sarsaparillæ, 415
compositum, 436
scillæ, 415
scoparii, 436
scutellariæ, 437
senecionis, 437
senegæ, 416
sennæ, 417
serpentariæ, 437
solani, 437
spigeliæ, 442
staphisagriæ, 442
stillingiæ, 437
compositum, 438
stramonii, 438
sumbul, 442
taraxaci, 438
thujæ, 439
thymi, 439
tongæ, 439
trifolii, 439
compositum, 439
trillii, 440
tritici, 440
uvæ ursi, 417
valerianæ, 440
Fluidextractum veratri viridis, 442
verbasci foliorum, 440
verbenæ, 442
viburni opuli, 441
prunifolii, 441
xanthoxyli, 441
zeæ, 441
zingiberis, 417
Fluidglycerata, 443
Fluidglycerate cascara sagrada, 443
aromatic, 443
glycyrrhiza, 444
krameria, 444
rhubarb, 444
Fluidglycerates, 443
Fluidglyceratum cascaræ sagradæ, 443
aromaticum, 443
glycyrrhizæ, 444
krameriæ, 444
rhei, 444
Flumerin, 878
Fluorescein, 852, 853, 936, 1533
copper, 852
pyronine dyes, 852
zinc, 852
Fluoresceine dyes, 850
Fluoresceinum, 852
Fluoride, aluminum and sodium, 579
ammonium, 660
antimony, 763
calcium, 579
chromium, 734
cupric, 744
hydrogen, 579
sodium, 579
and aluminum, 579
Fluorides, 579
Fluorine, 531, 567, 579
Fluorol, 1970
Fluorspar, 579, 1970
Flux, black, 1967
Flystone, 736, 1970
Fœniculum, 966
vulgare, 966
Folding filtering paper, 196
packages, 1673
Food allergens, 1929
and Drugs Act, Federal, 1262
antigens, 1929
atopens, 1929
chemical, 279
extracts, 1929
protein extracts, 1929
skin, 1241
Foods, carbohydrate, 1821
for diabetics, 1822
medicinal, 1820
protein, 1820
Fool's gold, 1970
Foot bellows, 110
Fomentum, 249, 517
Force, 539
Foreign Indian hemp, 999
organic matter in whole vegetable drugs, 1521
Form of credit rating, 1276
selecting help, 1294
Formaldehyde, 929
antidote, 1943
as a disinfectant, 1866
cresolated, 815
methyl, 786

Formaldehyde solution, 257, **929**, 1775
as a disinfectant, 1874
assay, 1454
with soap, 259
tannin, 1100
test solution, 1546
Formaldehydum cresolatum **815**
Formalin, **929**
Forman, 933
Formanilid, 936
Formate, ammonium, 660
ethyl, 934, 1215
geranyl, 1215
phenylethyl, 1217
rhodinol, 1217
Formates, compound elixir, 338
elixir, 338
Formic acid, 799, 1192
spirit, **311**
ether, 934
Formica rufa, 1192, 1205
Formin, 931
incompatibility, 1648
salicylate, 939
Formol, 1970
Formonetin, 1063
Forms, employment, 1294
Formula, 529
empiric, 530
empirical, 530
graphic, 530
rational, 530
stereochemical, 530
structural, 530
symbolic, 17, 20
Formulary, National, 23
Formulas and prescriptions, 89
stereochemic, 780
Formylphenetidin, 936
Formylum chloratum, 1970
Fortoin, 937
Fossil alkali, 1970
flour, 1970
wax, 1970
Fossiline, 1970
Fotus, 249, 517
Four chlorides, elixir, **323**
Fowler's solution, 257, **766**
antidote, 1941, 1943
incompatibility, 1650
Foxglove, 1065
Fractional crystallization, 223
distillation, 143
percolation, 245, 404
Fractions, coal tar, 811
Fragaria, 947
Franciscea uniflora, 1161
Frangipanni sachet, **1230**
Frangula, 1089
fluidextract, **427**
Frangulic acid, 1089
Frangulin, 1089
Frankincense, 1030, 1970
Frasera, 1079
Walteri, 1030, 1079
Fraude reagent, 1970
Fraxetin, 1063, 1080
Fraxin, 1063, 1080
Fraxinus americana, 1080
ornus, 899, 1063
"Freely soluble", 175
Freezine, 1970
Freezing salt, 1970
French chalk, 592
French cork press, 1669
digitalin, 1065, 1067
mixture, **578**
polish, 1970
rose perfume, 1224
white, 1970
Fresh apple juice, 946
drugs, tinctures, **400**
egg, 1186
albumen, 1186
yolk, 1187
lemon peel, 955
Friable pills, 1697
Fringe tree bark, 1074
Front of store, expense proportion, 1424
Fronts of stores, 1309
Frost weed, 1016
Frothing, 133
Fructose, 1970
Fruit, angelica, 969
bael, 891
caraway, 965
carrot, 970
celery, 970
juices, 945
salt, 1976
sugar, 1970
Fruits, saccharine, action of ferments upon, 941
unofficial, 947
Fuchsin, 853, 936
acid, 853
basic, 853, 1534
S, 853
-sulphurous acid test solution, 1546
Fucose, 893
Fucoxanthin, 840
Fucus, 890
fluidextract, **427**
vesiculosus, 890
Fuel, kinds of, 93
Fuels, hydrocarbon, 92
Fuligokali, 1970
Fuller's earth, 698
Fumarate, bibenzyl, 933
Fumaric acid, 1158
Fumarine, 1162
Fume closet, 129, 130
Fumigants, 1860
Fuming nitric acid, 1537
sulphuric acid, 1543
Fungin, 794
Funnel, Buchner, 202
glass, 200
hard rubber, 201
open separatory, 214
plain, 200
ribbed, 200
stand, 139, 201
tinned copper, 201
tube, 138
improvised, 138
stoppered, 138
thistle top, 138
valve, 202
Funnels, 200
copper, 201
Furfur, 1970
Furfurane, 792
Furfurol, 799
Furnace, electric crucible, 110
muffle, 111, 112
Fletcher's gas crucible, 110
gas, 100
Furnace muffle gas, 111
portable, 94
Furnaces, pharmaceutical, 93
Furol, 1970
Fused calcium chloride, 1531
silver nitrate, **746**
assay, 1462
Fusel oil, 904
Fusible body, Bensemann's method of collecting, 107
metal, 1972
Fusion, 112
Fustic, 845
old, 1970
young, 1970

G

Gabbett's acid blue, 1574
Gadinine, 1204
Gadolinite, 704
Gadolinium, 531
Gaduol, 1205
Gadus morrhua, 1187
Galactenzyme bouillon, 1181
tablets, 1182
Galactic, 1970
Galactosane, 893
Galactose, 885, 893, 1062
Galanga, 1002
Galangal, 1002
oil, 985
Galangin, 1002
Galangol, 1002
Galbanum, 1029, 1219
Galega, 890
fluidextract, **427**
officinalis, 890
Galen, 5
Galena, 737, 744, 1970
Galenical preparations, 247
Galenicals, extraction of, 1487
Galenite, 737
Galipea cusparia, 985, 1016
Gall with opium, ointment, 511
glass, 1970
Galla, 1091
Gallacetophenone, 936, 1970
Gallanilid, 936, 1100
Gallanol, 936, 1100
Gallate, bismuth, basic, **771**
Gallein, 1970
Gallic acid, 1094, 1534
anilide, 1100
Gallinol, 1100
Gallipoli, 1970
Gallium, 531
Gallobromol, 936, 1970
Gallogen, incompatibility, 1646
Gallotannic acid, 1092
Galls, Aleppo, 1091
Smyrna, 1091
Gallus Bankiva, 1205
domesticus, 1186, 1187
Gambir, 1096
and opium tincture, compound, **395**
compound powder, 484
incompatibility, 1646
tincture compound, **373**
troches, 499
Gamboge, 1085
antidote, 1942
pipe, 1085
Gambogic acid, 1085
Gamene, 1970

Gamma acid, 811
rays, 684
Gangrene, anti-gas serum, 1906
Ganjah, 999
Gannal's, 1970
method for specific gravity, 65
Garantose, 1970
Garcinia Hanburyi, 1085
indica, 1046
Garden angelica root, 969
thyme, 962
valerian, 1000
Gardenia, 1225
Gardeniol, 1216
Gargarisma guaiaci compositum, **297**
Gargarismæ, 297
Gargle guaiac, compound, **297**
Gargles, 297
Garlic, 994
hedge, 994
oil, 994
syrup of, **272**
Garnierite, 735
Gas, 97
black, 1970
blowpipe, 109
crucible furnace, Fletcher's, 110
flame, 98
furnace, 100
generator, 183
heated boiler, 117
water-jacketed air bath, 114
illuminating, antidote, 1943
laughing, **551**
liquor, 656
marsh, 785
muffle furnace, 111
mustard, 787
stove, 100
solid top, 100
Gaseous disinfectants, 1866
Gases, solution in liquids, 182
Gasoline, 96, 785
stove, 96
Gasometric estimations, 1517
methods of analysis, 1481
Gastric contents, reagents for examination of, 1571
Gastron, 1178
Gaultheria oil, 982
procumbens, 982
Gauze, aluminium acetate, 1761
bandages, 1759
blue, **1762**
borated, 1758
boric, **1761**
acid, **1761**
carbolated, 1758
carbolic, **1761**
acid, **1761**
corrosive sublimate, 1758
double cyanide, **1762**
iodoform, 1758, **1762**
with glycerin, **1762**
mercuric chloride, **1761**
mercury and zinc cyanide, **1762**
moist iodoform, **1762**
phenolated, **1761**
picric, **1761**
acid, 1758, **1761**
sal alembroth, **1762**
Gauze, styptic, **1762**
sublimate, **1761**
surgical, 1757
tarred, **1762**
zinc sulphite, **1762**
Gay-Lussac's centesimal alcoholometer, 64
Gaylussacia resinosa, 947
Geissospermine, 1166
Geissospermum lœve, 1166
Gelatin, **1171**, 1534
capsules, 1678
Chinese, 887
coating, 1720
machine, 1720
solution, 1721
glucose, 1575
glycerinated, **524**
Japanese, 887
plain, 1575
solution for sub-coating, 1724
test solution, 1546
Gelatina, 249
Gelatinum, **1171**
glycerinatum, **524**
Gelidium corneum, 887
Gels, reversible, 186
Gelsemine, 1160, 1166
hydrochloride, 1166
Gelseminine, 1160
Gelsemium, 1159
antidote, 1943
extract, **470**
fluidextract, **427**
sempervirens, 1030, 1159, 1166
tincture, **390**
Generation of heat, 92
Generator, gas, 183
Geneserine, 1131
Genista, 1016
tinctoria, 1016
Genisteine, 1163
Genthite, 735
Gentian, 1063
and ferric phosphate, elixir, **327**
iron elixir, **327**
rhubarb tincture, **398**
fluidextract, **428**
elixir, **327**
glycerinated, **328**
with tincture ferric citrochloride, **327**
extract, **466**
infusion, compound, **360**
root, yellow, 1063
tincture, compound, **373**
violet, medicinal, 852
white, 1006, 1970
Gentiana, 1063
lutea, 1063
Gentianose, 893, 1064
Gentiobiose, 893
Gentiogenin, 1063
Gentiopicrin, 1063, 1064, 1079
Gentisic acid, 1064, 1079
Gentisin, 840
Georgia pine resin, 1021
Geosote, 936
Geraniol, 961, 1212
pure, 1226
Geranium, 1098
fluidextract, **428**
maculatum, 1098
Geranyl acetate, 1215, 1226
Geranyl butyrate, 1215
formate, 1215
propionate, 1215
Gerhardt's test for diacetic acid in urine, 1443
German benzoic acid, 833
cachet apparatus, 1687
chamomile, 1012
digitalin, 1065, 1067
prepared mustard, 992
silver, 735, 1970
Germander, 1017
Germanium, 531
Germantown black, 1970
Geum, 1016
rivale, 1016
Giemsa's stain, 1573
Gigartina mamillosa, 889
Gigot's press, 225
Gillenia, 1079
trifoliata, 1079
Gillenin, 1079
Gin, common, 904
Holland, 904
Ginger, 984
African, 984
black, 984
Cochin, 984
flavoring extract, **976**
fluidextract, **417**
grass oil, 985
Jamaica, 984
tincture, **382**
oil, 985
oleoresin, **447**
root, 984
syrup, **271**
wild, 985
tincture, **382**
Ginseng, 1079
Glacial acetic acid, **802**, 1528
assay, 1453
Glacies, 1970
mariæ, 1970
Glance, silver, **744**
Gland, parathyroid, 1202
desiccated, 1202
pineal, desiccated, 1203
thymus, desiccated, 1203
Glandes quercus (tostæ), 1970
Glands, suprarenal desiccated, 1197
thyroid, desiccated, 1198
Glass, 591
antimony, 1970
condenser, special form, 133
dialyzer, 188
dish, 1490
evaporating dish, 125
filter pump, 206
funnel, 200
gall, 1970
graduates, Bureau of Standards specifications for, 52
-lined evaporating kettle, 125
steam kettle, 118
measures, 51
graduated, 51
soluble, 616, 643
syringe, 214
tubes, bending, 134
cutting, 134
uranium, 734
-valved burette, 1451
water, **592**, 643
wool, 1534

Glass, wool lead acetate, 1547
-wool filters, 203
worm condenser, 141
Glauber's salt, **633**
Glauceum luteum, 1166
Glaucine, 1164, 1166
Glaucium, 1164
luteum, 1164
Glaucopicrine, 1164, 1166
Glechoma, 964
hederacea, 964
Globularetin, 1063
Globularia Alypum, 1063
Globularin, 1063
Globule, 249
mold, 1683
Globules, 1682, 1691
homeopathic, 1731
medicated, 1831
Globuli Martiales, 1970
Globulins, 1170
antidiphth,eric, 1900
antitetanic 1903
Glonoin, 1049
spirit, **310**
Gloriosa superba, 1164
Glossary, medical terms, 1979
Gloxaline, 1101
Glucides, 1062
Glucinum, 531
Glucose, **894**
agar-agar, 1576
bouillon, 1575
D., 895
gelatin, 1575
in urine, qualitative test, 1440
quantitative estimation, Benedict's, 1441
liquid, **894**
syrup, **284**
syrupy, **894**
Glucosennin, 1084
Glucosides, 1062
Glucosum, **894**
Glucoxylose, 893
Gluside, **833**
soluble, **834**
Glusidum, **833**
solubile, **834**
Glutamic acid, 1170
Glutelins, 1170
Gluten, 882
food, 1823
special flour, Hoyt's, 1823
Glutin, 1171
Glutoid capsules, 1684
Glutol, 1970
Glyceric alcohol, 1048
aldehyde, 903
Glycerides, 1048
Glycerin, 787, 1048
agar-agar, 1576
alum, 304
as solvent, **174**
bath, 113
incompatibility, 1646
lead subacetate, 304
preparation unofficial, 444
preparations made by maceration or percolation, 443
solutions, 300
suppositories, **523**
tonic compound, 328
Glycerinated elixir of gentian, **328**
Glycerinated gelatin, **524**
suppositories, 1737
vaccine virus, 1912
Glycerinophosphate, calcium, **677**
ferric, **725**
manganous soluble, 707
sodium, **638**
Glycerinum, 249, 1048
Glycerita, 300
Glycerite bismuth, **302**, 775
assay, 1497
boroglycerin, **301**
carbolic acid, **301**
egg yolk, **303**
glyceryl borate, **301**
guaiac, 304
hydrastis, **444**
iron, quinine and strychnine phosphate, **304**
pepsin, **302**
phenol, **301**
starch, **300**
tannic acid, **300**
tannin, **300**
tar, **303**
tragacanth, **303**
Glycerites, 300
unofficial, 304
Glyceritum acidi tannici, 300
amyli, **300**
bismuthi, **302**, 775
boroglycerini, 301
ferri, quininæ et strychninæ phosphatum, **304**
guaiaci, **304**
hydrastis, **444**
pepsini, **302**
phenolis, **301**
picis liquidæ, **303**
pini, **303**
plumbi subacetatis, **304**
tragacanthæ **303**
vitelli, **303**
Glycerogelatin, iodoform, **515**
salicylic acid, **515**
zinc, firm, **515**
soft, **515**
Glycerogelatina, 514
Glycerogelatins, 514
Glycerogelatinum acidi salicylici, **515**
iodoformi, **515**
zinci durum, **515**
molle, **515**
Glycerol, 787, 903, 1048
Glycerolé, 1970
diazyme, 1178
Glycerophosphate, calcium, **677**
assay, 1478
ferric, **725**
assay, 1468
manganese, soluble, 707
assay, 1481
quinine, 1121
sodium, **638**
assay, 1459
strychnine, 1128
Glycerophosphates, calcium and sodium, elixir, **320**
elixir, compound, **328**
sodium and calcium, elixir, **320**
solution, compound, **328**
tests, **678**
Glycerose, 893
Glyceryl, **787**
borate, 1970
glycerite, **301**
guaiacolate, incompatibility, 1647
oleo-palmito-stearate, 1033
trinitrate, spirit, **310**
assay, 1476
trioleate, 1033
tripalmitate, 1033
tristearate, 1033
Glycine, 1170
Glycocine, 832
Glycogen, 893
Glycol, butene, 787
propene, 786
Glycols, 786
Glyconin, **303**
Glycoproteins, 1170
Glycotauro, 1185
Glycyrrhetin, 1063
Glycyrrhiza, 900
aromatic elixir, 338
elixir, **316**
aqueous, **329**
extract, **460**
pure, **460**
fluidextract, **412**
fluidglycerate, **444**
glabra, 900, 1063
mixture, compound, **291**
preparations, unofficial, 901
powder, compound, **479**
syrup of, **277**
Glycyrrhizic acid, 900
Glycyrrhizin, 900, 1063
ammoniated, 901
Glycyrrhizinum ammoniatum, 901
Glyoxal, methyl, 903
Glysal, 828
Gmelin's test for bile in urine, 1443
Gnaphalium, 1016
Gnoscopine, 1105, 1106
Goat's rue, European, 890
Gold, 188, 531, **777**
and arsenic bromide solutions, 258, **769**
and sodium chloride, 778
incompatibility, 1647
bromide, 778
chloride, 778, 1534
test solution, 1546
coating, 1721
fool's, 1970
iodide, 778
mosaic, 1973
salts, tests for, **777**
unofficial, 778
Golden ragroot, 1013
rod oil, 985
seal, 1144
extract, **467**
fluidextract, **412**
tincture, **392**
Goldthread, 1158
East Indian, 1164
Gommeline, 1970
Gonococcus vaccine, 1918
Gooch crucible, 207
Gooseberry, 947
Gossypii cortex, 1076
Gossypium acidi borici, **1762**
salicylici, **1762**
forte, **1762**

Gossypium, Barbadense, 1076
capsici, **1762**
carbolisatum, **1762**
ferri perchloridi, **1762**
hamamelidis, **1762**
herbaceum, 795, 1037, 1076
hirsutum, 1076
hydrargyri et zinci cyanidi, **1762**
iodidi, **1762**
perchloridi, **1763**
iodisatum, **1763**
iodoformi, **1763**
menthol, **1763**
compositum, **1763**
purificatum, 795
salis alembroth, **1763**
stypticum, **796**, **1762**
Goulard's cerate, **514**
extract, 257, **738**
incompatibility, 1650
Graduate, conical, apothecaries, 52
metric, 52
cylindrical, 52
hook, 53
Graduated evaporating dish, 129
glass measures, 51
medicine glass, 29
pipette, 214
receiving bottle, 245
specific gravity tube, 67
Graduates, glass, Bureau of Standards specifications for, 52
Grain alcohol, 94
musk, 1218
oil, 1973
weights, aluminum, 50
Grains d'Avignon, 1970
Guinea, 1970
of Paradise, 1970
Gram, 31
Gram's iodine solution, 1574
stain, 1574
Granatum, 1146
Granula, 249
Granulæ effervescentes, 476
Granular casts in urine, 1445
effervescent salts, 475
unofficial, 477
pepsin, 1172
Granulated ferrous sulphate, **721**
opium, 1104
assay, 1499
Granulation, 120, 218, 224
Granulator, Colton's, 1708
Stokes', 1707
Granule, 249
Granules, 1691
effervescent, **476**
homeopathic, **1731**
Grape oil, 935
root, Oregon, **1156**
sugar, **894**
Graphic formula, 530
Grass, couch, 901
decoction, **363**
dog, 901
Grater, rotary, **156**
Grating, 156
Gratiola, 1079
officinalis, 1063, 1079
Gratiolaretin, 1063
Gratioletin, 1063
Gratiolin, 1063, 1079
Gratiosoletin, 1063
Gratiosolin, 1063
Gravimetric estimation as lithium sulphate, 1480
as sulphide, 1479
of magnesium, 1480
of manganese, 1481
methods of analysis, 1475
prescriptions, 1594
Gravity, specific, 55, 78
Gray powder, **750**
Great cordial elixir, Stoughton's, **373**
Green color, 841
drugs, fluidextracts from, 406
emerald, 1969
fire, 688
hellebore, 1142
iron citrate, 717
methylene, 854
Paris, 769, 1974
Scheele's, 769
Schweinfurt, 769
soap, 1055
tincture, **346**
vitriol, 560, 720
Gregory's powder, **480**
Griffith's White, 1970
Grin plant, 1011
Grindelia, 1011
camporum, 1011
cuneifolia, 1011
fluidextract, **428**
squarrosa, 1011
Grinding and pulverizing, 157
Grit soap, 1052
Grommets, use of, 130
Grooved rollers, 161
Gross margin, 1332
profit, 1272, 1332
Ground ivy, 964
roll sulphur, 582
Groundnut oil, 1045
Gruel flour, soy bean, 1824
oatmeal, 888
Gruffs and tailings, 170
Guaethol, 936
Guaiac, 1027
compound confection, 489
gargle, compound, **297**
gum, 1018
incompatibility, 1647
mixture, 297
resin, 1027
troches, 499
solution, 1569
test for blood in urine, 1448
tincture, **391**
ammoniated, **391**
compound, **391**
Dewee's, **391**
wood, 1029
Guaiacetin, **936**
Guaiacic acid, 1027
Guaiacol, 799, 804, 806, **807**
benzoate, 809, **933**
carbonate, **808**
cinnamate, 936
incompatibility, 1650
compounds, unofficial, 809
incompatibility, 1647
petroxolin, **352**
potassium sulphonate, 940
salicylate, 936
Guaiacol, salol, 936
valerate, 936
Guaiacolate, glyceryl, incompatibility, 1647
Guaiacolis carbonas, **808**
Guaiaconic acid, 1027
Guaiacum, 1027
officinale, 1027, 1029
sanctum, 1027, 1029
Guaialin, 936
Guaiamar, incompatibility, 1647
Guaiaretic acid, 1027
Guaiasanol, 936
Guanidobutylamine, 1130
Guano, 1970
Guarana, 1160
and celery elixir, **329**
assay, 1501
elixir, **329**
fluidextract, **428**
assay, 1500
Guaranine, 1166
Guarea Rusbyi, 1074
Guaza, 999, 1970
Guhr, 1970
Guiding rod, use of, 190
Guinea grains, 1970
Guizotia oleifera, **1046**
Gum, 885
arabic, 885
mucilage, **286**
artificial, 883, 889
asafetida, 1018, 1022
Barbary, brown, 1970
Benjamin, 1024, 1970
British, 883, 889
camphor, 986
dragon, 1970
eucalyptus, 1026
troches, **498**
guaiac, 1018
hog, 892
Indian, 886
juniper, 1030
leaves, blue, **978**
mezquite, 892
mineral, 1972
myrrh, 1023
red, troches, **498**
resin emulsions, **1657**
resins, 1018
starch, 1977
thus, 1018, 1021, 1970
tragacanth, 886
tree, blue, 978
vegetable, 1978
wood, 978
Gummed labels, 1623
roll, 1674
Gummi elasticum, 1970
guttæ, 1970
rubrum gambiense, 1970
scorpionis, 1970
thebaicum, 1970
Gums and mucilaginous substances, 885
natural, 893
Guncotton, soluble, **796**
Gunjah, 1970
Günzburg's reagent, 1571
Gurjun, 1029
balsam, 985
Guru, 1970
Gut, silkworm, 1767
Gutta, 249

Gutta percha, 1029
solution, 259, 1029
tissue, 1761
Guttæ, 341
Jesuitarum, 369
nader, 369
pectorales, **395**
Guy's pills, **494**
Gypsum, 670, 1970

H

H acid, 811
Habit-forming narcotic drugs, content of, 12
Hæmatite, 1970
Hæmatoxylon, 844
campechianum, 844
Hæmoglobin, 1204
Hagenia abyssinica, 1073
Hahnemann's soluble mercury, 1972
Half-normal hydrochloric acid 1556
potassium hydroxide, alcoholic, 1558
sodium hydroxide, 1563
sulphuric acid, 1566
Haine's solution, 1571
Halazone, 547, 936
Halicore dugoug, 1205
Halides, alkyl, 786
Halish, 999
Halite, 1970
Hall's dinner pills, **497**
solution of strychnine, **1129**
Halogen compounds, organic, 855
Halogens, 567
preparations of, 567
Halowax, 1970
Hamamelis folia, 1098
leaf, 1098
leaves fluidextract, **429**
ointment, 511
tincture, 401
virginiana, 1030, 1098
water, **256**
wool, **1762**
Hamburg drops, 1970
tea, 1970
Hammoniacus sal, 657
Hance mill, 1707
Hance's mill, 163, 164
Hand laboratory centrifuge, 229
Hand lotion, quince jelly, **1239**
tragacanth, **1236**
lotions and creams, 1235, 1236
mills, 161
rules for operating, 163
scales, 43
Handling of thermometers, 103
strong acids, 552
Hard coal, 93
paraffin, 1059
rubber, funnel, 201
strainers, 194
water soaps, 1052
Hardened catgut, 1768
oil, 1973
Hardesty sugar percolator, 263
vanilla percolator, 244
Hardhack, 1100
Harmaline, 1164, 1970
Harrington's solution, 1774
Harrison narcotic law and regulations, 1257
Hartshorn liniment, **347**
spirits, 651
Hasheesh, 999
Hausmannite, 706
Haustus, 249
Haw, black, 1014
elixir, 337
Hawkweed, 1100
Hawthorne, 1225
Hay fever pollen extracts, 1928
new mown, 1225
Hayem's solution, 1572
Hayo, 1970
Hazelnut oil, 1045
Headache cologne, 1228, 1229
crystals, 959
Heal-all, 964
Health insurance, 1288
Heat, direct, evaporation by, 128
electricity as source of, 101
generation of, 92
methods of measuring, 102
operations requiring, 92
uses of, 109
Heater, immersion, 101
water, 100
Heavy magnesia, **663**
magnesium oxide, **663**
metals test, 1519
chemicals, 1519
volatile oils, 1519
oils, receiver for, 215
spar, 686
Hebra's itch ointment, **511**
Hedeoma, 964
oil, 985
pulegioides, 964, 985
Hedera helix, 1079
Hedge garlic, 994
hyssop, 1079
Hedonal, 936
incompatibility, 1647
Helcosal, 1970
Helianthemum, 1016
canadense, 1016
Helianthemus, fluidextract, 442
Helicin, 1063
Heliotrope, 1222
amorphous, 1222
blanc, 1222
concrete, 1222
liquid, 1222
oil, 986
perfume, 1221
sachet, **1231**
Heliotropine, 1213, 1219
Heliotropium grandiflorum, 986
peruvianum, 986
Helium, 531
Hellebore, American, 1142
black, 1165, 1079
green, 1142
Helleborin, 1079
Helleborus, 1079
niger, 1079
Heller's test for albumin in urine, 1438
Helmitol, 936
Helonias, 1076
dioica, 1030
elixir compound, **329**
fluidextract, **429**
Help, selecting, **1293**
Hemalum, Mayer's, 1573
Hematein, 844, 1534
Hematoxylon, 844
decoction, **363**
extract, **467**
Hemisine, 1196
Hemiterpenes, 791, 948
Hemlock, poison, 1158
water, 970
Hemogallol, 1204
Hemoglobin, 1204
Hemoglobins, 1170
estimation, solution for, 1572
Hemol, 1204
Hemostatin, 1196
Hemp, 999
American Indian, 999
Bangue, 999
Indian, 999
antidote, 1943
foreign, 999
seed oil, 1045
Henbane, 1137
extract, **460**
fluidextract, **413**
tincture, 374
Hepar, 1970
calcis, 1970
antimonii, 1970
sulphuris, 1970
Hepatica, 1100
triloba, 1100
Hepco flour, 1823
Heptane, 785, 948
Heptine carbonate, methyl, 1216
Heracleum, 970
Herapath's salt, 1976
lanatum, 970, 986
Herb, peppermint, 957
spearmint, 960
willow, 892, 1100
Hermodactylus, 1141
Heroin, 1166
hydrochloride, 1166
Heroine, 1166
Hesperetin, 953
Hesperidin, 953, 955
Hessian crucible, 110
Heterocyclic chain, 788
compounds, 792
Hetocresol, 936
Hetralin, 936
Heuchera, 1100
americana, 1100
Hexamethylenamina, **931**
Hexamethylenamine compound, unofficial, 931
incompatibility, 1648
salicylate, incompatibility, 1649
sterile solution, **1799**
tetraiodide, 866
Hexamethylenetetramine, 93, **931**
bromethylate, 933
comphorate, 931
Hexamine, 931
Hexane, 784, 785, 811
Hexatonic alcohols, 899
Hexoses, 893
Hexylresorcinol, 824
Hibiscus esculentus 892
Hickery-Pickery, 1970
Hicra Picra, 1970
Hiera Picra, **481**

Hieraceum, 1100
Hieras, 1081
High bush cranberry bark, 1014
speed mills, 164
Hippocastanum, 1100
Hippocrates, 4
oath, 4
sleeve strainer, 193
Hippocratic oath, 4
Hippurate, sodium, 1029
Hippuric acid, 1029
Hips, 1970
Hirathiol, 867
Hirudo, 1205
medicinalis, 1205
quinquestriata, 1205
Histidine, 1170
Histons, 1170
Historical introduction, 2
History and scope of Pharmacy, 1
Hive syrup, **270**
Coxe's, **270**
Hoffmann's anodyne, **312**
balsam, **295**
drops, **312**
Hog gum, 892
Holadin, 1178
incompatibility, 1648
Holder, clamp, 139
Holland gin, 904
Holly, 1079
Hollygold, 1010
Holmium, 531
Holocaine hydrochloride, 838, 936
incompatibility, 1647
Holywood, 1970
Homatropinæ hydrobromidum, 1135
hydrochloridum, 1135
Homatropine bromide, 1135
hydrobromide, 1135
hydrochloride, 1135
Homberg's phosphorus, 1971
pyrophorus, 1971
Homeopathic globules, 1731
granules, 1731
pharmacy, 1825
prescriptions, 1828
tinctures, 1827
triturations, 1828
Homochelidonine, 1162
Homocinchonidine, 1114
Homogenizer, 1659, 1660
Homolle's digitalin, 1065, 1067
Homoquinine, 1114
Homosalicylic acid, 811
Honduras bark, 1073
Honey, 898
and borax, **285**
clarified, 898
of rose, **284**
and sodium borate, **285**
of sodium borate, **285**
sugar, 1971
Honeys, 284
Honeysuckle, 1225
Hoods, use of, 129, 130
Hoodwort, 964
Hook, graduate, 53
Hop, 1002
fluidextract, **429**
oil, 986
tincture, **391**
Hops, elixir, 338
Hordein, 794
Hordeum vulgare, 883
Horizontal autoclave, 1784
steam coil, 118
Hormone, 1170
Horn poppy, 1164
stirrer, 126
bent, 126
Horsebalm, 964
Horsechestnut bark, 1100
oil, 1045
Horsehair sutures, 1767
Horsehead, 1012
Horsemint, 965
oil, 986
Horse-nettle berries, 1163
Horseradish, 994
Horse salt, 1971
savin berries, 1003
serum, normal, 1910
Hospital supplies, 1311, 1343
Hot drops, **383**
extraction percolation, 244
filtration, 205
Hound's tongue, 892
Household pests and their elimination, 1833
Hoyt's gluten special flour, 1823
Huanuco coca, 1163
Huckleberry, 947
Humidity, 123
Humulus, 1002
lupulus, 986, 1002, 1003, 1031, 1167
Hundredth-normal sodium hydroxide, 1564
Hungarian balsam, 1967
Hungary water, 962
Hunter's sifter, 168
mixer and sifter, 168
Hunt's bottle cap, 1670
Husson's eau medicinale, 1142
Huxham's tincture, **371**
of bark, 1971
Hyacinth perfume, 1222
Hyacinthin, 1217
Hyaline casts in urine, 1445
Hychlorite, 572
Hydracetine, 1971
Hydracids, 552
Hydrangea, 1077
and lithium elixir, **330**
arborescens, 1077
fluidextract, **430**
Hydrangin, 1077
Hydrargyri acetas, 759
benzoas, 759, 878
bromidum, 759
carbonas, 759
chloras, 759
chloridum corrosivum, **752**
mite, **753**
colloidale, 881
chromas, 759
cyanidum, 759, 878
iodidum rubrum, **755**
nitras, 760
nucleinas, 879
oxidum flavum, **756**
rubrum, **758**
oxycyanidum, 759, 879
oxymurias,
salicylas, **756**
subsulphas flavus, 759
succinimidum, 879
sulphas, 760
Hydrargyri sulphidum nigrum, 759
rubrum, 760
unguentum P. I., **505**
Hydrargyrum, 748
ammoniatum, **751**
benzoicum, 878
cyanatum, 878
cum creta, **750**
iodidum flavum, **754**
oxycyanatum, 879
Hydrargyrus calcinatus, 1971
muriatus, 1971
Hydrastinæ hydrochloridum, 1145
Hydrastine, 1144, 1166
chloride, 1145
hydrochloride, 1145, 1166
solution, compound, 258, **1145**
colorless, **1145**
Hydrastis, 1144
assay, 1498
canadensis, 1030, 1045, 1144
elixir, compound, **330**
extract, **467**
assay, 1500
powdered, **467**
fluidextract, **412**
assay, 1498
glycerite, **444**
oil, 1045
tincture, **392**
assay, 1500
Hydrate, butyl chloral, **933**
cajuputene, 978
chloral, **857**, 1532
antidote, 1942
assay, 1460
ferric, with magnesia, **717**
potassium, **597**
sodium, **617**
terpin, 1020
and codeine elixir, **335**
and creosote elixir, compound, **336**
elixir, **335**
Hydrated chloral, **857**
salts, 223
Hydraulic press, 227, 228
Hydrazo compound, 792
Hydrazobenzene, 792
Hydriodic acid, 577
diluted, **555**
assay, 1462
incompatibility, 1647
syrup, **577**, 265
assay, 1462
Hydrions, 541
Hydroalcoholic solvents, 174
Hydrobromic acid, diluted, 556 **566**
incompatibility, 1647
Hydrobromide, arecoline, 1165
coniine, 1165
homatropine, 1135
hyoscine, 1136
hyoscyamine, 1137
quinine, 1118
scopolamine, 1136
Hydrocarbon fuels, 92
Hydrocarbons, aliphatic, 783
aromatic, 788
closed chain, 788
cyclic, 788
fatty, 783
open chain, 783

Hydrocarbons saturated, 784
unsaturated, 784
Hydrocellulose, 794
Hydrochinone, 936
Hydrochlorate, phenyldihydrochinazolin, 938
Hydrochloric acid, **553**, 1534
antidote, 1940
assay, 1453
concentrated, 1534
diluted, **555**, 1535
assay, 1453
fiftieth-normal, 1556
half-normal, 1556
incompatibility, 1647
normal, 1555
solution, 1775
solution of arsenic, 765
Hydrochloride betaeucaine, incompatibility, 1645
cocaine, 1149
tablets, assay, 1501
diacetylmorphine, 1166
emetine, 1147
epinephrine, solution, 1196
assay, 1509
erythrophleine, 1166
ethylmorphine, incompatibility, 1646
eucaine, 1150
assay, 1453
euphthalmine, 935
gelsemine, 1166
heroin, 1166
holocaine, 838, 936
incompatibility, 1647
homatropine, 1135
hydrastine, 1145
hydrastinine, 1166
metaphenylenediamine, 1536
methylthionine, incompatibility, 1648
morphine, 1107
naphthylamine (alpha), 1537
papaverine, 1113
phenocoll, 938
incompatibility, 1648
pilocarpine, 1139
procaine, 835
solution, **836**
quinine, 1117
and urea, 1121
assay, 1476
incompatibility, 1649
rosaniline, 1534
tropacocaine, 1167
incompatibility, 1650
tyramine, 1131, 1198
Hydrochlorite, 1971
Hydrocinchonidine, 1114
Hydrocinchonine, 1114
Hydrocinnamic aldehyde, 1213
Hydrocollidine, 1204
Hydrocotarnine, 1105, 1106
Hydrocyanic acid, 1063
antidote, 1943
diluted, **991**
Scheele's, 992
ether, 934
Hydrocyanimic aldehyde, 1214
Hydroergotinine, 1129
Hydrofluoric acid, 579
Hydrogels, 186
Hydrogen, 531, 544
dioxide solution, 257, **548**
assay, 1474
Hydrogen dioxide solution, incompatibility, 1649
test solution, 1546
fluoride, 579
peroxide solution, 548
sulphide, 580, **581**, 1535
test solution, 1546
sulphureted, 580
Hydrogenation, 1033
Hydrolat, 1971
Hydrolé, 1971
Hydrolytic enzymes 902
Hydrometer, Beck's 64
Brix's, 64
Cartier's, 64
Dica's, 64
Fahrenheit's, 64
jar, 62
Jones', 64
Nicholson's, 65
Sikes', 64
specific gravity, scales of, 62
Tralle's, 63
Twaddell's, 64
with elongated bulb, 62
Zanetti's, 64
Hydrometers, 57
and thermometers, 91
Baumé's, 58
specific gravity, 58
testing of, 62
Hydropege, 1971
Hydrophilous, 1971
Hydropicrotoxic acid, 1157
Hydroquebrachine, 1163
Hydroquinine, 1114
Hydroquinone, 823, 936, 1063
Hydrosols, 186
Hydrostatic press, 227
Hydrosulphide, ethyl, 787
Hydrosulphuric acid, 580
Hydroterpenes, 948
Hydrous wool fat, 1043
Hydroxide aluminum, 703
barium, 688, 1530
calcium, 683
solution, **672**
ethyl, 786, 904
ferric, with magnesium oxide, **717**
lead, 742
phenyl, 791
potassium, **597**, 1539
antidote, 1941
assay, 1459
dekanormal, 598
solution, **599**
assay, 1459
sodium, **617**, 1541
antidote, 1941
assay, 1459
solution, 618
assay, 1459
stannous, 736
strontium, 689
Hydroxides, 786
incompatibility, 1647
Hydroxidions, 541
Hydroxybenzene, 791
Hydroxy-citronellal, 1213, 1219
Hydroxy-citronellol, 1226
Hydroxyl, 782
ions, 541
Hygienic Laboratory method for disinfectant testing, 818
Hygrine, 1163, 1166
Hygrophilous, 1971
Hygroscopic moisture, 148
substances, 223
Hyoscine, 1133, 1137, 1138, 1166
hydrobromide, 1136
Hyoscyami extractum P. I., **460**
folium P. I., 1137
tinctura P. I., **374**
Hyoscyaminæ hydrobromidum, 1137
Hyoscyamine, 1137, 1138, 1164
bromide, 1137
hydrobromide, 1137
Hyoscyamus, 1137
antidote, 1941, 1943
assay, 1498
extract, **460**
assay, 1498
pilular, **460**
powdered, **461**
fluidextract, **413**
assay, 1498
muticus, 1132
niger, 1045, 1132, 1166
P. I., 1137
oil, compound, **448**
seed oil, 1045
tincture, **374**
assay, 1499
Hyoscypicrin, 1137
Hyperessences, 1210
Hypericum, 1016
perforatum, 1016
Hypersensitiveness, products causing, 1925
Hypnal, 1971
Hypnone, 936, 1214
"Hypo," 635
Hypochlorites as disinfectants, 1877
Hypochlorous acid, **568**
Hypodermic tablets assay, 1501
tolerances, 1501
Hypophosphite, ammonium, 658
assay, 1464
syrup, **272**
calcium, 678
assay, 1464
syrup, **274**
ferric, 726
assay, 1468
elixir, **337**
manganese, 708
assay, 1464
potassium, 614
assay, 1464
incompatibility, 1648
quinine, 1121
sodium, **638**
assay, 1464
elixir, **338**
syrup, **284**
Hypophosphites, 586
and iron elixir, 338
calcium and sodium, syrup of, **274**
compound solution, 258
syrup, **278**
elixir, 338
incompatibility, 1647
solution, 260
compound, 682
syrup, **277**
test, 564
tests for, 586

Hypophosphorous acid, **564**, 585
assay, 1453
test solution, 1546
Hypophysin, 1195
Hypophysis sicca, 1193
Hyposulphite, sodium, **634**
incompatibility, 1649
Hyposulphurous acid, 580, **581**
Hyraceum, 1204
Hyrax capensis, 1204
Hyssop, 964
hedge, 1079
oil, 986
Hyssopus, 964
officinalis, 964, 986

I

Iberis amare, 994
Ibit, 1971
Icaya, 1163
Ichthalbin, 936
Ichthargan, 936
incompatibility, 1647
Ichthoform, 937
Ichthynat, 867
Ichthyocolla, 1205, 1971
Ichthyol, 867
albuminate, 936
ammonium, 867
formaldehyde, 937
incompatibility, 1647
silver, 936
incompatibility, 1647
suppositories, 1742
Ichthyolate, 867
Idæin, 840
Ideal perfume, 1227
Identity and purity, tests, 21
Igasuric acid, 1126
Ignatia, 1160
amara, 1160
antidote, 1943
assay, 1501
extract, **467**
assay, 1500
powdered, **467**
tincture, **392**
assay, 1500
Ignition, 111
Ihrig capsule filler, 1680
Ikaga, 1163
Ilex, 1079
paraguayensis, 1100
Ilicic acid, 1079
Ilixanthin, 1079
Illicium, oil, 968
verum, 968
Illinium, 531
Illuminating gas, antidote, 1943
Imides, 783
Imido group, 783
Imines, 783
Immersion heater, 101
Immiscible liquids, separation of, 214
solvents, 174
Immunity, 1891
active, 1892, 1893
antibacterial, 1892, 1894
antitoxic, 1892
passive, 1892
Immunization, active, biological products for, 1912
Immunization passive, biological products for, 1900
Imperial green, 1971
measure, 28
Improvised funnel tube, 138
Impure cephalin, 1203
kephalin, 1203
Incineration, 111
Inclinator, carboy, 552
Income tax, 1289
Incompatibilities, more important, 1645
Incompatibility, 1627
chemical, 1627
evidence, 1628
physical, 1627
prescriptions, 1629
therapeutic, 1627
Index, refractive, 1525
India rubber, 1029
Indian balsam, 1024
berry, 1157
cannabis oil, 986
elm, 887
gum, 886
mucilage of, **287**
hemp, 999
American, 999
antidote, 1943
foreign, 999
pink, 1971
podophyllum, tincture, 401
squill vinegar, 450
tobacco, 1155
Indican, 1063
in urine, 1442
reactions, 1569
Indicator bottle, 1450
Indicators, 1449
Indicum, 1971
Indigo, 845
carmine, 849, 1535
sterile solution, **1799**
test solution, 1546
wild, 1156
Indigodisulphonate, sodium, 841
Indigofera, 845
anil, 1063
Indigoids, 841
Indigotindisulphonate, sodium, **849**
Indirect buying, 1338
Indium, 531
Indol, 1217
Indoxyl, 1063
Inductive metrology, 27
Infant rectal suppositories, 1733
Inflammable air, 1971
Inflatin, 1156
Influenza, disinfection, 1885
Infusa, 357
Infused oils, **448**
Infusion, alstonia, **361**
bearberry, **362**
bitter orange, 361
bottle, 359
brayera, **360**
broom, **362**
buchu, **361**
calumba, **361**
cascarilla, **361**
chiretta, **361**
cinchona, **361**
clove, **361**
digitalis, **360**
Infusion, ergot, **361**
gentian, compound, **360**
jar, Alsop's, 358
krameria, **361**
mug (home made), 358
Squire's, 358
orange, **361**
compound, **361**
quassia, **362**
rhubarb, **362**
rose compound, **361**
sage, **362**
senega, **362**
senna, **362**
compound, **361**
wild cherry, **362**
Withering's, **360**, 1066
Infusions, 357
from concentrated preparations, 359
official general process, **357**
preservation, 359
unofficial, 361
Infusorial earth, purified, 593
Infusum alstoniæ, **361**
aurantii, **361**
compositum, **361**
brayeræ, **360**
buchu, **361**
calumbæ, **361**
caryophylli, **361**
cascarillæ, **361**
chiratæ, **361**
cinchonæ, **361**
digitalis, **360**
ergotæ, **361**
gentianæ compositum, **360**
krameriæ, **361**
pruni virginianæ, **362**
quassiæ, **362**
rhei, **362**
rosæ compositum, **361**
salviæ, **362**
scoparii, **362**
senegæ, **362**
sennæ, **362**
compositum, **361**
uvæ ursi, **362**
Ingluvin, 1205
Injectio, 249
hypodermica, 249, 260
Injections, 260
Ink eradicator, antidote, 1941
Inorganic acids, 552
incompatibility, 1647
unofficial, 566
chemical compounds, 527
chemistry, theory, 527
Inosit, 1163
Inscription, 1588
Insecta, class, 1205
products, 1190
Inspissated juices, 451, 454
Insufflatio, 249, 524
Insufflations, 524
Insulin, 1200
Insurance, 1285
accident, 1288
assignment, 1287
compensation, 1289
fidelity, 1289
fire, 1286, 1397
health, 1288
liability, 1288, 1398
life, 1287
plate glass, 1288

Insurance, theft, 1288
  title, 1288
  workman's compensation, 1398
Intarvin, 1823
Intermediate crystallization, 223
Internal phase, 1655
International filter, 208
Intervention, pulverization by, 155
Intracutaneous, tuberculin, 1936
  test, 1935
Inula, 1012
  helenium, 986, 1012
  oil, 986
Inulase, 902
Inulin, 883, 893
Inuncta, 512
Inunction, menthol, 512
  compound, **512**
Inunctions, **512**
Inunctum mentholis, **512**
  compositum, **512**
Invar, 1971
Inventories, 1257, 1352, 1417
Inventory, 1352
  calculating, 1354
Invertase, 902
Invoice record, 1415
Invoices, list of, 1415
Iocamfen, 578
Iodalbin, 865
Iodate, calcium, 683
  potassium, 616
Iodeikon, 865
Iodic acid, **568**
Iodide, allyl, 993
  aluminum, 703
  ammonium, 660
    liniment, **349**
  amyl, 932
  antimony, 763
  arsenic, **767**
  arsenous, 767
    and mercuric, solution, **768**
      assay, 1471
    assay, 1462
  barium, 688
  bismuth emetine, 1148
  cadmium, 705, 1531
    and potassium, 1531
  calcium, 683
    syrup, **274**
  cresol, 934
  cuprous, 744
  ethyl, 934
  ferrous, pills, **495**
    syrup, **267**, **718**
      assay, 1462
  gold, 778
  lead, **740**
    assay, 1463
  lithium, 648
  magnesium, 670
  mercuric, **755**
    potassium, incompatibility, 1648
    red, **755**
      assay, 1483
      incompatibility, 1648
  mercurous, 754
    yellow, **754**
      incompatibility, 1648
  mercury, yellow, **754**
Iodide, mercury, yellow, assay, 1472
    red, **755**
  methyl, 937
  potassio-mercuric, 616
  potassium, **609**, 1540
    and cadmium, 1531
    assay, 1462
    mercuric, 616, 760
    ointment, **508**
    solution, **610**
      assay, 1463
      saturated, **610**
  silver, 747
  sodium, **628**
  strontium, 689
  sulphur, 584, 1467
  thymol, **864**
    assay, 1465
  zinc, 697
Iodides, assay, 1514
  incompatibility, 1647
  soluble, incompatibility, 1647
  tests for, 575
  tincture, **392**
Iodine, 188, 531, 567, **575**
  ampuls, **1797**
  and aconite dental liniment compound, 341
  and potassium iodide test solution, 1546
  and zinc phenolsulphonate, solution, 258, **578**
  antidote, 1943
  assay, 1467
  collodion, 344
  compound solution, 257
  compounds, unofficial, 865
  disulphide, 584
  dusting powders, 578
  incompatibility, 1647
  ointment, **505**
    stainless, **509**
  petroxolin, **353**
    diluted, **353**
  potassium iodide solution, 1568
  preparations containing free iodine, 578
  purified, 1535
  solution, carbolized, **578**
    compound, **576**
      assay, 1468, 1476
    Gram's, 1574
    phenolated, 258, **578**
  tenth-normal, 1556
  test solution, 1546
  tincture, **374**
    assay, 1469, 1476
    Churchill's, **393**
    decolorized, **392**
    stronger, **393**
      assay, 1469
  value, 1519
  wool, **1763**
Iodipin, 865
Iodised wool, **1763**
Iodized fats and fatty acids, 865
  phenol, **820**
  starch, **568**
Iodoapplicators, 578
  special, 578
Iodobehenas, calcium, assay, 1465
Iodobehenate, calcium, 862
Iodobromide test solution, 1546
Iodo-casein, 865
    incompatibility, 1647
Iodoform, **862**
  collodion, 344
  gauze, 1758, **1762**
    moist, **1762**
    with glycerin, **1762**
  glycerogelatin, **515**
  ointment, **506**
  preparations, unofficial, 864
  suppositories, 523
  wool, **1763**
Iodoformum, **862**
  aromatisatum, 864
Iodo-gallicin, 937
Iodoglycerole, Talbot's, 304
Iodohydrargyrate, potassium, 616
Iodo hydromal, 1971
Iodol, 937
Iodophen, 938
Iodophenacetin, 937
  incompatibility, 1747
Iodophenin, 937
  incompatibility, 1647
Iodopyrine, 937, 1971
Iodosol, 1971
Iodostarine, 865
Iodosticks, 578
Iodosubgallate, bismuth, incompatibility, 1645
Iodotannin, syrup, **278**
Iodothymol, 1971
Iodum, **575**
Ional, 1214
Ionic dissociation, 539
    determination, 541
Ionization, 540
Ionone, 1214, 1219
  -alpha, 1214
  -beta, 1214
  -gamma, 1214
Ions, 540
  hydroxyl, 541
Iopropane, 866
Iothion, 866
Ipado, 1971
Ipecac, 1147
  alcresta, 1148
  and opium powder, **479**
    syrup, **279**
    tincture, **394**
  assay, 1498
  fluidextract, **413**
    assay, 1498
  powder compound, **479**
  preparations, unofficial, 1148
  syrup, **267**
  tincture, **393**
    assay, 1500
  with squill pills, 497
  with urginea pills, 497
Ipecacuanha, 1147
Ipecacuanhæ cum urgineæ, 497
  radix P. I., 1147
Ipecacuanhic acid, 1147
Ipomea, 1086
  resin, **471**
Ipomœa, 1086
  -orizabensis, 1086
Iralol, 1214
Iridin, 1003
Iridium, 531
Iris, 1003

Iris, caroliniana, 1012
florentina, 1003
germanica, 1003
pallida, 1003
versicolor, 1012
Irish moss, 889
mucilage, **286**
Irisone, 1214
pure, 1226
Iron, 531, 706, 709, 710, 1535
acetate solution, 259
albuminate, **724**
solution, 258, **724**
albuminized, **724**
assay, 1468
alcoholized, 711, 906
and aloe pills, **492**
and ammonium acetate, solution, 257, **722**
assay, 1457, 1467
chloride, 660
citrate, **716**
assay, 1467
tartrate, 732
and beef elixir, **321**
and calcium lactophosphate, syrup, **275**
and cinchona alkaloids, elixir, **323**
and gentian elixir, **327**
and iron compounds, 709
and manganese iodide, syrup, **284**
and quinine citrate, 732
and sodium pyrophosphate, 732
and strychnine citrate, 732
arsenite, sterile solution, **1799**
bismuth and cinchona alkaloids, elixir, **324**
strychnine and cinchona alkaloids, elixir, **324**
by hydrogen, **710**
cacodylate, sterile solution, **1799**
cast, 709
chloride solution, 257, 259
citrate, green, **717**
solution, 258
sterile solution, **1800**
colloidal, 188
compounds, 709
dialyzed, 188
dish, enameled, 125
hypophosphite solution, 259
iodide syrup, Ruspini, 284
lactate, **727**
lactophosphate syrup, 284
malate, crude, **466**
tincture, **390**
Martis or Mars, 1972
metric weights, 49
mixture, compound, 297
salicylated, **730**
nitrate solution, 259
oleate, 1047
oxide, magnetic, 732
red, 732
saccharated, syrup, **277**
soluble, syrup, **277**
oxychloride solution, 259
oxysulphate solution, 259
peptonate, **728**
and manganese solution, 258
solution, 258, **729**
Iron, peptonized, **728**
and manganese solution, **730**
assay, 1468
solution, **729**
perchloride, **714**
solution, **714**, 731
protochloride syrup, 284
protosulphate, **719**
pyrolignite, 1971
pyrophosphate, elixir, 338
Quevenne's, **710**
quinine, aloe and nux vomica pills, **495**
and strychnine elixir, **326**
phosphate elixir, 338
phosphates, syrup, **276**
tablets, 1716
strychnine and arsenic pills, mild, **496**
stronger, **495**
reduced, **710**
assay, 1474
salicylate solution, 258
salts, tests, 710
unofficial, 732
sesquichloride, **714**
soluble saccharated, syrup, **277**
strychnine and cinchona alkaloids, elixir, **324**
subsulphate solution, 258
tersulphate, solution, 257, **723**
assay, 1467
tincture, **373**
tasteless, **389**
wire, 710
wrought, 709
Irone, 1003
Irosone, 1214
Irregular cells in urine, 1446
Irrigatio, 249, 341
Irrigation, 341
Isarol, 867
Isatin, 1535
Isinglass, 887, 1205
Isoamylamine, 1130
Isoanemonic acid, 1013
Isobutane, 781
Isobutyl acetate, 1216
benzoate, 1216
phenylacetate, 1216
salicylate, 1216
Isocholesterol, 1042
Isocyclic chain, 788
Isoemodin, 1084
Isoeugenol, 1217, 1226
Isoleucine, 1170
Isomaltose, 893
Isomerism, 781
metameric, 781
polymeric, 781
Isomers, 781
Isopelletierine, 1146
Isopilocarpine, 1138
Isopropyl alcohol, 175
Isopyrine, 1164
Isopyrum thalictroides, 1164
Iso-quinoline, 1101
Isothiocyanate acrinyl, 993
allyl, 992, 993, 1063
Isotonic eye lotion, 260
Ispaghula, decoction, **363**
Issue peas, 1971
Italian juice root, 900
Itch ointment, Hebra's, **511**
Itrol, 1971
Ivy, 1079
ground, 964
poison, 1080
Izal, 816
disinfectant powder, 816

J

Jaborandi, 1138
Maranham, 1138
Pernambuco, 1138
Jaborane, 1138
Jacinthe, 1213
absolute, 1226
perfume, 1222
Jaconet, 1761
Jaconettum, 249
Jaggery, 1971
Jalap, 1085
and calomel, **483**
and mild mercurous chloride powder, **483**
extract, **470**
fluidextract, **430**
powder, compound, **480**
resin, **472**
root, Orizaba, 1086
tincture, **394**
compound, **394**
Jalapa, 1085
Jalapin, 1063
Jalapinol, 1063
Jalapurgin, 1085
Jamaica dogwood, 1079
ginger, 984
tincture, **382**
James' powder, 481
Jamestown weed, 1138
Janeway's pills, **492**
Japan earth, 1969, 1971
Japanese gelatin, 887
lambick, 131
Jar, hydrometer, 62
precipitating, 216
Jasmine perfume, 1222
root, yellow, 1159
Jasminium fragrans, 986
grandiflorum, 986
Jateorrhiza palmata, 1064
Java pepper, 995, 1971
Javelle water, 260, 570
Jellies, 515
Jelly, castor oil, **1039**
petroleum, 1058
white, 1059
quince, hand lotion, **1239**
Jennerian vaccine, 1912
Jenner's stain, 1572
Jerusalem balsam, 369
Jervic acid, 1142
Jervine, 1142, 1166
Jessamine oil, 986
yellow, 1159
antidote, 1944
Jesuits' balsam, 1971
bark, 1114, 1971
drops, 1971
Jewelers' rouge, 1971
Jews' pitch, 1971
Jimson weed, 1138
antidote, 1941
Joints, bladder, 136
life insurance, 1287

Joints, rubber, 136
Jones' hydrometer, 64
  mixer and sifter, 167. 168
Jonquil, 1225
Journal, 1404
Journalizing, 1404
Judas's ear, 1971
Juglandic acid, 1089
Juglans, 1089
  cinerea, 1030, 1045, 1089
  fluidextract, **430**
  oil, 1045
Juice, apple, 946
    fresh, 946
  lemon, 947
  lime, 943, 947
    and pepsin, **1177**
Juices, fruit, 945
  inspissated, 451, 454
Jujube berries, 892
Juniper berries, 1003
    fluidextract, **431**
    oil, 1001
  buchu and potassium acetate elixir, **320**
  camphor, 1001
  gum, 1030
  oil, 1001
  spirit, compound, **315**
  tar oil, 805
Juniperin, 1003
Juniperus, 1003
  communis, 1001, 1003
  oxycedrus, 805
  sabina, 1006
  virginiana, 986, 1005
Junket, 1190
  tablets, 1190
Jupiter, 1971
Jusculum, 1971
Jute, 1759

K

Kainite, 615
Kairine, 1167
Kairoline, 1167
Kaladana, compound powder, 484
  tincture, 401
Kali aeratum, 1971
Kalicum hydras, 1971
Kamala, 1090
Kaolin, 593, 698
  cataplasm, **517**
Kaolinum, 593
Kava, 1028
  fluidextract, **431**
  -kava, 1028
Kefir, 1971
  fungi, 1182
Kelene, 1971
Kenic acid, 1114
Kentish ointment, **349**
Kephalin, Armour, 1203
  impure, 1203
Keratin, 1204
  coating, 1732
Kermes mineral, 763
Kerosene, 96, 785, 1535
  deodorized, 1061
Ketone, dimethyl, 786
  musk, 1218
Ketones, 786, 1214
Ketonic group, 783
Ketopropane, 1971
Kettle, glass-lined evaporating, 125
  steam, 117
    enameled, 118
    glass-lined, 118
    on trunnions, 117
    over naked fire, 118
    tilting, 117
  with steam coil, 118
Kiefer glass tray filter, 202
Kieselguhr, 204
  purified, 593
Kieserite, 661, **665**
Kilo, 31
Kilogram, 31
King's yellow, 1971
Kino, 1096
  and opium, compound powder, 484
    tincture, 401
  eucalyptus, troches, 499
  incompatibility, 1646
  tincture, **375**
Kinotannic acid, 1096
Kinovic acid, 1114
Kinovin, 1114
Kissingen salt, artificial, **475**
    effervescent, **477**
Knife, roller, 157
Knock-out drops, 1971
Knotty brake, 1007
Kola, 1161
  assay, 1501
  fluidextract, **431**
    assay, 1500
Kolanin, 1161
Kolatin, 1161
Konseal apparatus, 1688
Konseals, 1685, 1688
Koppeschaar's solution, 1555
Kosin, 1073
Kousso, 1073
Krameria, 1095
  and cocaine troches, 499
  argentia, 1095
  extract, **468**
    powdered, **468**
  fluidextract, **431**
  fluidglycerate, **444**
  infusion, **361**
  syrup, **279**
  -tannic acid, 1095
  tincture, **375**
  triandra, 1095
  troches, 499
Krameric acid, 1095
Krelos, 816
Kroton, 1039
Kryofin, 937
Krypton, 531
Kümmel, 965, 966
Kumyss, **1182**
Kupfer-nickel, 735
Kurung oil, 1045

L

Labarraque's solution, 569
Labdanum, 1029, 1219
Label dampener, 1624
  drug store, 1620
  for urine sample, 1434
  paste for tin, 1623
  prescription, 1612
Labeling poisonous substances, 1621
Labels, gummed, **1623**
  pasting, 1622
  poison, 1249
Labiatæ products, 957
  unofficial plants of, 964
Labor division, 1271
Laboratory, analytical, 1578
  cabinet, 1430
  centrifuge covered, 229
    hand, 229
  course in manufacturing pharmacy and dispensing, 1945
  layout, 1584
  physiologic testing, 1578
  planning, 1585
  research, 1578
  scale manufacturing, 45
  the, 1626
Laburnine, 1164
Laburnum, 1164
Lac, 1029
  dye, 845
  fermentatum, 1182
  magnesiæ, 1971
  sulphuris, **583**
  vaccinum, 1179
  virginis, 1971
Lacca, 1029
  cœrulea, 1971
  musica, 1971
Lactampoule, 1182
Lactase, 902
Lactate, benzamine, 932
  betaeucaine, incompatibility, 1645
  bismuth, 775
  calcium, **678**
    assay, 1459
  ethyl, 175
  ferric, elixir, **337**
  ferrous, **727**, 732
    assay, 1468
  iron, **727**
  magnesium, 670
  silver, 747, 1203
  strontium, 689
  zinc, 697
Lactates, tests, 1183
Lactic acid, 786, 1183
    assay, 1454
    producing organisms, unofficial, 1179
  bacillary tablets, 1182
Lactim, 1971
Lacto-dextrin, 1822
Lactometer, 63
Lactophenin, 937
Lactophosphate, calcium, **679**
    and iron, syrup, **275**
    elixir, **320**
    syrup, **275**
Lactose, 898
  -litmus agar-agar, **1576**
Lactoserum, 1660
Lactosum, 898
Lactuca virosa, 1017
Lactucarium, 1017
  syrup, **284**
  tincture, 401
Lactucic acid, 1017
Lactucin, 1017
Lactucon, 1017
Lactucopicrin, 1017
Lactylparaphenetidin, 937
Lady Webster dinner pills, **492**

Lady's blush, 1971
Ladyslipper root, 1010
Lævo-carvone, 960
-limonene, 960
-methylaminoethanolcatechol, 1195
phellandrene, 1022
pinene, 978, 1022
-suprarenin synthetic bitartrate, 1198
-terpineol, 954
Lafayette mixture, **293**
Lake, 842
Lakmus, 1971
Lambek, 131
Lambik, Japenese, 131
Lamella, 249
Laminaria, 892
cloustonia, 892
Lamotte's drops, **389**, 1971
Lamp, alcohol blast, 95
benzene blast, 96
Russian blast, 95
spirit, 94
Lana philosophica, 694, 1971
Lanain, 1971
Lanalin, 1971
Lanesin, 1971
Lange's test for acetone in urine, 1443
Lanichol, 1971
Laniol, 1971
Lanolin, 1043
anhydrous, 1042
Lanthanum, 531, 704
Lanthopine, 1105, 1106
Lapides cancrorum, 1971
Lapilli cancrorum, 1971
Lapis alkalinus, 1971
amianthus, 1971
baptista, 1971
calaminaris, **697**, 1971
causticus, 1971
coeruleus, 1971
divinus, 1971
hæmatites, 1971
infernalis, 1971
lazuli, 1971
ophthalmicus, 1971
smiridis, 1971
Lapodin, 1099
Lappa, 1077
fluidextract, **432**
Larch agaric, 1026
turpentine, 1030
Lard, 1040
benzoinated, **1041**
oil, 1041
Larix europœa, 1030
Larkspur, antidote, 1943
lotion, **299**
seed, 1159, 1045
tincture, **388**
Larosan, 1820
Laserpitium, 1006
latifolium, 1006
Lassar's stronger resorcinol paste, **516**
mild resorcinol paste, **516**
naphthol paste, **516**
zinc paste, **517**
Latin abbreviations, 1596
prescriptions, symbolic characters, 1589
title, official, 17
Laudanidine, 1105, 1106
Laudanine, 1106
Laudanosine, 1105, 1106
Laudanum, 377
Quaker, 378, 361
Sydenham's, 395
Laughing gas, **551**
Lauraceæ, 981
products, 971
Laurel, 1006
cherry, 1006
oil, 986, 1006, 1045
Laurent's acid, 811
Lauric aldehyde, 1213
Laurinate, ethyl, 1215
Laurine, 1213
Laurocerasus, 1006
Laurotetanine, 1167
Laurus, 1006
nobilis, 986, 1006, 1045
Lavandula officinalis, 960
spica, 960, 961
vera, 960, 961, 964
Lavatio Ori, **339**
Lavationes, 339
Lavender, 964
flowers, 1225
oil, 960
oil, 960
assay, 1461
sachet, **1231**
spike, oil, 961
spirit, **310**
compound, **375**
tincture, compound, **375**
water, **1229**
Law, commercial, 1245
Harrison narcotic, 1257
model, for pharmacy, 1251
responsibility under, 1292
Laws, advertising, 1292
anti-trust, 1292
business, 1245
diversity of, 1245
employees, liability, 1292
federal, 1292
food and drugs, 1292
governing practice of pharmacy, 1250
insecticide, 1292
local, 1292
narcotic, 1292
patent, 1292
pharmacy, 1292
prohibition, 1292
sanitation, 1292
state, 1292
tax, 1292
trademark, 1292
Laxativæ post partum, 497
Laxative elixir, **322**
pills, compound, **496**
post partum, 497
species, **486**
Layout of showcard, 1389
store, 1310
pharmacy laboratory, 1584
Layouts, 1317
Lead, 531, 737
acetate, **737**, 1535
antidote, 1943
assay, 1473
glass wool, 1547
incompatibility, 1647
solution, 1570
test paper, 1547
solution, 1547
Lead acetate test solution, alcoholic, 1547
basic, 1547
and opium lotion, **299**
pills, **497**
wash, **299**
bromide, **742**
carbonate, 742, 1535
chloride, 742
chromate, 742
compounds, test for, 737
Connecticut, 1968
dioxide, 742, 1535
flake, 1970, 1971
hydroxide, 742
iodide, **740**
assay, 1463
monoxide, **739**, 1535
assay, 1473
nitrate, 742, 1535
oleate ointment, **506**
plaster, **519**, 1752
oxide ointment, **508**
red, **741**
assay, 1469
peroxide, 1535
plaster, **519**, 521
red, 737, **741**
saccharate, 742
salts and preparations, unofficial, 742
subacetate, cerate, **514**
diluted solution, 257
ointment, 512
solution, 257, **738**
assay, 1473
diluted, **742**, 258
assay, 1473
incompatibility, 1650
sugar of, 737
sulphate, 742
suppositories, compound, 523
water, 257, 258, 742
white, 742, 1978
Leaf, hamamelis, 1098
Lease, 1396
Leather oil, Russian, 805
Leaves, althea, 888
belladonna, 1133
assay, 1496
fluidextract, **406**
assay, 1498
benne, 891
chestnut, 1097
fluidextract, **421**
deadly nightshade, 1133
hamamelis, fluidextract, **429**
mallow, 890
marshmallow, 888
mullein, 891
fluidextract, **440**
peppermint, 957
witchhazel, 1098
Lecanora acharius, 844
tartarea, 845
Lecithin, 1184, 1187, 1205
Lecithoproteins, 1170
Lederle's bacillus acidophilus milk, 1181
Ledger, 1394, 1407–1409
billing, 1403
loose leaf, 1403
personal, 1402
Ledum, 1079
palustre, 986, 1079

Leech, 1205
Legal responsibility, 1292
Legislation, special, 1249
Leiocom, 1971
Leipzig yellow, 1971
Lemon flavoring extract, 976
  camphor, 955
  flavoring extract, terpeneless, 976
  juice, 947
  oil, 955
    assay, 1460
  peel, 955
    fresh, 955
  salt, 945
  spirit, **315**
  syrup, **284**
  tincture, **376**
Lemongrass oil, 986
Lemons, essential salt of, 798
Lenitive electuary, 1971
Lennigallol incompatibility, 1647
Lenox bottle brush, 1662
Leontin, 1073
Leonurus, 964
  cardiaca, 964
Leopardsbane, 1009
Lepidium sátivum, 994
Lepidolite, 644
Leprosy, disinfection, 1886
Leptandra, 1089
  extract, **468**
    powdered, **468**
  fluidextract, **432**
  virginica, 1031
Leptandrin, 1090
Lethal dose, minimum, 1506
Lettering by brush, 1384
    pen, 1389
Letters for show cards, 1387
Leucine, 1170
Leucœnus, 1971
Leucogene, 1971
Leucoline, 1165
Leucomaines, 1101, 1170
Leukocytes in urine, 1447
Levant nut, 1971
Lever balances, compound, 45
  press, 227
Levisticum, 970, 1006
  officinale, 970, 986, 1006
Levulose, 787, 893
Lewin's hot extraction apparatus, 244
Liabilities, 1273
Liability and assets statement, 1410
  for error in filling prescriptions, 1248
  insurance, 1288, 1398
Liantrol, 937
Liatris, 1006
Library and reference room, 1578
  paste, 889
Lichen Islandicus, 1971
Licorice, 900
  elixir, **316**
    aqueous, **329**
  powder, compound, **479**
  root, 900
    extract, **460**
      pure, **460**
    fluidextract, **412**
  syrup, **277**
Lieben's solution, 1568
Liebig condensers, 139
Life-everlasting, 1016, 1971
Life insurance, 1287
  root plant, 1013
Ligamentum, 249, 1759
Ligatures and sutures, 1766
    dispensing, 1777
  bacteriological testing, 1775
  silk, sizes, 1771
Light magnesia, **663**
  oils, receiver for, 215
Lighting for cities, 1313
Lightning clause in fire insurance, 1398
Lignia nitrica, 1971
Lignin, 794
Lignum sanctum, 1971
  vitæ, 1029, 1971
Ligustrin, 1079
Ligustrum, 1079
  vulgare, 1079
Lilac oil, 986
  perfume, 1223
  sachet, **1232**
Lilacine, 1971
Lily-of-the-valley flowers, 1019
  oil, 986
  perfume, 1223
  root, 1075
Lily, water, 1100
Limatura ferri, 1971
Lime, **671**
  as a disinfectant, 1876
  chloride, **568**
  chlorinated, **568**, 673, 1532
    assay, 1465
  freshly slaked, 1536
  juice, 943, 947
    and pepsin, **1177**
  liniment, **345**
  milk, 672
  sulphurated, 683
    solution, **681**
  syrup, **283**
  water, 257, **672**
    assay, 1455
Limestone, 670
Limited partnership, 1247
  pulverizer, 165
  term insurance, 1287
Limonis succus, 947
  cortex, 955
Limousin's cachet board, 1686
Linalol, 954, 1212
Linaloöl, 963, 967, 1212, 1226
Linalyl acetate, 961, 1216, 1226
  benzoate, 1216
  cinnamate, 1216
Linctus, 249
Linctuses, 488
Linden flowers, 1017
  oil, 986
Linear measure, 77
  measures, equivalents, 39
Linen sutures, 1767
Liniment aconite, 349
    and chloroform, **347**
    dental compound, **341**
    and iodine dental, compound, **341**
  ammonia, **347**
  ammonium iodide, 349
  belladonna, **347**
  calamine, **347**
  camphor, 345
    ammoniated, **350**
Liniment camphorated soap, 348
  Canada, **348**
  chloroform, **346**
  croton oil, **350**
    compound, **350**
  drying, **350**
  hartshorn, **347**
  lime, **345**
  mercury, **350**
  mustard, compound, **349**
  opium, **350**
    compound, **348**
  potassium iodide with soap, **350**
  soap, **346**
  soft soap, **346**
    compound, **348**
  St. John Longs', **349**
  Stokes', **349**
  turpentine, **349**
    acetic, **349**
  volatile, **347**
Linimenta, 345
Liniments, 345
  dental, 341
  unofficial, 349
Linimentum, 249
  album, **349**
  aconiti, **349**
    et chloroformi, **347**
  ammoniæ, **347**
  ammonii iodidi, **349**
  belladonnæ, **347**
  calaminæ, **347**
  calcis, **345**
  camphoræ, **345**
    ammoniatum, **350**
  chloroformi, **346**
  exsiccans, **350**
  exsiccantium, 249
  hydrargyri, **350**
  opii, **350**
    compositum, **348**
  potassii iodidi cum saponis, **350**
  saponato-camphoratum, **248**, 346
  saponis, **346**
    mollis, **346**
      compositum, **348**
  sinapis compositum, **349**
  terebinthinæ, **349**
    aceticum, **349**
  tiglii, **350**
    compositum, **350**
Linolein, 1037
Linoxyn, 1037
Linseed, 888
  cataplasm, 518
  oil, 1037
    raw, 1037
  poultice, 518
Lint, 1758
  marine, 1759
Linteum, 249, 1758
Linum, 888
  usitatissimum, 888
Lipanin, 1205
Lipase, 902
Lipides, 1032
Lipoid, brain, 1203
Lipoids, 1032
Lipoiodine, 865
Liquefied carbolic acid, **819**
  phenol, **819**

Liquefied phenol assay, 1468
Liquid absolute, 1210
attenuation, 1828
Dutch, 1969
extract bael, 442
face powder, **1235**
ferrous carbonate, **713**
glucose, **894**
opodeldoc, **346**
paraffin, 1057
petrolatum, 1057
petrox, **352**
petroxolin, **352**
pituitary, 1195
rennet, 1190
soap, 1052
storax, 1025
sulphur dioxide as a disinfectant, 1872
supernatant, 216
Liquidambar orientalis, 1025
styraciflua, 1025
Liquids, dispensing, 1662
dropping, 1668
measuring, 50
miscibility of, 173
pouring, 1667
separation of immiscible, 214
specific gravity, 57, 78
volatile, filtration, 202, 203
Liquor acidi arsenosi, 257, **765**
chromici, **259**
alkalinus aromaticus, 340
alumini acetatis, **702**
subacetatis, 258, **703**
aceticotartratis, **259**
ammoniæ anisatus, **312**
ammonii acetatis, 257, **652**
citratis, **259**
anodynus (Hoffmanni), 1971
antisepticus, 237, **339**
aromaticus alkalinus, 257, **340**
arseni et hydrargyri iodidi, 257 **768**,
arsenicalis, Clemens, **259**
Fowleri, P.I., **766**
Pearsonii, **637**
atropinæ sulphatis, **259**
auri bromidi et arseni, 769
et arseni bromidi, **769**, 258
bismuthi, 258, **775**
bromi, **259**, **575**
Burowii, **702**
calcii hydroxidi, **672**
calcis, 257, **672**
sulphuratæ, 258, **681**
carbonis detergens, 258, **812**
carmini, 258, **843**
chlori compositus, 258, **573**
cocci, 258, **842**
coccineus, **842**
cornu cervi, 1971
succinatus, 1972
cresolis compositus, 257, **814**
electropœicus, 1972
epinephrinæ hydrochloridi, 257, 1196
epispasticus, **259**
ergot, 1131
extracti cerebri, 1203
ferri acetatis, **259**
albuminati, 258, **724**
citratis, 258, **725**
chloridi, 257, **714**
Liquor ferri et ammonii acetatis, 257, **722**
hypophosphitis, **259**
nitratis, **259**
oxychlorati, 1972
oxychloridi, **259**
oxysulphatis, **259**
peptonati, 258, **729**
et mangani, 258, **730**
perchloridi, **259**
fortis, **259**
protochloridi, **259**
salicylatis, 258, **730**
subsulphatis, 258, **731**
tersulphatis, 257, **723**
formaldehydi, 257, **929**
saponatus, **259**
fumans Boylii, 1972
gas, 656
guttæ perchæ, **259**
hydrargyri et potassii iodidi, **259**
nitratis, **259**
acidus, **260**
perchloridi, **260**
hydrastinæ compositus, 258, **1145**
hydrogenii dioxidi, 257, **548**
hypophosphitum, **260**
compositus, 258, **682**
hypophysis, 1194
iodi carbolatus, **578**
compositus, 257, **576**
et zinci phenolsulphonatis, 258, **578**
phenolatus, 258, **578**
magnesii bicarbonatis, **260**
citratis, 257, **666**
sulphatis effervescens, **260**, 670
mineralis, 767
morphinæ acetatis, **260**
hydrochloridi, **260**
tartratis, **260**
mother, 223
pancreaticus, **1176**
pancreatini, 258, **1176**
pepsini, 258, **1174**
antisepticus, 256, **1174**
aromaticus, 258, **1174**
phosphatum acidus, 258, **682**
compositus, 258, **683**
phosphori, 258, **587**
picis alkalinus, **260**, 804
carbonis, 258, **812**
pituitarii, 257, 1194
plumbi subacetatis, 257, **738**
dilutus, 258, **742**
potassæ, **599**
chlorinatæ, 260
potassii arsenitis, 257, **766**
chlorinatæ, **260**
citratis, 257, **607**
hydroxidi, 257, **599**
iodidi, 258, **610**
permanganatis, **260**
procainæ hydrochloridi, 258 **836**
red, 1975
seriparus, 1972
sodæ, **618**
chlorinatæ, 257, **569**
chirurgicalis, 257, **570**
et menthæ, 258, **640**
sodii arsenatis, 257, **637**, 769
dilutus, 258, **637**, 769
Liquor, sodii, Pearsonii, 258, **637**
boratis compositus, 258, **641**
chloridi physiologicus, 257, 627, **1795**
citratis, 258, **641**
-citrotartratis effervescens, **260**
hydroxidi, 257, **618**
phosphatis compositus, 258, **641**
silicatis, **260**, **592**
strychninæ acetatis, **260**, **1129**
hydrochloridi, **260**
stypticus Loofii, 1972
white, 1978
zinci chloridi, 257, **692**
et alumini compositus, **260**
ferri compositus, **260**
Liquores, 256, 257
Liquorice root, 900
Liquors, alcoholic, prescriptions for, 1248
Liriodendrin, 1079
Liriodendron, 1079
tulipifera, 1079
Lister's prepared casein diabetic flour, 1823
Lists of mail addresses, 1367
Liter, 31
Litharge, **739**
Lithic acid, 1965
Lithii benzoas, **644**
borocitras, 648
bromidum, **645**
carbonas, **646**, 648
chloridum, 648
citras, **647**
iodidum, 648
nitras, 648
phosphas, 648
salicylas, **648**
sulphas, 648
Lithium, 531, 644
and hydrangea elixir, **330**
benzoate, **644**
assay, 1480
borocitrate, 648
bromide, **645**
assay, 1462
elixir, **338**
carbonate, **646**, 648
assay, 1458
chloride, 648
citrate, **647**
assay, 1456
elixir, 338
salt, effervescent, **647**
iodide, 648
mica, 644
nitrate, 648
phosphate, 648
salicylate, **648**
assay, 1456
elixir, 338
salts, 644
unofficial, 648
sulphate, 648
tests for, 644
Lithopone, 1972
Litmus, 845, 1450
paper, 1450
test solution, **1450**
Litus, 249

Liver, cod, oil, 1187
of sulphur, **596**
Liverwort, 1100
Lixivium, 618
saponarium, 1972
Lloyd extractor and concentrator, 213
Loaf, sugar, 896
Loans from banks, 1275
Lobelacrin, 1156
Lobelia, 1155
fluidextract, **432**
inflata, 1155, 1167
tincture, **376**
Lobeliæ ætherea, 401
tinctura, P.I., **376**
Lobelianin, 1156
Lobelic acid, 1156
Lobeline, 1156, 1167
Location, neighborhood, 1305
of store, 1302, 1303
transient, 1303
Lochmann's cork press, 1669
Locke-Ringer's solution, 1547
Lœflund's malt soup stock, 1822
Löffler's methylene blue solution, 1573
mixture, 1576
Loganin, 1126
Logwood, 844
decoction, 363
Lohoch, 249
Lohochs, 488
London paste, 1972
Long buchu, 998
Looch album, 1972
Loofah, 1972
Loretin, 937
L'origan perfume, 1227
Losophan, 934
Loss and profit statement, 1410, 1419
in drying medicinal substances, 149
Lotio alba, 299, **597**
veterinaria, **298**
ammoniacalis camphorata, **298**
calaminæ, **298**
composita, **299**
delphinii, **299**
flava, **299**
nigra, **299**
plumbi et opii, **299**
Lotion, 189
Abercrombies, 1965
benzoin, 1211, **1236**
black, **299**
calamine, **298**
compound, **299**
eye, isotonic, 260
hand, quince jelly, **1239**
larkspur, **299**
lead and opium, **299**
quince seed, **1236**
toilet, **1238**
tragacanth, hand, **1236**
Vleminckx's, **681**
white, 299, **597**
veterinary, **298**
yellow, **299**
Lotiones, 298
Lotions, 260-298
eye, 260
hand, 1236
Lotions, unofficial, 299
Loto flavin, 1063
Lotus arabicus, 1063
Lotusin, 1063
Lovage, 970, 1006
oil, 986
Love-apple,
Lovi's beads, 65
Low wines, 914
Lozenge board, 1698
cutter, 1699
punch, 1698
sugar, 896
sulphur, 499
Wister's, 1700
Lozenges, 498, 1697
ammonium chloride, compound, 1717
Lugol's solution, **576**
diluted, 1574
Luminal, 925
-soluble, 926
Lump sugar, 896
Luna, 1972
Lunar caustic, **746**
Lungwort, 892, 1100
Virginia, 892
Lunosol, 877
Lupin, 1079
seeds, yellow, 1167
Lupinidine, 1163, 1167
Lupinin, 1079
Lupinine, 1167
Lupinus albus, 1079
Lupulin, 1003
fluidextract, **432**
oleoresin, **447**
Lupuline, 1003, 1167
Lupulinum, 1003
Lustron, 1972
Lutecium, 531
Lutein, 1202
solution, sterile, 1202
Luteolin, 840
Lutes, 136
Lycetol, incompatibility, 1647
Lycopodium, 1045
clavatum, 1045
Lycopus, 964
virginicus, 964, 1031
Lye, antidote, 1941
Lysidin, incompatibility, 1647
Lysine, 1170
Lysol, 814

M

Mace, 994
oil, 980, 1045
Maceration, 231, 366
circulatory, 231
previous, 238
Mache units, 685
Machines, centrifugal, 229
Machura tinctoria, 845
Mackintosh, 1761
Macrotin, 1030
Macrotys, 1009, 1030
Mactose, 893
Madame Nouffer's cure for tapeworm, 1007
Madder, 845
Madia oil, 1045
sativa, 1045
Madweed, 964
Magendie's solution, 1109
Magenta, 853
acid, 853
Magisterium bismuthi, 1972
coccionellæ, 1972
opii, 1107
sulphuris, 1972
Magistral pharmacy, 1587
Magma, 216
bismuth, **774**
assay, 1477
ferri hydroxidi, 732
magnesiæ, **664**
Magmæ, 297
Magmas, 297
unofficial, 297
Magnalium, 1972
Magnesia, **663**
alba, 1972
and rhubarb powder, anisated, **484**
asafetida and opium mixture, **294**
calcined, **663**
heavy, **663**
light, **663**
magma, **664**
milk, **664**
assay, 1457
mixture test solution, 1547
nigra, 1972
Magnesii acetas, 670
carbonas, **661**
chloridum, 669
iodidum, 670
lactas, 670
oxidum, **663**
ponderosum, **663**
phenolsulphonas, 670
salicylas, 670
silicas, 670
sulphas, **665**
sulphis, 670
Magnesite, 661, 665, 669
Magnesium, 531, 661
acetate, 670
bicarbonate solution, 260
carbonate, 205, **661**
assay, 1457
chloride, **669**, 1536
assay, 1463
citrate, acid, 669
solution, 257, 666
assay, 1481
iodide, 670
lactate, 670
oxide, **663**, 1536
assay, 1457
heavy, **663**
phenolsulphonate, 670
salicylate, 670
salts and preparations, unofficial, 670
tests for, 661
silicate, 591, 670
sulphate, **665**, 1536
assay, 1480
effervescent, **670**
solution, effervescent, 260, 670
sterile solution, **1800**
test solution, 1547
sulphite, **670**
Magnetic iron oxide, 732
Magnolia, 1225
Mahonia, 1156
Maidenhair, 892

Mailing lists, 1367
Maimonides' oath and prayer, 5
Maintaining prices, 1379
Maizenic acid, 1016
Make-up of drug business, 1327
Mala, 1972
Malabar cardamom, 983
Malaria, prevention, 1889
Malate, iron, crude, **466**
tincture, **390**
Male fern, 1007
oleoresin, **446**
root, 1007
shield fern, 1007
Malic acid, 787, 946
Mallotus philippensis, 1090
Mallow leaves, 890
Malt, **883**
extract, **462**, 1821
Borcherdt's, 1821
unmedicated, 1821
with cod liver oil, 1821
sugar, Borcherdt's, 1821
Maltine, 1821
ferrated, 1821
malt soup extract, 1821
with cascara sagrada, 1821
cod liver oil, 1821
creosote, 1821
Malting, 884
Maltose, 884, 893, 902
Malto-yerbine, 1821
Maltum, **883**
Malva rotundifolia, 890
sylvestres, 890
Malvæ folia, 890
Malvin, 840
Mammalia, class, 1203
Mammary substance, 1203
Manaca, **1161**
elixir, compound, **330**
fluidextract, **432**
Manacine, **1161**
Management of sales, 1381
Manager's qualifications, 1271
"Manchart" of A.E.F., 1269
Mandarine oil, petit-grain, 1216
Mandelic acid, 1135
Mandelonitrile, 268
Mandragora officinalis, 1164
Mandragorine, 1164
Mandrake, 1086, 1164
Manganese, 532, 706
and peptonized iron, solution, **730**
sodium citrate, **706**
arsenate, 709
battery, 1972
carbonate, 709
citrate, 709
soluble, 706
assay, 1481
dioxide, 1536
glycerophosphate, soluble, 707
assay, 1481
hypophosphite, 708
assay, 1464
oleate, 1047
oxalate, 709
salts, unofficial, 709
sulphate, 709, 1536
test solution, 1547
tartrate, 709
Mangani arsenas, 709
Mangani carbonas, 709
chloridum, 709
citras, 709
solubilis, 706
glycerophosphas solubilis, 707
hypophosphis, **708**
oxalas, 709
sulphas, 709
tartras, 709
Manganin, **1972**
Manganous chloride, 709
compounds, test for, 706
glycerinophosphate, soluble, 707
-manganic oxide, 706
monoxide, 706
oxide, 706
Mangosteen oil, 1046
Manihot utilissima, 883
Manioc, 883
Manna, 899
metallorum, 1972
syrup, **279**
Mannite, 899
Mannosane, 893
Mannose, 893
Manroot, 1079
Mantoux and Mendel, test, 1935
Manufactured perfume products, 1227
Manufacturers biological products, 1936
names and addresses, 1985
standards, India rubber base plasters, 521
Manufacturing laboratory scale, 45
on a large scale, 1585
pharmacist, 1577
pharmacy course, 1945
Maple, mountain, 1014
Maranham Jaborandi, 1138
Maranta, 883
arundinacea, 883
Marcasit, 1972
Margarin, 1033
Margin, 1272, 1332
Marigold, 1010
Marine acid, 1972
lint, 1759
salt, 1972
soap, 1052
Marjoram oil, sweet, 986
Marketing methods, 12
Mark-up, 1332
Marrubium oil, 986
vulgare, 986
Mars iron, 1972
salt, 1976
vitriol, 560
Marsdenia condurango, 1075
Marsh gas, 785
Marsh rosemary, 1100
tea, 1079
oil, 986
trefoil, 1079
Marshmallow, 887
leaves, 888
root, 887
Martis iron, 1972
Maruta cotula, 1012
Marybud, 1010
Mashing, 914
Mass, blue, **488**, **749**
Mass, copaiba, **488**
ferrous carbonate, **487**, **713**
assay, 1472
mercury, **488**, **749**
assay, 1462
mixer, Colton's, 1691
Vallet's, **487**, **713**
Massa ferri carbonatis, **487**, **713**
copaibæ, **488**
hydrargyri, **488**. **749**
Massæ, 487, 1690
Massage or rolling cream, **1242**
Masses, 487, 1690
Massicot, 1972
Master formula card, 1582
Masterwort, 970
oil, 986
Mastic, 1028
and aloe pills, **492**
compound chloroformic solution, 342
Mastiche, 1028
Mate, 1100
Mater metallorum, 1972
Materia medica, definition, 1
Matico, 1003
fluidextract, **433**
oil, 986
tincture, 401
Matricaria, 1012
chamomilla, 986, 1012
oil, 986
Matta, 1972
Matter, 527
Maury's ointment, 1973
Mauveine, 841
Maw seed, 1972
Max mill, 164
Maximum density, 122
May apple rhizome, 1086
blossoms, 1225
Mayer's hemalum, 1573
reagent, 1547, 1548
incompatibility, 1648
Meadow saffron, 1972
Mead's disintegrator, 167
dry malt soup stock, 1822
powdered protein milk, 1822
Measles, disinfection, 1883
Measure and weight, 26
apothecaries fluid, 80
U. S., 28
fluid, 77
Imperial (Br.), 28
linear, 77
wine, 28
and weights, 73
equivalents, 33
relationship of, 77
approximate, 29
copper, 51
glass, 51
graduated, 51
linear equivalents, 39
metric, 51
Measuring and weighing, 41
evaporation, 129
heat, methods of, 102
in a graduate, 53
liquids, 50
pipette, 214
Meat extracts, 1824
juices, 1824
Mechanical shaker, 1486
Meconic acid, 1104, 1164
Meconidine, 1105, 1106

Meconin, 1104
Meconion, 1103
Meconium, 1972
Meconoiosin, 1104
Media, culture, 1574
  filtering, 203
Medial alligation, 86
Medical building, 1302
  terms, glossary, 1979
Medicated cones, 1831
  globules, 1831
  oils, 355
  pencils, 524
  petroxolins, **352**
Medicinal dyes, 850
  foods, 1820
  gentian violet, 852
  scarlet red, Biebrich, 850
  substances, loss in drying 149
Medicine glass, graduated, 29
  store, 1268
Medicines, patent, 1264
    and proprietary, 1264
  proprietary, 1264
Mediums for advertising, **1363**
Medulla bovis, 1972
  lactis, 1972
  sassafras, 1972
Medullin, 794
Meerschaum, 591, 661
Megarrhin, 1079
Megarrhiza californica, 1079
Megarrhizitin, 1079
Meker burner, 99
Mel, 898
  ægyptiacum, 1972
  boracis, **285**
  depuratum, 898
  rosæ, **284**
    et sodii boratis, **285**
  sodii boratis, **285**
Melagueta pepper, 1972
Melaleuca Leucadendron, 978
Melanosmegma, 1972
Meleguette pepper, 1972
Melezitose, 893
Melia azadiracta, 1079
Meliatin, 1079
Melibiose, 893
Melilot, 1077
  yellow, 1077
Melilotus, 1077
  officinalis, 1077
Melissa, 964
  officinalis, 964, 986
  oil, 986
Mellita, 284
Melon seed oil, 1046
Melting points, 106, 1524
    U. S. P. X method for determining, 106
Melubrin, 937
Mendel and mantoux test, 1935
Mendelejeff's periodic system, 528
Menhaden oil, 1205
Meningococcus bacterin, 1918
  serobacterin, 1921
  vaccine, 1918
Meniscus, reading, 53
Menispermine, 1157, 1167
Menispermum, 1164
  canadense, 1031, 1164
  fluidextract, 442
Menispine, 1164
Menstrua, 174
  choice, 239
Menstruum, absorbed, 239
  adding, 237
Mentha piperita, 957
  pulegium, 965
  spicata, 960
  viridis, 960
Menthiodol, 937
Menthol, 957, 959
  and camphor, **959**
  camphorated, **959**
  camphoratum, **959**
  chloral, 933
  incompatibility, 1646
  inunction, **512**
    compound, **512**
  petroxolin, **353**
  plaster, 521
  spray, **354**
    compound, **355**
  troches, compound, 499
  wool, **1763**
    compound, **1763**
Mentholated chloral, 933
Menthone, 958
Menyanthes, 1079
  trifoliata, 1079
Menyanthin, 1079
Mephite of soda, 1972
Mercaptan, 935
  ethyl, 787
Mercerized cellulose, 794
Merchandise account, 1404, 1407
  buying, 1328
Mercurammonium chloride, **751**
Mercurial barometer, 122
  ointment diluted, **505**
    mild, **505**
      assay, 1462
    strong, assay, 1462
    stronger, **504**
  plaster, 521
  shaker, Squibb's, 749
Mercurialized serum, 878
Mercuric acetate, 759
  and arsenous iodide, solution, **768**
      assay, 1471
  benzoate, 759, 878
  bromide, 759, 1536
    test paper, 1547
      solution, alcoholic, 1547
  chlorate, 759
  chloride, **752**, 1536
    corrosive, **752**
      assay, 1479
      mull, **522**
      poison tablets, assay, 1479
    gauze, **1761**
    incompatibility, 1647
    solution, 260
    test solution, 1548
    wool, **1763**
  chromate, 759
  compounds, 747, 878
  cyanide, 759, 878
  iodide, **755**
    and arsenous solution, assay, 1462
    red, **755**
      assay, 1483
      incompatibility, 1648
Mercuric iodide solution, 1775
    wool, **1762**
  nitrate, acid solution, 260
    diluted ointment, 511
    ointment, **509**
    solution, 259
    test solution, 1548
  oleate ointment, 512
  oxide, red, **758**, 1536
      assay, 1461
      ointment, **509**
    yellow, **756**
      assay, 1461
      incompatibility, 1648
      ointment, **505**
  oxycyanide, 759, 879
    solution, 1775
  potassium iodide, 616
      incompatibility, 1648
      test solution, 1548
        alkaline, 1548
  salicylate, **756**
    assay, 1461
    incompatibility, 1648
  subsalicylate, **756**
  subsulphate, yellow, 759
  succinimide, 879
  sulphate, 760
    incompatibility, 1650
    test solution, 1548
  sulphide, black, 760
    red, 760
Mercurius dulcis, 1972
  mortis, 1972
  præcipitatus, 1972
  vitæ, 1972
Mercurochrome, soluble, 220, 879
Mercurol, 879
Mercurosal, 879
Mercurous carbonate, 759
  chloride, **753**, 1536
    incompatibility, 1648
    mild, **753**
      and jalap powder, **483**
      assay, 1471
      compound pills, **491**
      ointment, **508**, 512
      tablets, **500**
  compounds, 747
  iodide, **754**
    yellow, **754**
      incompatibility, 1648
  nitrate, 760
    test solution, 1548
Mercury, 532, 737, 747, 748, 1536
  alanin, 1965
  aloe and podophyllum pills, **493**
  ammoniated, **751**
    assay, **1479**
    ointment, **504**
  and morphine oleate, 1047
    zinc cyanide gauze, **1762**
      wool, **1762**
  assay, 1461
  and potassium iodide solution, 259
  bichloride, **752**
    antidote, 1942, 1943
  biniodide, **755**
  cacodylate, sterile solution, **1800**
  chloramide, 1972

Mercury, coagulated, 1972
colloidal incompatibility, 1648
compound ointment, 511
compounds, tests for, 747
unofficial, 878
cyanide, sterile solution, **1800**
digitalis and squill pills, 494
dulcified, 754
Hahnemann's soluble, 1972
iodide, red, **755**
yellow, **754**
assay, 1472
liniment, **350**
mass, **488**, **749**
assay, 1462
nucleinate, 879
oleate, **350**
oxycyanide, sterile solution, **1800**
perchloride, **752**
petrox, **351**
petroxolin, **351**
plaster, 521
protochloride, **753**
protoiodide, **754**
red iodide, ointment, 511
salicylate, sterile solution, **1801**
salicylated, 758
salts, unofficial, 759
subchloride, **753**
ointment, 512
succinimide, sterile solution, **1801**
vegetable, 1161
with chalk, **750**
assay, 1462, 1483
Mergal, 880
Meroxyl, 880
Merrell suppository mold, 1740
Mesit, 799
Mesitylene, 799
Mesotan, 828, 937
Meta-arsenic acid, 764
Metaboric acid, **590**
Metacresol, 813
cinnamate, 936
Metadioxybenzene, **823**
Metal, Dutch, 1969
fusible, 1972
monel, 1972, 1973
stills, 141
Metallic aluminum, 1529
pills, **495**
bitter, **495**
weights, 48
worm condenser, 141
Metals, alkali and their compounds, 595
heavy, test, 1519
Metameric, isomerism, 781
Metamerism, 781
Metanilate, sodium, 811
Metanitraniline, 811
Metantimonate, potassium, 615
Metapectic acid, 945
Metaphen, 880
Metaphenylenediamine, 811
hydrochloride, 1536
test solution, 1548
Metaphosphoric acid, 581, **585**
Metaproteins, 1170
Metarsenous acid, 764
Metatoluenediamine, 811
Metavanadate, ammonium, 1529
Meteloidine, 1133
Meter, 31
Methacetin, 937
Methacetine, 1972
Methane, 780, 785, 799
Methanilid, 1972
Methanol, 94, 809, 1972
antidote, 1943
Metheglin, 1972
Methenamina, **931**
Methenamine, 93, **931**
assay, 1458
incompatibility, 1648
Methene chloride, 785
Methenyl chloride, 785
series, 787
Method of allotting quantities, 1589
determining solubilities, 182
Methods of effecting precipitation, 216
folding filtering paper, 196
marketing, 12
measuring heat, 102
obtaining crystals, 221
supporting percolators, **245**
Methol, 799
Methyl acetanilid incompatibility, 1646
acetate, 175, 937
acetophenone, 1214
alcohol, 94, 799, 809, **937**
antidote, 1943
amino-oxybenzoate, 937
amylketone, 973
anthranilate, 954, 1216
benzoate, 1216, 1226
benzol, 1972
benzolaconine, 1143
-cephaëline, 1147
chavicol, 968
chloride, 785, 937
cinnamate, 1216, 1226
-codeine bromide, 935
creosol, 806
-ethyl-acetic acid, 1063
ether, 937
formaldehyde, 786
formic acid, 786
glyoxal, 903
heptine carbonate, 1216
hydroquinone, 1063
iodide, 937
-naphthalene, 811
orange, 1450
test solution, 1450
oxide, 781, 937
-propyl carbinol urethane, 936
red, 543, 1451
test solution, 1451
salicylate, 982, 1226
assay, 1461
petroxolin, **353**
series, 785
theobromine, 1972
valerate, incompatibility, 1650
violet-6B, 854
alcoholic solution, 1573
solution, 1574
Methylacetal, 1972
Methylacetanilid, 936, 937
Methylal, 937
Methylamine, 799
Methylanthracene, 811
Methylated spirit, 94
Methylatropine, 935
Methylbenzene, 791
Methylconiine, 1158
Methylcreosol, 799
Methylene-azur II, 853
bichloride, 937
blue, 848
incompatibility, 1648
solution, Löffler's, 1573
-citryl salicylic acid, 828, 938
Methylene creosote, 939
dichloride, 937
Methylenedicotoin, 937
Methylene-diemethyl ether, 937
-digallate bismuth, 933
diguaiacol, benzoic ester, 936
Methyleneditannin, 940, 1100
Methylene green, 854
Methyleugenol, 1226
Methylglycollicphenetidin, 937
Methylic alcohol, 809
ether, 937
Methylis salicylas, 982
Methylisopelletierine, 1146
Methylmorphine, 1109
Methylnonylacetic aldehyde, **1213**
Methylthioninæ chloridum, 848
hydrochloridum, 848
Methylthionine chloride, 848
hydrochloride, incompatibility, 1648
Methysticum, 1028
Metol, 1972
Metopium, 1972
Metozin, 1972
Metrenchyta, 1972
Metric and apothecaries weight, 77
diagram, 32
graduate, conical, 52
measures, 51
prescriptions, 1594
system, 29, 73
weights, 49
block, 49
iron, 49
Metrology, 26
documentary, 27
inductive, 27
Metroxylon læve, 883
Rumphii, 883
Mexican pepper, 996
scammony resin, **472**
root, 1086
Mezereon, 1008
Mezereum, 1008
fluidextract, **433**
Mezquite gum, 892
Mica, 698
lithium, 644
ramis, 1972
Micro burner, 99
Microcidin, 1972
Microcosmic salt, 1972, **1976**
Microcuries, 685
Micromillimeter, 31
Micron, 31
Microörganisms, stains and accessories for study of, 1573
Microscope, Spencer, 1435

Microscopic examination of urine, 1444
Microscopy, definition,
Mignonette, 1225
oil, 986
Migrainin, 937
Mikozone, 1972
Mil, 31
Mild cantharidin plaster, 520
mercurial ointment, **505**
assay, 1462
mercurous chloride, **753**
and jalap powder, **483**
assay, 1471
ointment, **508**
pills, compound, **491**
tablets, **500**
pills, iron, quinine, strychnine and arsenic, **496**
protargin, 876
resorcinol paste, **516**
Lassar's, **516**
silver-protein, 876
assay, 1462
Milder compound decoction of sarsaparilla, **363**
Milk, bacillus acidophilus, Lederle, 1180
asafetida, **287**
bismuth, **774**
casein, 1204
cow's, 1179
dry protein, 1822
fermented, **1182**
lime, **672**
magnesia, **664**
assay, 1457
pasteurizing, 1790
powdered, making of, 1179
protein, 1822
products, modified, 1822
sugar, 898
sulphur, 583, 1972
virgin's, 1972, 1978
Mill, barrel, 159
ball or pebble, **158**
Bogardus, 160
buhrstone, 159
cannon ball, 159
chaser, **160**
drug, **159**
double jar, 158
Enterprise, 162
Hance's, 163, 164, 1707
hand, **161**
general rules for operating, 163
high speed, 164
large jar, 159
Max, 164
pot, 159
Quaker City F. No. 4, 162
roller, Raymond, 161, 166
single jar, 158
Swift's, 162
B, 163
Wiley, 167
Milled soap, 1052
Millicuries, 685
Milligram, 31
Milliliter, 31
Millimeter, 31
Mills, pebble or ball, 158
roller, 161
Mimosa, 1225
Mineral alkali, 618
Mineral Ethiops, 760
gum, 1972
oil, white, 1057
salts, 1168
wax, 1972
wool, 1972
Mineralogy, definition, 1
Minim pipette, 53
Minimum lethal dose, 1506
Minium, 737, 1972
græcorum, 1972
purum, 1972
Mint, 960
and soda solution, **640**
soda, **640**
Mirabilite, 1972
Miraculum chemicum,
Mirbane, oil, 938
vinegar, 1969
Miscellaneous unofficial preparations, 524
Miscibility of liquids, 173
Mistletoe, 1030
Mistura acaciæ, 1972
adstringens, **292**
ammonii chloridi, **297**
camphoræ acida, **297**
aromatica, 297
carminativa, **292**
chloralis et potassii bromidi composita, **293**
chloroformi et morphinæ composita, **293**
copaibæ et opii, **294**
cretæ, **291**
ferri composita, **297**
glycyrrhizæ composita, **291**
guaiaci, **297**
magnesiæ, asafœtidæ et opii, **294**
olei picis, **297**
-balsamica, **295**, 1972
opii et chloroformi composita, **295**
rhei composita, **295**
sassafras, **297**
pectoralis, **296**
Stokes', 296
potassii citratis, **607**
rhei alkalina, **296**
composita, **296**
et sodæ, **296**
sennæ composita, **297**
sodæ et menthæ, **640**
sodii citratis, **641**
Misturæ, 291
Mitchella, 1029
fluidextract, **433**
repens, 1029
Mitchell's separator, 215
Mithridate, 1972
Mithridates, 995
Mitigated silver nitrate, 747
Mixtura alba, 1972
salina, 1972
solvens, 1972
stibiata, 1973
Mixture, acid camphor, 297
ammonium chloride, 297
antidysenteric, 1973
astringent, **292**
Basham's, **722**
brown, **291**
camphor, aromatic, 297
carminative, **292**
chalk, **291**
Mixture, Chapman's, **294**
chloral and potassium bromide, compound, **293**
chloroform and morphine, compound, **293**
copaiba, **293**
and opium, **294**
dysmenorrhœa, 1973
expectorant, 296
French, **578**
glycyrrhiza compound, **291**
guaiac, 297
iron, compound, 297
salicylated, **730**
Lafayette, **293**
Löffler's, 1576
magnesia, asafetida and opium, **294**
neutral, 607, 947
oil of tar, 297
oleo-balsamic, **295**
opium and chloroform, compound, **295**
rhubarb compound, **295**
sassafras, **297**
rhubarb, alkaline, **296**
and soda, **296**
compound, **296**
senna compound, 297
Squibb's diarrhea, **295**
steel, 1977
Sun cholera, **295**
zinc acetate, 1569
Mixed bacterial vaccines, 1920
mononitrotoluenes, 811
salts, 536
serobacterins, 1921
toluidenes, 811
Mixer and sifter, Hunter's, 168
Jones', 167, 168
Mixing machine, 1659
Mixtures, 291, 1654
effervescent, 1708
extemporaneous, 1651
unofficial, **297**
Model drug stores, 1319
letters, 1385, 1386
pharmacy law, 1251
Moderately coarse powder, 170
Modern selling methods, 1378
Modified Dakin's solution, **570**
milk products, 1822
Volhard method for chlorides in urine, 1443
Mohr's salt, 1973
Moist iodoform gauze, **1762**
Moistener for drugs, 236
Moistening powder, 236
Moisture, hygroscopic, 148
in vegetable drugs, 1522
method for drugs containing ether-soluble constituents volatile at 100° C., 1522
no constituents volatile at 100° C., 1522
Mold, bougie, 1743
caustic cone, 746
Molded silver nitrate, **746**
suppositories, 1736
tablet triturates, 1701
tablets, 1701
Molds, suppository, 1738
Molecular solution, 171
weights, 537
Molecules, 528

Mollin, 1973
Molybdenum, 532
Molybdic acid, 1537
Molybdos, 1973
Mombassa chillies, 996
Monarda, 965
  didyma, 963
  punctata, 963, 965, 986
Monazite, 704
Monel metal, 1972, 1973
Monesia, 1100
Monkshood, 1143
Monoacetate, resorcin, 935
Monoacetyl para-amidophenetol, 828
Monobromantipyrine, 933
Monobromated camphor, 988
Monocell filter, 208
Monochlorobenzene, 811
Monochlormethane, 785
Monochlorphenol, 937
Monoglycol salicylate, 828
Monohydrated sodium carbonate, **624**, 1541
    assay, 1455
Monohypochlorite, quinoline, 1165
Monoiodobehenate, calcium, 862
Mono-nitro-methylene blue, 854
Mononitrotoluenes, mixed, 811
Monopad filter, 203
Monophenetidin citrate, 932
Monosaccharides, 893
Monoses, 893
Monosodium orthophosphate, **631**
Monoxide, carbon, 588, 799
    antidote, 1942
  lead, **739**, 1535
    assay, 1473
  manganous, 706
  nitrogen, **551**
Monsel's solution, 258, **731**
Montau wax, 1973
Monthly records, 1415, 1416
Moonseed, Canadian, 1164
Mordant dyes, 841
  salt, 1976
Morin, 840
Moringa aptera, 1045
  pterygosperma, 1045
Moro and Doganoff test, 1935
  reaction, tuberculin ointment for, 1936
Morphina, 1107
Morphinæ hydrochloridum, 1107
  sulphas, 1108
Morphine, 1105, 1107, 1164
  acetate solution, 260
  and acacia, syrup, **284**
    atropine hypodermic tablets assay, **1502**
    chloroform mixture, compound, **293**
    ipecac troches, 499
    mercury oleate, 1047
  antidote, 1943
  chloride, 1107
  compound powder, 484
  hydrochloride, 1107
    solution, 260
  sulphate, 1108
    solution, 1109
Morphine sulphate tablets, assay, 1502
  suppositories, 523
  tartrate solution, 260
  troches, 499
Morphium, 1107
Morrhuol, 1205
Mortar for trituration, 151
Mosaic gold, 1973
Moschus, 1204
  moschiferus, 1204, 1218
Mosquitoes, elimination of, 1836
Moss, 1758
  Irish, 889
    oak, 1219
  pearl, 1974
Mother liquor, 223
  plaster, camphorated, **520**
Mother's ointment, 508
  salve, **508**
Motherwort, 964
Moths, elimination of, 1839
Mottled soap, 1052
Mountain balm, 1008
    oil, 986
  fat, 1973
  maple, 1014
Mouth wash, **339**, 341
Moxa, 249, 524
Muawin bark, 1164
Muawinine, 1164
Mucic acid, 885
Mucilage acacia, **286**
  chondrus, **286**
  elm, **287**
  gum arabic, **286**
  Indian gum, **287**
  Irish moss, **286**
  sassafras pith, **287**
  tragacanth, **286**
Mucilages, 285, 885, 893
  unofficial, 287
Mucilagines, 285
Mucilaginous principles, 882
  substances and gums, 885
    unofficial, 891
Mucilago acaciæ, **286**
  chondri, **286**
  cydonii, 891
  gummi indici, **287**
  sassafras medullæ, **287**
  tragacanthæ, **286**
  ulmi, **287**
Mud, Denver, 1968
Muffle furnace, electric, 111, 112
    gas, 111
Muguet, 1223
Mugwort, 1016
Mull, corrosive mercuric chloride, **522**
  creosote, salicylated, **522**
  salicylic acid, **522**
  zinc, **522**
Mulla acidi salicylici, **522**
  creosoti salicylata, **522**
  hydrargyri chloridi corrosivi, **522**
  zinci, **522**
Mullæ, 521
Mullein flowers, 891
  leaves, 891
    fluidextract, **440**
Muller and slab, 154
Mulls, 521
Mulls, salve, 521
Multiple pulp filter, 210
Muriatic acid, 554
Muride, 1973
Murina, 1973
Musa sapientum, 947
Muscarine, 1167, 1204
Muscus, 1973
Musk, 1218
  ambrette, 1218
  artificial, 1219
  grain, 1218
  ketone, 1218
  -root, 967
  tincture, 401
  Tonquin, 1204, 1218
  xylene, 1218
  xylol, 1218
Muslin, oiled, 1760
  strainers, 194
Mustard, black, 992
    assay, 1463
  brown, 992
  cataplasm, 518
  English prepared, 993
  gas, 787
  German prepared. 992
  liniment, compound, **349**
  oil, 993
    black, 1045
    ointment, **510**
    volatile, 993
      assay, 1463
    white, 1046
  ointment, **510**
  paper, 1755
  plaster, 520, 992, 1753
  poultice, 518, 1753
  seed, brown, 992
    red, 992
  spirit, **314**
  white, 993
  wild, 994
  yellow, 993
Mutton suet, 1043
Mycoderma aceti, 800, 902, 903
Mynsicht's emetic tartar, 762
Myrcia cerifera, 1045
  oil, 975
  spirit, compound, **313**
Myrica, 1004
  cerifera, 1004, 1031
Myricin, 1191
Myricyl alcohol, 1191
  palmitate, 1191
Myristica, 980
  fragrans, 980, 994, 1045, 1046
  oil, 980
Myristicaceæ products, 980
Myristicin, 980
Myristicol, 980
Myristin, 1037
Myrobalans ointment, 512
  ointment, with opium, 512
Myrobalanus, 1100
Myrosin, 902, 992, 993, 1062
Myrrh, 1023, 1219
  and aloe tincture, **383**
    pills, **492**
    capsicum tincture, 386
  gum, 1023
  oil, 986
  tincture, **376**
Myrrha, 1023
Myrtaceæ products, 973
Myrtillin, 840

Myrtle, 1006
Myrtus, 1006
communis, 985, 1006

N

N. N. R., 24
Nægelis solution, 1973
Naftalan, 938
Name, botanical, 20
of store, 1306
Names, trade, 1265
Nancic acid, 1965
Naphæ flores, 1973
Naphtha, 1973
coal tar, 1973
petroleum, 1973
vinegar, 1978
vitrioli, 1973
wood, 809
Naphthal (beta) ethyl ether, 1216
methyl ether, 1216
Naphthalene,799, 811, 832, 938
ring, 791
Naphthalol, 1973
betol, 933
Naphthionate, sodium, 811
Naphthol, 811, **812**
alpha, 792
benzoate, 933
beta, 792
paste, Lassar's, **516**
yellows, 841
Naphtholate, bismuth, 938
Naphthols, 792
Naphthosalol, 933, 1973
Naphthyl, 1973
Naphthylamine (beta) acetate, 1537
test solution, 1548
(alpha) hydrochloride, 1537
Narcein sodium-sodium salicylate, 1165
Narceine, 1105, 1164
Narcissus, 1225
Narcotic drugs, content of, 12
how to procure them, 1258
import and export act, 1261
law and regulations, Harrison, 1257
preparations, non-taxable, 1259
Narcotics, inquiries concerning, 1260
prescriptions for, 1248
Narcotine, 1105, 1164
Narrow percolator, 235
Nasal wash, 341
Nascent ferrous carbonate, **713**
Nataloin, 1080
National Association Boards of Pharmacy, 1250
banks, 1281
Formulary, 23
Native talc, 592
Natrii arsenas P. I., **635**
Natrium sodium natron, 1973
Natro-kali tartaricum, 1973
Natron tartarizatum, 609
Natural emulsions, 1657
oleoresins, 1018
philosophy, definition, 1
Neapolitan ointment, 1973
Neat's-foot oil, 1204
Nebula aromatica, **354**
eucalyptolis, **354**
mentholis, **354**
composita, **355**
thymolis, **355**
Nebulæ, 354
Nectandra rodiœi, 1161, 1165
Needles, antimony, 1966
dwarf pine oil, 1021
Negligence, 1248
Neighborhood location, 1305
Neisser bacterin, 1918
serobacterin, 1921
Neoarsphenamina, 871
Neoarsphenamine assay, 1466
incompatibility, 1648
Neochincophen, 1125
Neodiarsenol, 872
Neodymium, 532
Neogale, 1973
Neon, 532
Neopine, 1105, 1106
Neorobin, 1084
Neosalvarsan, 872
incompatibility, 1648
Neo-silvol, 877
Nepeta cataria, 964, 985
Nepodin, 1099
Nerol, 1212
Neroli oil, 956, 1223
Nerolin, 1216
Nessler's reagent, 1548
Net profit, 1272, 1332
relation to expense, 1425
Neuridine, 1204
Neurine, 1204
Neuronal, 938
Neutral acriflavine, 851
mixture, **607**, 947
principles, 1062
sodium tartrate, 1542
Neutralization, assay methods based upon principle of, 1453
Neutralized alcohol, 1529
Neutralizing cordial, **296**
Neville and Winter's acid, 811
New and Non-official Remedies, 24
-mown hay, 1225
orthoform, 839
N. F. and U. S. P. general tests, 1512
Niccoli bromidum, 735
carbonas, 735
chloridum, 735
cyanidum, 735
sulphas, 735
Niccolum, 735
Nicholson's hydrometer, 65
Nichrome, 1973
Nickel, 532, 735
bromide, 735
carbonate, 735
chloride, 735
compounds, tests for, 735
cyanide, 735
oleate, 1047
salts, unofficial, 735
sulphate, 735
sulphide, 735
Nickelic oxide, 735
Nickelous oxide, 735
Nicker seed oil, 1046
Nico, 1973
Nicol's specific gravity bottle, 66
Nicotiana tabacum, 1167
Nicotine, 1167
Niemeyer pills for dropsy, **494**
for phthisis, **496**
Nigella oil, 1046
sativa, 1046
Niger seed oil, 1046
Night blooming cereus, 1157
Nightshade leaves, deadly, 1133
root, deadly, 1133
Nigramentum, 1973
Nigrine, filicic, 1007
Nigrosine, 1973
Nihil album, 694, 1973
griseum, 1973
Niobe oil, 1216, 1973
Nirvanin, 938
Niton, 532, 684
Nitrate, aluminum, 703
ammonium, 660, 1529
barium, 688, 1530
bismuth, basic, **772**
cerium, 705
cupric, 744
ferric, 732
lead, 742, 1535
lithium, 648
mercuric, ointment, **509**
mercurous, 760
pilocarpine, 1139
potassium, **611**, 1540
assay, 1463
incompatibility, 1649
paper, **523**
procaine, 838
silver, **745**, 1540
antidote, 1944
assay, 1462
fused, **746**
assay, 1462
incompatibility, 1649
mitigated, 747
molded, **746**
sodium, 643
strontium, 689
strychnine, 1127
tablets, assay, 1502
thorium, 704
uranium, 734
Nitrates, test, 551
Nitratine, 1973
Nitre, **611**
cake, 1973
rough, 1973
spirit, 1977
sweet, **305**, **919**
Nitric acid, **557**, 1537
antidote, 1940
assay, 1453
diluted, 558, 1537
fuming, 1537
incompatibility, 1648
solution, 1574
Nitrico-nitrosum, acidum, 1965
Nitrite, ammonium, 660
amyl, **926**
assay, 1481
ethyl, pure, 919
spirit, **305**, **919**
assay, 1482
potassium, 616, 1540
sodium, **628**, 1541
assay, 1475
Nitrites, test, 551
Nitrobenzene, 811, 938
Nitrobenzol, 938

Nitro-dyes, 841
Nitroferricyanide, sodium, 1541
Nitrogen, 532, 544, 551
monoxide, **551**
Nitrogenii monoxidum, **551**
Nitroglycerin pills, 497
spirit, **310**
Nitrohydrochloric acid, **565**
diluted, **566**
Nitrometer, 1517
Nitromuriatic acid, **565**
diluted, **566**
Nitroprusside, sodium, 643, 1541
Nitroso-dyes, 841
Nitrosylsulphuric acid, 559
Nitrous acid, 557
ether, spirit, **305**, **919**
oxide, **551**
Nitrum flammans, 1973
saturninum, 1973
Nix, white, 1978
zinci, 1973
No. 8 acid, 800
Nomenclature, 537
of the U. S. P., 17
Non-absorbent cotton, 795
-absorbable sutures, 1766
-electrolytes, 540
-official remedies, 24
-reducing sugars, 893
-sugars, 893
-taxable narcotic preparations, 1259
-volatile ether-soluble extractive, 1523
matter or ash in chemicals, 1513
Nonyl alcohol, 954, 1211
aldehyde, 955, 1212
Nonylate, ethyl, 1215
Nordhausen sulphuric acid, 560
Norit, 1973
Normal salts, 536
butane, 781
constituents of urine, 1434
dropper, 54
horse serum, 1910
hydrochloric acid, 1555
potassium hydroxide, 1558
salt solution, 257, 627, **1795**
sodium hydroxide, 1562
sulphuric acid, 1565
volumetric solutions, 1553
Normality, 1449
Northern prickly ash bark, 1015
Norwood's tincture veratrum, 382
Nosophen, 938
Notation, system of, 529
Notched cork, 237
Notes, promissory, 1281
Notice of dishonor, 1248
Novargan, 1204
Novarsenobenzol, 872
Novaspirin, 828, 938
Novasurol, 880
Novocain base, 838
Nucis vomicæ extractum P. I., **462**
Nucleinate, mercury, 879
Nucleo-albumins, 1170
-proteins, 1170
Nulomoline, 1973
Number, acid, 1512
ester, 1517
six, 1973
Number six, Thomsonian, **386**
Numbering machine, 1610
Nuremberg plaster, 1974
Nut, betel, 1967
earth, 1969
poison, 1974
Nutgall, 1091
ointment, **504**
tincture, **390**
Nutmeg, 980
flavoring extract, 976
oil, 980, 1046
expressed, 980
Nutrivoid flour, 1824
Nuts, areca, 1165
betel, 1165
Nux aromatica, 1973
metelia, 1973
moschota, 1973
nucista, 1973
vomica, 1126
assay, 1498
and phosphorus elixir, **333**
antidote, 1943
extract, **462**
assay, 1498
powdered, **462**
fluidextract, **433**
assay, 1500
iron, quinine and aloe pills, **495**
tincture, **377**
assay, 1499
Nylander's reagent, 1571
Nymphæa, 1100
odorata, 1100

O

Oak bark, black, 1100
white, 1099
moss, 1219
-red, 1099
Oakum, 1759
Oat, 888
fluidextract, 419
Oath and prayer of Maimonides, 5
Hippocratic, 4
Oatmeal, 888
gruel, 888
Oats, 883
Obermeyer's solution, 1569
Ocher, 1973
Ochre, 1973
Octyl alcohol, 1211
aldehyde, 955, 1212
Oculentum, 249
Ocymum basilicum, 963, 986
Odontalgicum, 356
Odors, floral, 1221
Œillet, 1221
Œnanthe Phellandrium, 970, 986
Œnanthic ether, 1973
Œsipus, 1973
Official acids, strength, 553
definition, 21
description, 21
English title, 17,18
general process for decoctions, **362**
for infusions, **357**
Latin title, 17
percolator, 234
pharmacopœias, 14
Oil, absinthium, 985
allspice, 975,
almond, bitter, 988
expressed, 1034
sweet, 1034
amber, 938
American, 1973
wormseed, 1000
angustura, 985, 1016
animal, 1973
anise, 968
artificial, 969
synthetic, 969
anthemis, 985
apple, 1966
arnica, 985
asafetida, 994
asarum, 985
astral, 1967, 1973
banana, 1973
bassia, 1045
bath, 113
bay, 975, 1973
bayberry, 1045
beech, 1045
behen, 1045
ben, 1045, 1973
benne, 1044
bergamot, 956
assay, 1461
betula, 982
birch, pyroligneous, rectified, 805
tar, rectified, 805
bitter almond, 988, 1063
antidote, 1943
assay, 1460, 1464
black mustard, 1045
bone, 1973
bran, 1967
Brazil nut, 1045
British, 1057
buchu, 985
Burgundy pitch, 985
cade, 805
cajeput, 978
cajuput, 978
calamus, 985
camphor, 985
camphorated, **345**
candle nut, 1045
canella, 985
capsicum, 985
caraway, 965
assay, 1483
carbolized, **355**
cardamom, 983, 1045
carron, 345
carrot, 970, 985
cascarilla, 985
cassia, artificial, 1973
synthetic, 972
castor, 1038
aromatic, **356**
emulsion, **290**
jelly, **1039**
catnep, 985
cedarwood, 1537
cedrat, 985
celery, 985
Ceylon cinnamon, 972
chaulmoogra, 1035
chenopodium, 1000
assay, 1483
China, 1968
Chinese cinnamon, 972

Oil, cinnamon, 971
assay, 1483
clove, 973
assay, 1483
cloves, 973
synthetic, 974
coal, 96
cocoanut, 1045
cod liver, 1187
emulsion, **288**
cognac, 916
colza, 1973
copaiba, 997
copra, 1973
coriander, 967
cottonseed, 1037
crab, 1045
croton, 1039
antidote, 1942
compound liniment, **350**
liniment, **350**
crude, 1973
cubeb, 995
cucumber seed, 1045
cumin, 970
curcuma, 985
cyna, 985
Dagget, 1973
dahlia, 985
dill, 970
Dippel's, 1973
dugong, 1205
Dutch, 1969
dwarf pine, 1021
needles, 1021
assay, 1461
eggs, 1973
elder, European, 985
elemi, 985
ergot, 1045
erigeron, 1016
ethereal, **918**
eucalyptus, 979
eulachon, 1205
fennel, 966
feverfew, 985
flaxseed, 1037
fleabane, 1016
Florence, 1970
fusel, 904
galangal, 985
garlic, 994
gaultheria, 982
ginger, 985
grass, 985
golden rod, 985
grain, 1973
grape, 935
groundnut, 1045
hardened, 1973
hazelnut, 1045
hedeoma, 985
heliotrope, 986
hemp seed, 1045
hop, 986
horsechestnut, 1045
horsemint, 986
hydrastis, 1045
hyoscyamus, compound, **448**
seed, 1045
hyssop, 986
illicium, 968
Indian cannabis, 986
inula, 986
-in-water emulsions, 1655
jessamine, 986
Oil, juglans, 1045
juniper, 1001
berries, 1001
tar, 805
kümmel, 966
kurung, 1045
lard, 1041
larkspur seed, 1045
laurel, 986, 1006, 1045
lavender, 960
assay, 1461
flowers, 960
lemon, 955
assay, 1460
lemongrass, 986
lilac, 986
lily-of-the-valley, 986
linden, 986
linseed, 1037
raw, 1037
lovage, 986
mace, 980, 1045
madia, 1045
mandarine, petit-grain, 1216
mangosteen, 1046
marrubium, 986
marsh tea, 986
masterwort, 986
matico, 986
matricaria, 986
melissa, 986
melon seed, 1046
menhaden, 1205
mignonette, 986
mineral, white, 1057
mirbane, 938
mountain balm, 986
mustard, 993
black, 1045
ointment, **510**
volatile, 993
assay, 1463
myrcia, 975
myristica, 980
myrrh, 986
neat's foot, 1204
neroli, 956, 1223
nicker seed, 1046
nigella, 1046
niger seed, 1046
niobe, 1216, 1973
nutmeg, 980, 1046
expressed, 980
olibanum, 986
olive, 1036
castile soap, 1054
orange, 954
bitter, 956
flowers, 956
sweet, 954
palm, 1046
paraffin, 1057
parsley, 986
patchouly, 986
peach, 1046
pear, 1974
pennyroyal, 985
peppermint, 957
assay, 1461
persic, 1239
petit-grain, 1223
phellandrium, 986
phenolated, **355**
phosphorated, **355**
pimenta, 975
assay, 1483
Oil, pimento, 975
pineapple, 1215
poppy seed, 1046
porpoise, 1205
pumpkin seed, 1046
purging nut, 1046
rape seed, 1046
red, 1046, 1975
cedar, 986, 1005
rhodium, 986
rock, 1056, 1973
rosemary, 961
assay, 1461
rue, 1006
Russian leather, 805
saffron, 986
sandalwood, 997
Australian, 998
West Indian, 998
santal, 997, 1219
assay, 1461
santalwood, 997
sassafras, 981
savin, 1006
seal, 1205
seneka, 1973
serpentaria, 986
sesame, 1044
brominized, 861
shark, 1205
skate, 1205
smoke, 1973
sod, 1973, 1976
solar, 1973
spearmint, 960
assay, 1483
sperm, 1205
spike lavender, 961
spray, aromatic, **354**
staphisagria, 1046
star anise, 968
stramonium seed, 1046
sugars, 484, **485**
summer pressed, 1033
savory, 986
swallow, 1973
sweet, 1973, 1977
basil, 986
birch, 982
cicely, 986
marjoram, 986
orange, 954
violet, 986
tansy, 986
tar mixture, 297
rectified, 805
tartar, 1973
tea, 986
teaberry, 982
teel, 1044
theobroma, 1040
suppositories, **1734**
thuja, 986
thyme, 962
assay, 1483
tonka, 1046
tuberose, 986
tucom, 1046
turpentine, 1018
emulsion, **288**
rectified, **1019**
verbena, 986
vitriol, 560, 561
water plantain, 1005
watermelon seed, **1046**
whale, 1205

Oil, white mustard, 1046
wintergreen, 982
artificial, 982
incompatibility, 1649
synthetic, 982
winter's bark, 1006
wood, 1029
wormwood, 986
yarrow, 1016
ylang-ylang, 986
zedoary, 986
Oiled cambric, 1760
muslin, 1760
silk, 1760
Oils as solvents, 174
empyreumatic, 799
essential, 948
fixed, 1032
unofficial, 1032, 1045
infused, 448
medicated, 355
receiver for, 215
volatile, 948, 1209
antidotes, 1943
distillation, 951
preparation of, 950
spirits, 314
stearoptenes from, 986
unofficial, 970
winter pressed, 1033
Ointment, 502
aconitine, 511
ammoniated mercury, 504
atropine, 411
basilicon, 513
belladonna, 503
black basilicon, 1973
blue, 505
boric acid, 502
brown, 508
calamine, 507
calomel, 508
camiofen, 578
camphor, 507
cantharidin, 511
capsicum, 507, 511
carbolic acid, 506
chaulmoogra, 511
chrysarobin, 504
citrine, 509
cocaine, 511
collargol, 877
creosote, 511
eucalyptus, 511
finisher, 1750
gall with opium, 511
hamamelis, 511
iodine, 505
stainless, 509
iodoform, 506
itch, Hebra's, 511
jar, 1746
Kentish, 349
lanolin, compound, 512
lead oleate, 506
oxide, 508
subacetate, 512
Maury's, 1973
mercurial, diluted, 505
mild, 505
assay, 1462
stronger, 504
assay, 1462
mercuric nitrate, 509
diluted, 511
oleate, 512
Ointment, mercurous chloride, 512
mild, 508
mercury, compound, 511
subchloride, 512
mild mercurous chloride, 508
mother's, 508
mustard, 510
myrobalans, 512
with opium, 512
Neopolitan, 1973
nutgall, 504
oil of mustard, 510
paraffin, 512
phenol, 506
pot, 1746
potassium iodide, 508
prophylactic, 508
red iodide mercury, 511
mercuric oxide, 509
resin, 512
resorcinol compound, 510
rose water, 503
salicylic acid, 511
simple, 502
slabs, 1745
spermaceti, 511
staphisagria, 512
stramonium, 510
sulphonated bitumen, 507
sulphur, 506
alkaline, 510
compound, 511
tannic acid, 503
tar, 506
compound, 508
trooper's, 1973
tuberculin, for Moro reaction, 1936
veratrine, 511
volatile, 1973
white precipitate, 504
Wilkinson's, 511
yellow mercuric oxide, 505
zinc, 507
oleate, 512
oxide, 507
stearate, 511
Ointments, 502, 745
dispensing, 1746
preserving, 1746
unofficial, 511
Okra, 892
Old fustic, 1970
tuberculin, O. T., 1936
Oldberg percolator, 234, 235
Olea europea, 1036
infusa, 448
Oleaginous solutions, 345
Oleata, 350
Oleate of aconitine, 351
aconitine, 1047
aluminum, 1047
arsenic, 1047
atropine, 351, 1047
bismuth, 775, 1047
cocaine, 351, 1047
copper, 1047
ferric, 1047
iron, 1047
lead, ointment, 506
plaster, 519, 1752
manganese, 1047
mercury, 350
and morphine, 1047
ointment, 512
Oleate of morphine and mercury, 1047
nickel, 1047
quinine, 351
silver, 1047
sodium, 1047
acid, 1047
tin, 1047
veratrine, 351
zinc, 351, 698
Oleates, 350
unofficial, 351, 1047
Oleatum aconitinæ, 351
atropinæ, 351
cocainæ, 351
hydrargyri, 350
quininæ, 351
veratrinæ, 351
zinci, 351, 698
Olefins, 787
Oleic acid, 1046
Olein, 1032
Oleinata, 249
Oleite, 1973
Oleo-balsamic mixture, 295
-palmito-stearate, glyceryl, 1033
Oleoresin aspidium, 446
capsicum, 446
cubeb, 447
ginger, 447
lupulin, 447
male fern, 446
parsley fruit, 447
pepper, 447
Oleoresina aspidii, 446
capsici, 446
cubebæ, 447
lupulini, 447
petroselini, 447
piperis, 447
zingiberis, 447
Oleoresinæ, 445
Oleoresinous liquids made by percolation, 445
Oleoresins, 445, 1018
natural, 1018
unofficial, 447
Oleosacchara, 485
Oleosaccharæ, 484
Oleum, 560
achilleæ, 1016
æthereum, 918
amygdalæ amaræ, 988
expressum, 1034
anethi, 970
animale fœtidum, 1973
anisi, 968
anthos, 1973
aurantii, 954
amari, 956
florum, 956
bergamottæ, 956
betulæ empyreumaticum rectificatum, 805
betulinum, 1973
bubulum, 1973
cadinum, 805
cajuputi, 978
carbolatum, 355
cardamomi, 983
cari, 965
caryophylli, 973
cassiæ, 971
cedræ, 1973
chaberti, 1973

Oleum, chamomillæ, 1973
chaulmoograe, 1035
chenopodii, 1000
cinnamomi, 971
cocois, 1973
coctum, 1973
coriandri, 967
cornu cervi (fœtidum), 1973
cubebæ, 995
eucalypti, 979
fermentationis, 1973
fœniculi, 966
gossypii seminis, 1037
hyoscyami compositum, 448
jecoris aselli, 1187
juniperi, 1001
empyreumaticum, 805
oxycedri empyreumaticum, 1973
laurinum, 1973
lavandulæ, 960
limonis, 955
lini, 1037
lumbricorum, 1974
mentha viridis, 960
piperitæ, 957
morrhuæ, 1187
myrciæ, 975
myristicæ, 980
napi, 1974
nervinum, 1974
nucis moschatæ, 1974
nucistæ, 1974
olivæ, 1036
omphacinum, 1974
palmæ Christi, 1974
pear, 1974
persica, 1034
petræ, 1974
phenolatum, **355**
philosophorum, 1974
phosphoratum, **355**
picis liquidæ rectificatum, 805
rectificatum, 805
pimentæ, 975
pini pumilionis, 1021
portugallicum, 1974
ricini, 1038
aromaticum, **356**
rosmarini, 961
rusci, 1974
rectificatum, 805
rutæ, 1006
sabinæ, 1006
santali, 997
sassafras, 981
sesami, 1044
sinapis volatile, 993
succini, 938
tartari per deliquium, 1974
templinum, 1974
terebinthinæ, 1018
rectificatum, **1019**
terræ, 1974
theobromatis, 1040
thymi, 962
tiglii, 1039
vitriolo dulce, 917
Olibanum, 1030, 1219
oil, 986
Olive oil, 1036
castile soap, 1054
spurge, 1008
Oliver's bark, tincture, 401
Omal, 940, 1974
"One-cent-sale", 1380
Ononin, 1063
Ononis spinosa, 1063
Open chain hydrocarbons, 783
separatory funnel, 214
steam bath, 115
Operations, crucible, 110
requiring heat, 92
Operative pharmacy, 2
course, 1945
Opii et ipecacuanhæ pulvis compositus P. I., **479**
extractum P. I., **469**
pulvis, 1104
P. I., 1104
tinctura P. I., **377**
benzoici P. I., **378**
Opion, 1103
Opium, 1102
ammoniated tincture, 401
and camphor pills, **496**
and chalk powder, aromatic, **483**
and chloroform mixture, compound, **295**
and copaiba mixture, **294**
and gambir tincture, compound, **395**
and ipecac powder, **479**
syrup, **279**
tincture, **394**
and lead, lotion, **299**
pills, **497**
wash, **299**
and rhubarb mixture, compound, **295**
and sassafras mixture, 297
antidote, 1944
assay, 1498
compound powder, 484
deodoratum, 1112
deodorized, 1112
derivatives, unofficial, 1112
digitalis and quinine pills, **496**
extract, **469**
powdered, **469**
fluidextract, 442
granulated, 1104
assay, 1499
granulatum, 1104
liniment, **350**
compound, **348**
magnesia and asafetida mixture, **294**
powdered, 1104
assay, 1499
pulveratum, 1104
tincture, **377**
assay, 1499
camphorated, **378**
denarcotized, **377**
deodorized, **377**
vinegar, 361, 450
with saffron, **395**
assay, 1500
Opodeldoc, liquid, **346**
solid, **348**
Steers's, 1974
Opoponax, 1219
Opsonins, 1906
Optical rotation, 1524
Orange, 947
I, 841
bigarade, 953
bitter, 953
elixir, **318**
Orange color, 841
dimethylaniline, 1450
flavoring extract, 976
terpeneless, 976
flower water, **252**
triple, **252**
flowers, oil, 956
perfume, 1223
syrup, **266**
G, 854
infusion, **361**
compound, **361**
methyl, 1450
test solution, 1450
oil, 954
bitter, 956
sweet, 954
peel, bitter, 953
tincture, **367**
curaçao, 953
sweet, 953
tincture, **367**
spirit, compound, **308**
syrup, **266**
Orangite, 704
Orbicule, 249
Orbicules, 1691
Orchid, 1225
Orchidea, 1214
Orchis mascula, 892
Orcin, 854, 938
Orcinol, 854
Ordeal bean, 1131
Order book, 1331
Ordinary percolator, 235
Oregon grape root, 1156
Orellana, 1974
Orexin, 938
Organic acids, assay of alkali salts, 1514
incompatibility, 1647
chemicals, 779
chemistry, theory, 779
compounds, unofficial, 932
halogen compounds, 855
Organic-silver compounds, 874
Organization of business, 1269
Organizing administration, 1270
Organo-metallic compounds, 855
Organotherapy, 1170
Organs, animal, 1193
Orgeat syrup, **283**
Oridine, 865
Oriental perfume, 1224
Origanum marjorana, 986
Original entries, 1411
entry, 1393, 1411
book, 1393
Orizaba jalap root, 1086
Orizabin, 1086
Orleana, 1974
Ornithine, 1170
Orthoform, new, incompatibility, 1648
Orphol, 938
Orpiment, 764, 769
Orris, 1003, 1219
butter, 1003
Florentine, 1003
root, 1003
Verona, 1003
Orr's white, 1974
Orthin, 938
Ortho-arsenic acid, 764
Orthoarsenite copper, 769

Orthoboric acid, 1965
Orthocresol, 813, 815
Orthoform, 839, 938
new, 839, 937, 938
Orthohydrazin paraoxybenzoate, 938
Orthohydroxy benzoic acid, **824**
Orthonitrotoluene, 811
Orthophenolsulphonic acid, 939
Orthophosphate, monosodium, **631**
sodium, 643
Orthophosphoric acid, 585
Ortho-sulphamide-benzoic acid, 833
Orthotoluidene, 811
Orth's acid alcohol, 1574
Oryza, 1974
sativa, 883
Os sepiæ, 1974
Osmium, 532
Osmorhiza longistylus, 986
Osmosis, 184
Ossein, 1171
Ossium, acidum, 1965
Ouabain, 1537
crystallized, 1068
Ouabainum, 1068
Ourouparia gambir, 1096
Outline, pharmacy laboratory course, 1945
of business transactions, 1395
"O. V", 560
Ovarian residue, H. W. and D., 1201
L. and F., desiccated, 1201
Lederle, 1201
Wilson, 1201
substance, Armour, 1201
L. and F., desiccated, 1201
Wilson, 1201
Ovary, 1201
whole, Lederle, 1201
H. W. and D., 1201
Overheads, 1272, 1335
"Overs", 1331
Ovi albumen recens, 1186
vitellum recens, 1187
Ovis aries, 1042, 1043
Ovoferrin, 1204
Ovogal, 1185
Ovum gallinaceum, 1186
Oxalate, ammonium, 798, 1529
bismuth, 775
cerium, 705
diethyl, 175
ferrous, 732
manganese, 709
potassium, 798
silver, 747
sodium, 1541
Oxalic acid, 798, 885, 1537
antidote, 1941
tenth-normal, 1557
test solution, 1548
Oxalium, 1974
Oxazines, 841
Oxgall, 1184
extract, **459**
powdered, **459**
Oxide, aluminum, 703
antimonic, 761
antimonous, 761
antimony, **763**
assay, 1470
arsenous, **764**
Oxide, bismuth, 775
cadmium, 705
calcium, 671
antidote, 1941
ceric, 704, 705
cerous, 704
chromic, 734
cupric, 744
diphenyl, 1217
ethyl, 785, 904
ferric, assay, 1468
saccharated, **727**
assay, 1467
soluble, **727**
iron, magnetic, 732
red, 732
saccharated, syrup, **277**
soluble, syrup, **277**
lead, ointment, 508
red, **741**
assay, 1469
magnesium, **663**, 1536
assay, 1457
heavy, **663**
manganous, 706
-manganic, 706
mercuric, red, **758**, 1536
assay, 1461
yellow, **756**
assay, 1461
incompatibility, 1648
methyl, 781, 937
nickelic, 735
nickelous, 735
nitrous, **551**
purple, 1975
red mercuric ointment, **509**
silver, 747
incompatibility, 1649
strontium, 689
yellow mercuric, ointment **505**
zinc, **693**, 1543
assay, 1457
ointment, **507**
Oxidized terpenes, 1018
Oxidizing enzymes, 902
tooth powder, **486**
Oxone, 1974
Oxyacanthine, 1156, 1167
Oxybenzene, 791
Oxycarbonate, bismuth, **770**
Oxychinaseptol, 938
Oxychloride, bismuth, 775
Oxyconiine, 1158
Oxycresol, 806
Oxycyanide, mercuric, 759, 879
Oxy-di-methyl-chinizin, 1974
Oxygallate, bismuth, **771**
Oxygen, 532, 544
assay, 1482
Oxygenium, **544**
Oxyhydrate, ferric, 732
Oxyiodogallate, bismuth, 775
Oxymel æruginis, 1974
scillæ, **285**
squill, **285**
Oxynarcotine, 1105, 1107
Oxynitrate, bismuth, **772**
Oxyquinolin sulphate, 933
Oxysulphide, antimony, 763
Oxysulphuret, calcium, solution, **681**
Oxyuris vermicularis, 860
Ozazones, 893
Ozokerite, 1974

P

Package medicines, 1311
Packer, 237
Packing powders for percolation, 237
Pack tong, 1974
Padre Tranquille, 448
Painting show cards, 1384
Palacetyrus, 1974
Palaquium, blanco, 1029
Pale catechu, 1096
tincture, compound, **373**
rose, 1100
Palladium, 532
Palladous chloride, 1538
test solution, 1548
Palm oil, 1046
Palma Christi tree, 1039
Palmarosa, 1225
Palmitate, myricyl, 1191
Palmitic acid, 1191
Palmitin, 1032, 1037
Palsy drops, 376, 1974
Pan for moistening drugs, 236
Panacea mercurialis, 1974
Panaquilon, 1079
Panase, 1178
Panax, 1079
quinquefolium, 1079
Panchymagogum minerale (P. Quercetani), 1974
Pancreas, 1200
product, unofficial, 1200
Pancreatic ferments, incompatibility, 1648
solution, 1176
Pancreatin, 1175
powder compound, **483**, 1176
solution, 258, **1176**
Pancreatinum, 1175
Pancreon, incompatibility, 1648
Pansy, 1080
Pantopium hydrochloricum, 1113
Pantopon, 1113
Papain, 902
Papaver somniferum, 1046, 1102, 1164
Papaveraldine, 1105, 1106
Papaveramine, 1105, 1106
Papaverina, 1113
Papaverinæ hydrochloridum, 1113
Papaverine, 1105, 1113, 1164
hydrochloride, 1113
Papaveris fructus, 1164
Papaw, 1164
Papaya, 1164
Paper, barometer, 736
filter, quantitative, 1533
filters, 196
litmus, 1450
mustard, 520, **1755**
package, 1673
paraffined, 1760
parchment, 795
scale thermometer, 102
scored, 237
test, phenolphthalein, 1451
waxed, 1760
Papers, 522, 1751, 1755
Papoose root, 1073
Papyrus Eber's, 3
Para-aminophenol, 811
Paracetaldehyde, 929

Paracoto, 1017
fluidextract, 442
tincture, 401
Paracyanogen, 992
Paradiaminodiphenyl, 1530
Paradise grains, 1970
Paraffin, 799, 1059
chlorinated, 1060
dressing, 1060
hard, 1059
liquid, 1057
oil, 1057
ointment, 512
paper, 1760
scale, 1974
wax, 1059
waxes, 785
Paraffined paper, 1760
Paraffins, 785, 811
Paraffinum, 1059
chlorinatum, 1060
Paraform, **930**
Paraformaldehyde, **930**
as a disinfectant, 1870
solution, assay, 1454
Paraformaldehydum, **930**
Paraglobulin, 1204
Paraguay tea, 1100
Parahydroxybenzaldehyde, 1063
Para-hydroxyphenylethamine, 1130
Paraldehyde, 781, **929**
Paraldehydum, **929**
Paramenispermine, 1157
Para-methoxyacetanilid, 937
Paramorphine, 1105
Paranephrin, 1196
Paranitraniline, 811
Paranitrochlorobenzene, 811
Paranitrotoluene, 811
Parapectin, 945
Paraphenolsulphonate, aluminum, 939
Para rhatany, 1095
Parathyroid gland, 1202
desiccated, 1202
substance, desiccated, 1202
Paratoluene sulphonchloramide, sodium, **855**
sulphondichloramide, 856
Paratoluidine, 811
Parchment paper, 795
Paregoric, **378**
elixir, **378**
Pareira, 1161
brava, 1161
fluidextract, **434**
Paricine, 1114
Parigenin, 1072
Parilla, yellow, 1164
Parillin, 1072
Paris black, 1974
green, 769, 1974
antidote, 1943
plaster, 683
violet-6 B, 854
yellow, 1974
white, 1974
Parkesine, 1974
Parmcety, 1186
Parodyne, 1974
Parogen, 351
Parogenum, 249, 351
Parresine, 1060
Parsley fruit, 994
Parsley fruit oleoresin, **447**
oil, 986
poison, 1974
root, 970, 994
fluidextract, 442
Parsnip, cow, 970
Parthenine, 1167
Parthenium, 1017
hysterophorus, 1167
Partnership, 1247
limited, 1247
Parvoline, 1204
Parvula, 249
Parvules, 1691
Pasque flower, 1013
Pass book, 1279
Passiflora, 1162
incarnata, 1162
Passion flower, 1162
tincture, **396**
vine, 1162
Passive immunity, 1892
immunization, biological products for, 1900
Passulæ, 1974
minores, 1974
Pasta betanaphtholis, **516**
dextrinata, **516**
naphtholis, Lassar, **516**
resorcini mitis, Lassar, **516**
resorcinolis fortis, **516**
mitis, **516**
zinci, **517**
Lassar, **517**
mollis, **517**
Unna, **517**
sulphurata, **517**
Unna, **517**
Pastæ dermatologicæ, 516
Paste, betanaphthol, **516**
dextrin, 1623
dextrinated, **516**
flour, 1622
library, 889
naphthol, Lassar's, **516**
pencils, 524
resorcinol, mild, **516**
Lassar's, **516**
strong, **516**
stronger, Lassar's, **516**
zinc, **517**
Lassar's, **517**
soft, **517**
Unna's, **517**
sulphurated, **517**
Unna's, **517**
for tin, label, 1623
Pastes, 1745
dermatologic, 516
Pasteurization, 1784
Pasteurizing milk, 1790
Pastilles, 1697
Pastillus, 249
Pasting labels, 1622
Patchouli, 1219
Patchouly oil, 986
Patent, alum, 1966
and proprietary medicines, 1264
medicines, 1264
Paullinia cupana, 1160
sorbilis, 1166
Pavy's solution, 1571
Paytamine, 1114
Paytine, 1114
Pea, 883
Peach, 947
oil, 1046
Pear, 947
oil, 1974
-shaped separator, 214
Pearl coating, 1721
mold, 1683
moss, 1974
tapioca, 883
white, 1974, 1978
Pearlash, 1974
Pearls, 1678, 1682
Pearson's solution of arsenic, 637
sodium arsenate, 258
Peas, issue, 1971
Peat, 1758
Pebble or ball mills, 158
Pectase, 902, 945
Pectic compounds, 893
Pectin, 945
Pectinase, 902
Pectinous bodies, 945
Pectins, 885
Pectoral drops, **395**
Bateman's, **395**
expectorant, 296
species, **486**
syrup, **284**
tincture, 401
Pectose, 945
Peel, lemon, 955
fresh, 955
orange, bitter, 953
curaçao, 953
sweet, 953
Peganum harmala, 1164
Pelargonate, ethyl, 916, 935
Pelargonin, 840
Pelican, 132
Pelletierinæ tannas, 1146
Pelletierine, 1146
tannate, 1146
Pelletorin, 1017
Pellets, 1691, 1831
Pellicle, 224
Pellitory, 1008
root, 1008, 1017
Pelosine, 1161, 1167
Pen lettering, 1389
Penase, incompatibility, 1648
Pencils, medicated, 524
paste, 524
salicylic acid, **524**
Unna, 524
Pennyroyal, American, 964
European, 965
oil, 985
Pens for show cards, 1385
Pental, 932, 1974
Pentane, 785, 811, 938
Pentasulphide, antimony, 763
Pentavalent arsenic compounds, 867
Pentene, 932
Pentosanes, 893
Pentose reactions, 1570
Pentoses, 885, 893
Pentoxide, antimony, 761
phosphoric, 585
phosphorous, 585
Pepo, 1038
Pepper, 1004
African, 996
bird, African, 996
black, 1004

Pepper, cayenne, 996
confection, 489
Java, 995
Mexican, 996
oleoresin, 447
red, 996
Sierra Leone, 996
tailed, 995, 1977
Pepperette, 1974
Peppermint, 957
camphor, 959
crystals, 959
essence, 310
flavoring extract, 976
herb, 957
leaves, 957
oil, 957
assay, 1461
spirit, 310
troches, 499
water, 255
Pepperwood, 1015
Pepsin, 902, 1172
and bismuth elixir, 332
and capsicum tablets, compound, 1718
and iron, elixir, 338
and lime juice, 1177
bismuth and strychnine elixir 331
elixir, 331
compound, 331, 332
essence, 332, 1190
Fairchild, 1178
glycerite, 302
granular, 1172
purified, 1172
saccharated, 1173
scale, 1172
solution, 258, 1174
antiseptic, 258, 1174
aromatic, 258, 1174
spongy, 1172
Pepsinum, 1172
saccharatum, 1173
Peptids, 1170
Peptization, 186
Peptonate, iron, 728
solution, 729
Peptones, 1170, 1204
Peptonized iron, 728
assay, 1468
and manganese solution, 730
solution, 729
Peptonizing powder, 483, 1176
Peptonoids, dry, 1821
Perborate, sodium, 640
assay, 1474
Perborin, 1974
Per cent comparisons, 1423
divisions of drug business, 1327
Percentage factors in business, 1272
problems, 83, 84
Percentages, sales, expense, etc. 1424
Perchlorate, potassium, 616
Perchloric acid, 568
Perchloride, iron, 714
solution, 714
wool, 1762
mercury, 752
wool, 1763
Percolate, controlling flow of, 240
Percolates, receiving bottle for, 245
Percolating weight, 238
Percolation, 233, 365
divided, 404
extraction by, 233
fractional, 245, 404
in making syrups, 263
on the large scale, 242
sugar, 245
with hot extraction, 244
Percolator, conical, 235
copper, 243
double tube, 241
for volatile liquids, 445
Hardesty's vanilla, 244
narrow, 235
official, 234
Oldberg, 234, 235
ordinary, 235
plain, 235
pressure, 244
shape, 234
stand, 245
sugar, Hardesty, 263
suspended, 242
well tube (Squibb), 241
Percolators, methods for supporting, 245
special, 241
Percutaneous test, 1936
tuberculin test, 1935
Perfringens antitoxin, 1906
Perfume, carnation, 1221
cassie, 1221
chypre, 1227
cyclamen, 1221
extracts, concentrated, 1227
heliotrope, 1221
hyacinth, 1222
ideal, 1227
jacinthe, 1222
jasmine, 1222
lilac, 1222
lily-of-the-valley, 1223
L'origan, 1227
orange flowers, 1223
oriental, 1224
products manufactured, 1227
rose, Bulgarian, 1224
French, 1224
structure, 1220
violet, 1224
white rose, 1224
Perfumed flowers, 1209
powder, 1234
spirit, 313, 1228
woods, 1209
Perfumery, alcohol for, 1227
and cosmetics, 1207
aromatic chemicals used in, 1210
art, 1207
books on, 1243
compounds, synthetic, 1217
material, synthetic, 1210
materials, source, 1208
synthetic, 953
Perfumes, 1351
dyes suitable for, 1219
Perhydrol, 550
Periodic acid, 568
system, Mendelejeff's, 528
Perkin's purple, 841
Permanent white, 686, 1974, 1978
Permanganate, potassium, 612, 706, 1540
assay, 1475
incompatibility, 1649
zinc, 698
Permitted colors, 841
Permutit, 1974
Pernambuco Jaborandi, 1138
Peroxidase, 902
Peroxide of hydrogen, 257
solution, 548
lead, 1535
zinc, 697
Peroxides, incompatibility, 1648
Perpetual pills, 1974
Persic oil, 1239
Persica vulgaris, 1046
Persimmon, 1100
Persio, 844
Personal account, 1407
ledger, 1402
Perspiration preventatives, 701
Persulphate, iron, solution, 731
Pertussis bacterin, 1919
serobacterin, 1921
vaccine, 1919
Peru balsam, 1024, 1219
Peruvian balsam, 369
bark, 1113
rhatany, 1095
Pessarium, 249
Pessum, 249
Pests, household, their elimination, 1833
Petalite, 644
Petit-grain mandarine oil, 1216
oil, 1223
Petrol, 1974
Petrolatum, 1058
-agar emulsion, 887, 1058
compound, 1058
album, 1059
amber, 1058
emulsion, 290
liquid, 1057
liquidum, 1057
saponatum liquidum, 352
spissum, 353
white, 1059
Petrolatums, 785
Petrolene, 1974
Petroleum benzin, 96, 785, 1531
as a solvent, 174
purified, 1061
crude, 1056
ether, 1060, 1061
jelly, 1058
white, 1059
products, 1032, 1056
Petrolina, 1059
Petromortis, 588
Petroselini radix, 970
Petroselinum sativum, 970, 986, 994
Petrox, liquid, 352
mercury, 351
solid, 353
Petroxolin, betanaphthol, 352
cade, 352
camphorated chloroform, 352
eucalyptol, 325
guaiacol, 352
iodine, 353

Petroxolin, iodine, diluted, **353**
liquid, **352**
menthol, **353**
mercury, **351**
methyl salicylate, **353**
phenol, **353**
camphorated, **353**
solid, **353**
sulphonated bitumen, **352**
sulphurated, **353**
compound, **353**
Petroxolina, 351
medicata, **352**
Petroxolins, 351
medicated, **352**
Petroxolinum betanaphtholis **352**
bitumenis sulphonati, **352**
cadinum, **352**
chloroformi camphoratum **352**
eucalyptolis, **352**
guaiacolis, **352**
hydrargyri, **351**
iodi, **353**
dilutum, **353**
iodoformi, 864
liquidum, **352**
mentholis, **353**
methylis salicylatis, **353**
phenolis, **353**
camphoratum, **353**
spissum, **353**
sulphuratum, **353**
compositum, **353**
Peumus boldus, 1165
Pewter, 1974
Phalaris, 1974
Pharmaceutical arithmetic, 72
books, 1625
ethics, principles of, 9
furnaces, 93
preparations, 247
products, 1342
stills, 141
Pharmaceuticals, stock, 1614
Pharmacist, as an analyst, 1427
in community health service, 1833
manufacturing, 1577
professional and prescription, 1587
Pharmacist's responsibility under the law, 1245
Pharmacodynamics, definition, 2
Pharmacognosy, definition, 1
Pharmacology, definition, 2
Pharmacopœial preparations, 23
Pharmacopœias and standard books on pharmacy, 14
official, 14
Pharmacy, arithmetic of, 72
business requirements, 1267
history and scope of, 1
homeopathic, 1825
laboratory course, 1945
report, 1946
law, model, 1251
manufacturing course, 1945
operative, 2
practical, 2
theoretical, 1
Phase, continuous, 1655
dispersed, 1655
Phase, external, 1655
internal, 1655
Phaseolus vulgaris, 883
Phasianidæ products, official, 1186
Pheasant's eye, 1072
Phellandrene, 955
Phellandrium, 970
oil, 986
Phenacaina, 838
Phenacaine, 838
Phenacetin, 828
incompatibility, 1648
urethane, 940
Phenacetinum, 828
Phenamin, 938
Phenanthrene, 811, 1101
Phenates, 1974
Phenazone, 830
Phenetidin acetosalicylate, 938
amygdalate, 932
Phenetol, 1974
Phenic acid, 1965, 1974
Phenmethylol, 837
Phenobarbital, 925
sodium, 926
Phenobarbitalum, 925
Phenoco, 816
Phenocoll, 1974
hydrochloride, 938
incompatibility, 1648
salicylate, incompatibility, 1648
Phenol, 791, 799, 804, **816**, 1538
antidote, 1943
as a disinfectant, 1875
assay, 1468
chloral, 933
coefficient, 813, 818
disulphonic acid test solution, 1548
ethers, 1217
glycerite, **301**
incompatibility, 1648
iodatum, **820**
iodized, **820**
liquefactum, **819**
liquefied, **819**
assay, 1468
ointment, **506**
petroxolin, **353**
camphorated, **353**
red, 543, 846, 1451
test solution, 1451
Phenolate, sodium, 643
Phenolated gauze, **1761**
iodine solution, 258
oil, **355**
solution of iodine, **578**
water, **256**
Phenoli solutio P. I., **256**
Phenolin, 1974
Phenolphthalein, **821**, 1451
-agar, 887
dyes, 846, 850
tablets, **500**
test paper, 1451
solution, 1451
troches, 499
Phenolphthaleinum, **821**
Phenols, 811
Phenolsulphonate, calcium, 683
magnesium, 670
sodium, 643
zinc, **696**
assay, 1479
Phenolsulphonate, zinc and iodine solution, **578**
Phenolsulphonic acid, 938
Phenolsulphonphthalein, 822, 846, 938, 1451
dyes, unofficial, 846
Phenolsulphonphthaleinum, 822
Phenoltetrachlorphthalein, 847
Phenoltetrachlorphthaleinum, 847
Phenosal, 938
Phenosalyl, 938
Phenosuccin, 939
Phenyl, 791
Phenylacetamide, 829
Phenylacetate, ethyl, 1215
isobutyl, 1216
Phenylacetic acid, 1211
aldehyde, 1213
Phenylalanine, 1170
Phenylbenzamide, 932
Phenyl-coumarin, 1017
Phenyldihydro-chinazolin hydrochlorate, 938
Phenyldimethyl-pyrazolon, 830
Phenylethyl acetate, 1216
alcohol, 1212
butyrate, 1216
formate, 1217
malonylurea, 925
propionate, 1217
Phenylethylic alcohol, 1226
Phenylformamide, 936
Phenylformic acid, 1965
Phenylglycolic acid, 1135
Phenylhydrazine, 893, 938, 1538
Phenylhydrazin-levulinic acid, 932
Phenyl hydroxide, 791
Phenylic acid, 1974
Phenylis salicylas, **826**
Phenylmethyl acetate, 1216
butyrate, 1217
Phenylone, 1974
Phenyl-propyl cinnamate, 1026
-quinoline-carboxylic acid, 1125
salicylate, **826**
incompatibility, 1646, 1648
urethane, 935
Phenylpropylic alcohol, 1226
aldehyde, 1214
PH factor, 542
Philligenin, 1063
Phillyria latifolia, 1063
Phillyrin, 1063
Philosopher's stone, 7
Philosophy, natural, definition 1
Phlobaphene, 1161
Phlobaphenes, 1091
Phloretin, 1063
Phlorizin, 1063, 1079
Phloroglucin, 938
Phloroglucinol, 1538
test, solution, 1548
Phloroglucol, 938
Phlorhizin, 1079
Phlorol, 799, 804, 806
Phoca, 1205
Phœretin, 1083
Phosgene, 1974
Phosphate, aluminum, 703
ammonium, **658**
bicalcic, 1967
bismuth, 775

Phosphate, bone, 629
calcium, precipitated, 680
codeine, 1110
assay, 1458
ferric, and gentian elixir, 327
elixir, 337
soluble, 719
assay, 1467
white, 732
with sodium nitrate, 719
lithium, 648
silver, 747
sodium, 629, 1541
assay, 1463
compound solution, 642
dihydrogen, 631
effervescent, 630
exsiccated, 631
assay, 1463
tribasic, 643
trisodium, 643
Phosphates, 586
compound syrup, 279
iron, quinine and strychnine, syrup, 276
solution, compound, 683
acid, 682
syrup with quinine and strychnine, 280
tests for, 586
Phosphatic emulsion, 291
Phosphide, calcium, 1968
zinc, 698
Phosphoproteins, 1170
Phosphorated oil, 355
resin, 581
rosin, 581
Phosphoric acid, 562, 1538
antidote, 1940
assay, 1463
diluted, 563
assay, 1463
syrupy, 562
pentoxide, 585
Phosphorite, 629
Phosphorous acid, 581, 585
pentoxide, 585
solution, 258
trioxide, 585
Phosphorus, 532, 580, 585
and nux vomica, elixir, 333
antidote, 1944
Baldwin's, 1967
elixir, 332
pills, 491
red, 585
solution, 587
Thompson's, 587
spirit, 315, 581
trioxide, 585
Phosphotungstic acid, 1538
Photophor, 1974
Photoxylin, 1974
Phthalate, cotarnine, 939
Phthalic acid, 832, 938
Phycoerythrin, 841
Phyllis amara, 1974
Phynin, 1205
Physeter macrocephalus, 1186, 1203, 1205
Physical constants, 1524
incompatibility, 1627
properties of urine, 1436
Physicians, detailing, 1365
relations to, 1300
Physics, definition, 1
Physiologic testing laboratory, 1578
salt solution, 257, 1795
solution sodium chloride, 257, 627, 1795
standardization, definition, 2
Physostigma, 1131
antidote, 1944
extract, 470
tincture, 401
venenosum, 1131, 1132
Physostigminæ salicylas, 1132
Physostigmine, 1131
salicylate, 1132
hypodermic tablets, assay, 1502
sulphate hypodermic tablets, assay, 1502
Phytase, 902
Phytolacca, 1078
antidote, 1944
decandra, 1017, 1031, 1078
fluidextract, 434
Phytolaccæ fructus, 1017
Phytolaccic acid, 1078
Phytolaccine, 1078
Pickling acid, 1965
Picramate, sodium, 811
Picramnia, 1073
Picrasma excelsa, 1064
Picrasmin, 1065
Picrate, butesin, 839
Picric acid, 811, 822, 1538
gauze, 1758, 1761
test solution, 1549
gauze, 1761
Picropodophyllin, 1086
Picrorhiza fluidextract, 442
tincture, 401
Picrotoxin, 1079, 1157
antidote, 1944
Picrotoxinum, 1079
Pigmentum, 249, 525
Pill bearing spurge, 1028
blue, 488, 749
box, hinged lid, 1697
excipients, 1692
finisher, 1695
machines, 1694
mass rollers, 1691
pestle, 1690
of ipecacuanha with squill, 497
with urginea, 497
of quinine sulphate, 497
sifter, 1695
spatula, 1694
tile, 1693
Pills, 489, 1690, 1691
Aitkin tonic, 496
aloe, 490
and asafetida, 491
iron, 492
mastic, 492
myrrh, 492
podophyllum compound, 492
mercury and podophyllum, 493
and scammony compound, 497
aloin, compound, 493
strychnine and belladonna, 493
compound, 493
antidyspeptic, 497
Pills, antimony, compound, 497
antiperiodic, 494
without aloe, 494
asafetida, 490
and aloe, 491
belladonna, aloin and strychnine, 493
compound, 493
Blancard's, 1967
Blaud's, 490
calomel, compound, 491
camphor and opium, 496
cathartic, vegetable, 494
chalybeate, 490
coating, 1720
colocynth and hyoscyamus, 497
and podophyllum, 497
compound, 497
compound cathartic, 491
compressed, 1704
digitalis, squill and mercury, 494
dinner, Chapman's, 497
Cole's, 497
Lady Webster, 492
Hall's, 497
dispensing, 1697
enteric, 826, 1731,
external, 1974
ferrous carbonate, 490
assay, 1472
iodide, 495
ferruginous, 490
friable, 1697
general excipient, 1693
Guy's, 494
ipecac with squill, 498
with urginea, 498
iron and aloe, 492
quinine, aloe and nux vomica, 495
strychnine and arsenic, mild, 496
stronger, 495
Janeway's, 492
laxative, compound, 490
lead and opium, 497
mastic and aloe, 492
mercury, aloe and podophyllum, 493
squill and digitalis, 494
metallic, 495
bitter, 495
mild mercurous chloride, compound, 491
myrrh and aloe, 492
Niemeyer's, for dropsy, 494
Niemeyer's, for phthisis, 496
nitroglycerin, 497
opium and camphor, 496
and lead, 497
digitalis and quinine, 496
perpetual, 1974
phosphorus, 491
podophyllum, aloe and mercury, 493
and aloe, compound, 492
post partum laxative, 497
pulverous, 1697
quadruple, 495
quinine sulphate, 498
rhubarb, 497
compound, 497
Rufus's, 1975
soap, compound, 498

Pills, squill, compound, 498
digitalis and mercury, 494
strychnine, aloin and belladonna, 493
compound, 493
sugar coating, 1722
triplex, 493
unofficial, 497
urginea, compound, 498
vegetable cathartic, 494
Warburg's, 494
without aloe, 494
Pilocarpinæ hydrochloridum, 1139
nitras, 1139
Pilocarpine, 1138
antidote, 1944
chloride, 1139
hydrochloride, 1139
hypodermic tablets assay, 1502
nitrate, 1139
Pilocarpus, 1138
fluidextract, 442
Jaborandi, 1138
microphyllus, 1138
pinnatifolius, 985
Pilula comprimata, 249
enterica, 249
triplex, 493
Pilulæ, 489, 1691
ad prandium, 497
aloes, 490
et asafœtidæ, 491
ferri, 492
masticbes, 492
myrrhæ, 492
podophylli compositæ, 492
hydrargyri et podophylli, 493
scammonii compositæ, 497
aloini compositæ, 493
strychninæ et belladonnæ, 493
compositæ, 493
antidyspepticæ, 497
antimonii compositæ, 497
antiperiodicæ, 494
sine aloe, 494
asafœtidæ, 490
catharticæ compositæ, 491
vegetabiles, 494
colocynthidis compositæ, 497
et hyoscyami, 497
podophylli, 497
digitalis, scillæ et hydrargyri, 494
ferri carbonatis, 490
iodidi, 495
et quininæ compositæ, 495
quininæ, aloes et nucis vomicæ, 495
strychninæ et arseni fortiores, 495
mites, 496
glycerylis nitratis, 497
hydrargyri chloridi mitis compositæ, 491
ipecacuanhæ cum scillæ, 497
urgineæ, 498
laxativæ compositæ, 496
post partum, 498
metallorum, 495
amaræ, 495
Pilulæ opii, digitalis et quininæ, 496
et camphoræ, 496
plumbi, 497
perpetuæ, 761
phosphori, 491
quadruplices, 495
quininæ sulphatis, 498
rhei, 497
compositæ, 497
saponis compositæ, 498
scillæ compositæ, 498
triplices, 493
urgineæ compositæ, 498
Pilular extract belladonna, 455
hyoscyamus, 460
stramonium, 463
extracts, 453, 1487
Pilules, 1831
Pimenta, 975
acris, 975
officinalis, 975
oil, 975
assay, 1483
Pimpernel root, 1006
Pimpinella tincture, 401
anisum, 968
magna, 1006
saxifraga, 1006
Pinchcocks, 140
Pine bark, white, 1029
digger, 948
needles oil, dwarf, 1021
assay, 1461
oil, dwarf, 1021
rosin, Georgia, 1021
yellow, 1021
tar, 804
syrup of, 268
white, compound syrup of, 280
with morphine, 280
Pineal gland, desiccated, 1203
Pineapple, 947
oil, 1215
Pinene, 955, 961, 963, 979, 1001
Pinguedo, 1974
Pinguoleum, 1974
Pinipicrin, 1005, 1063
Pink chalk, 1234
Indian, 1971
root, 1164
salt, 1974
Pinus alba, 1029
montana, 1021
palustris, 471, 804, 1018, 1021
pumilio, 985
sabiniana, 948
strobus, 1029
Pipe gamboge, 1085
Piper, 1004
angustifolium, 986, 1003
cubeba, 995
methysticum, 1006, 1028
nigrum, 1004
Piperazine, 939
incompatibility, 1648
quinate, incompatibility, 1649
Piperic acid, 1004
Piperidine, 1004
Piperine, 1004, 1167
Piperonal, 1213, 1974
Piperonylic acid, 1017
Pipette, graduated, 214
Pipette, measuring, 214
minim, 53
specific gravity, 66
with sheet rubber top, 214
Pipettes, 214
Pipsissewa, 1098
Picro-crosin, 1076
Piscedia erythrina, 1079
Pisces, class, 1205
official product, 1187
Pisselæum indicum, 1974
Pistacia lentiscus, 1028
Pisum sativa, 883
Pitch, black, 805
Burgundy, 1030
oil, 985
Canada, 1030
Jews', 1971
Pitchblende, 684, 734
Pith, sassafras, 890
Pituglandol, 1195
Pituitarium, 1193
Pituitary, 1193
body, desiccated, 1195
extract, 1194
solution, 1195
liquid, 1195
powdered, standard, 1194, 1511
preparations, unofficial, 1195
solution, 257, 1193–1195
assay, 1510
substance, desiccated, 1195
Pituitol, 1195
Pituitrin, 1193, 1195
surgical, 1195
Piturine, 1167
Pix Burgundica, 1030
Canadensis, 1030
carbonis, 811
liquida, 804
lithanthracis, 811
pini, 804
Plague bacterin, 1919
disinfection, 1887
vaccine, 1919
Plain agar-agar, 1575
bouillon, 1575
bulb blowpipe, 109
filter, 196, 197
double, 197
funnel, 200
gelatin, 1575
percolator, 235
receivers, 136, 137
retort, 132
charging, 138
Plaited filter, 197
Planning window display, 1370
Plantain oil, water, 1005
water, 1005
Plasma, 249, 300, 1974
Plaster, adhesive, 518, 1751
rubber, 518
arnica, 521
back, 1754
belladonna, 518, 520, 521, 1752
and capsicum, 521
green, 520
blister, 521
breast, 521, 1754
brown, camphorated, 520
calcined, 1968
cantharides, 519, 521, 1752
cantharidin, 520

Plaster, capsicum, 519–521, 1752
elastic, 520
chest, 1754
common, **519**
compound salicylic, 521
stronger salicylic, 521
diachylon, **519**, 1974
elastic adhesive, 520
iron, 1753
lead, **519**, 521
oleate, **519**, 1752
left ear, 1754
menthol, 521
mercurial, 521
mercury, 521
mild cantharidin, 520
mother, camphorated, **520**
mustard, **520**, 1753
Nuremberg, 1974
of Paris, 683
bandages, 1759
resin, 521
right ear, 1754
rubber adhesive, 1751
salicylic acid, 521
and cannabis indica, 521
elastic, 521
shoulder, 1754
side, 1754
soap, **520**, 521
strengthening, 521
surgeons' adhesive, 1751
thapsia, 521
warming, **520**
zinc oxide, 521
Plasters, 518, 1751
dispensing, 1753
manufacturers' standards, 521
mustard, 992
spreading, 1753
unofficial, 520
Plate glass insurance, 1288
Platinic chloride, 1538
test solution, 1549
Platinocyanide, potassium, 616
Platinum, 532, 777
and sodium chloride, 643
crucible, 110
dish, 1490
salts, tests for, 777
Plattner's blowpipe, 109
Pleurisy root, 1010
Plum, 947
Plumbago, 1974
Plumbi acetas, **737**
bromidum, 742
carbonas, 742
chloridum, 742
chromas, 742
dioxidum, 742
hydroxidum, 742
iodidum, **740**
monoxidum, **739**
nitras, 742
oxidum, **739**
rubrum, **741**
saccharas, 742
sulphas, 742
Plumbum, 737
album, 1974
scytodepsicum, 1974
Plutonium, 1974
Pneumin, 939
Pneumococcus antibody solution, 1911
antigen modified, 1919
Pneumococcus bacterin, 1919
serobacterin, 1921
vaccine, 1919
Pneumonia disinfection, 1885
Pocket alcohol stove, 95
Podophyllin, **473**, 1030
acid, 1086
Podophyllotoxin, 1086
Podophyllum, 1086
aloe and mercury pills, **493**
and aloe pills, compound, **492**
extract, **470**
fluidextract, 442
peltatum, 1086
resin, **473**
tincture, 401
Indian, 401
Pogostemon patchouly, 986
Poison bottle, 1666
closet, 1604
hemlock, 1158
ivy, 1080
labels, 1249
nut, 1974
parsley, 1974
tablets, corrosive mercuric chloride, 500
assay, 1479
tobacco, 1974
Poisonous substances, labeling, 1621
Poisons, 1248, 1256
antidotes, 1939
deadly, 1249
Poivrette, 1974
Poke berries, 1017
root, 1078
Polianthes tuberosa, 986
Policy, insurance, 1285
Poliomyelitis, disinfection, 1885
Polish, French, 1970
Polishing machines, 1723
Pollen allergens, 1927
antigens, 1927
atopens, 1927
extracts, 1927
hay fever, 1928
grains, absinth wormwood, 1928
of black walnut, 1930
marsh elder, 1928
Pollenin, 794
Polonium, 685
Polygala senega, 1072
Polygalic acid, 1072
Polygonum bistorta, 1100
Polymeric isomerism, 781
Polymers, 781
Polyneuritis, 1168
Polypharmacy, 3
Polyporus officinalis, 1026
Polysaccharides, 893
Polyterpenes, 791, 948
Poma aurantii, 1974
Pomades, 1209
Pomatum, 249
Pomegranate, 947, 1146
bark, 1146
fluidextract, **412**
Pompholix, 1974
Pompholyx, 694
Ponceau, 841
Pongamia glabra, 1045
Poplar buds, balsam, 1005
black, 1005
willow, 1005
Poppy capsules, 1164
horn, 1164
seed oil, 1034
syrup, 284
Populi gemmæ, 1005
Populin, 1063
Populus, 1070
balsamifera, 1005
nigra, 1005
tremuloides, 1031
Porcelain clay, 593
evaporating dish, 125
jar, 1746
press, 226
stirrer, 126
Porous alum, 1966
Porphyrosine, 1163
Porpoise oil, 1205
Portable agitator, 172
furnace, 94
Poryphyrine, 1163
Posology, definition, 2
Post dating, 1280
partum laxative pills, 497
Postal saving bank, 1284
Pot mill, 159
Potable water, 546
Potash, 596
by lime, 597
caustic, **597**
antidote, 1941
Potassa by alcohol, 598
barytes, 598
solution, **599**
sulphurata, **595**
sulphurated, **596**
assay, 1482
Potassii acetas, **600**
antimonias, 615
bicarbonas, **600**
bisulphas, 615
bisulphis, 615
bitartras, **601**
bromidum, **602**
carbonas, **604**
chloras, **604**
chloridum, **613**
chromas, 616
citras, **605**
effervescens, **607**
cyanidum, 616
dichromas, 616
et sodii tartras, **608**
ferricyanidum, 616
ferrocyanidum, 616
hydrargyri iodidum, 616, 760
hydroxidum, **597**
hypophosphis, **614**
iodas, 616
iodidum, **609**
iodohydrargyras, 616
nitras, **611**
nitris, 616
perchloras, 616
permanganas, **612**, 706
platinocyanidum, 616
salicylas, 616
silicas, 616
sulphas, **615**
sulphidum, 616
sulphis, 616
sulphocyanas, 616
tartras, 616
Potassio-mercuric iodide, **616**
Potassium, 532, 596
acetate, **600**, 1538

Potassium acetate and buchu, elixir, 320
buchu and juniper elixir, 320
and juniper, elixir, 338
assay, 1456
elixir, 338
test solution, 1549
alum, 698
arsenite solution, 257, 766
assay, 1471
incompatibility, 1650
bicarbonate, 600, 1538
assay, 1455
binoxalate, 798
bisulphate, 1538
bisulphite, 615
bitartrate, 601, 1538
and sulphur tablets, 502
troches, 499
assay, 1453
bromate, 1539
bromide, 602
and chloral mixture, compound, 293
assay, 1462
elixir, 333
compound effervescent salt, 603
effervescent salt, 477
with caffeine, effervescent, 603
cadmium iodide, 1531
carbonate, 604, 1539
anhydrous, 1539
assay, 1455
incompatibility, 1649
test solution, 1549
chlorate, 604, 1539
assay, 1475
troches, 499
chloride, 613, 1539
assay, 1463
chromate, 616, 1539, 1974
test solution, 1549
citrate, 606, 1539
assay, 1456
effervescent, 607
solution, 257, 607
assay, 1455
cyanide, 616
antidote, 1944
incompatibility, 1648
dichromate, 616, 1539
incompatibility, 1648
solution, 1775
tenth-normal, 1557
test solution, 1549
ferricyanide, 616, 1539
test solution, 1549
ferrocyanide, 616, 1539
test solution, 1549
guaiacol sulphonate, 940
hydrate, 597
hydriodate, 1974
hydroxide, 597, 1539
alcoholic, half-normal, 1558
antidote, 1941
assay, 1459
dekanormal, 598, 1558
normal, 1558
solution, 257, 599
assay, 1459
test solution, 1549
alcoholic, 1549
Potassium hyperoxymuriate, 1974
hypophosphite, 614
assay, 1464
incompatibility, 1648
iodate, 616
iodide, 609, 1540
assay, 1462
liniment with soap, 350
ointment, 508
solution, 258, 610
assay, 1463
saturated, 610
test solution, 1549
with soap, liniment, 350
iodohydrargyrate, 616
mercuric iodide, 616, 760
metantimonate, 615
nitrate, 611, 1540
assay, 1463
incompatibility, 1649
paper, 523
nitrite, 616, 1540
oxalate, 798
perchlorate, 616
permanganate, 612, 703, 1540
assay, 1475
disinfectant, 1875
incompatibility, 1649
tenth-normal, 1559
test solution, 1549
solution, 260
platinocyanide, 616
quadroxalate, 798
rhodanate, 1974
salicylate, 616
salts, 596
tests for, 596
unofficial, 615
silicate, 616
sodium tartrate, 608, 1538
assay, 1456
sulphate, 615, 1540
assay, 1479
test solution, 1549
sulphethylate, 939
sulphide, 616
sulphite, 616
sulphocyanate, 616, 993, 1540
test solution, 1549
tartrate, 616
and antimony, assay, 1470
thiocyanate, 1540
tenth-normal, 1560
test solution, 1549
Potato, 883
spirit, 1974
starch, 1542
sweet, 883
Potentilla, 1100
Canadensis, 1100
Potentiometer, 542, 543
Potio, 249
lavativa Viennensis, 361
Riverii, 641
Potpourri, 1230, 1974
Potstone, 1974
Potus, 249
Poultice, emollient, 485
linseed, 518
mustard, 518, 1753
slippery elm, 518
spice, 482, 517
starch, 518
and boric acid, 518
Poultices, 517
Poultices, unofficial, 518
Powder, acetanilid compound, 481
algaroth, 1966, 1974
almond compound, 484
aloes and canella, 481
anise, compound, 484
antimonial, 481
antiseptic, 481
soluble, 481
aromatic, 482
bayberry, compound, 483
boxes, 1676
butea seed, 484
canella and aloes, 481
catechu, compound, 484
chalk and opium aromatic, 483
aromatic, 482
compound, 478
cinnamon, compound, 484
coarse, 170
cocoa, 1044
composition, 387, 483
compound opium, 484
diaphoretic, 480
digestive, 1974
compound, 484
Dover's, 479
syrup, 279
tincture, 394
effervescing, compound, 478
assay, 1456, 1457
face, flesh, 1234
liquid, 1235
naturelle, 1234
white, 1234
fine, 170
fineness, 169
folder, 1676
gambir, compound, 484
glycyrrhiza compound, 479
gray, 750
Gregory's, 480
ipecac and opium, 479
compound, 479
jalap, compound, 480
James', 481
kaladana, compound, 484
kino and opium, compound, 484
licorice compound, 479
measure adjustable, 1674
mild mercurous chloride and jalap, 483
moderately coarse, 170
moistening, 236
morphine compound, 484
opium and ipecac, 479
pancreatin compound, 483, 1176
peptonizing, 483, 1176
perfumed, 1234
rhubarb and magnesia, anisated, 484
compound, 480
scammony compound, 484
Seidlitz, 478
spatula, 1675
spice, rubefacient, 482
sublimates, 147
talc, boro-salicylated, 484
compound, 484
talcum, 593
borated, white, 1235
violet, 1235

Powder, talcum (with zinc stearate), 1236
tooth, 486
oxidizing, 486
tragacanth, compound, 484
Tully's, 484
very fine, 170
Vienna, 1978
Powdered camphor, 986
cocoa, 1044
compound extract colocynth, 459
extract belladonna, 455
cascara sagrada, 457
colchicum, 457
colocynth, 458
euonymus, 466
hydrastis, 467
hyoscyamus, 461
ignatia, 467
krameria, 468
leptandra, 468
nux vomcia, 462
opium, 469
oxgall, 459
rhubarb, 463
stramonium, 464
extracts, 454, 1487
milk emulsions, 1661
opium, 1104
assay, 1499
pituitary, standard, 1194, 1511
protein milk, 1822
Powders, 478, 1672
dispensing, 1672
dividing and folding, 1675
dusting, 1695
iodine, 578
emulsifying, 1660
extemporaneous, 1672
face, 1233
fineness of, 1493
packing for percolation, 237
scouring, 1052
talcum, 1235
unofficial, 484
Practical applications of specific gravity, 80
pharmacy, 2
"Practically insoluble", 175
Practice of pharmacy, laws governing, 1250
Prairie anemone, 1013
Praseodymium, 532
Prayer and oath of Maimonides, 5
Pre-approach in sales, 1382
Precipitant, definition, 216
Precipitate, definition, 216
red, 758
white, 751
ointment, 504
yellow, 1978
Precipitated calcium carbonate, 674
assay, 1473
phosphate, 680
chalk, 674
ferrous sulphate, 721
sulphur, 583
assay, 1480
zinc carbonate, 697
Precipitating jar, 216
Precipitation, 186, 216
of barium sulphate, 1479
Precipitation, methods of effecting, 216
vessels, 216
Precipitates, collecting and washing, 217
Précipité blanc, 1974
Precipitins, 1906
Premium, 1285
Premna arborea, 1163
Prepared cacao, 1044
calamine, 697
assay, 1458
chalk, 675
assay, 1472
emulsions, 1657
suet, 1043
Preparing salt, 1974
Preparation of extracts, 453
Preparations of the Pharmacopœia, 23
Prescription and professional pharmacist, 1587
balance, torsion, 47
Troemner's, 46
balances, 44
binding, 1619
bottles, 1603, 1662
box scales, 46
checking, 1614
compounding, 1614
counter, 1602
department, 1311, 1323
fakes, 12
filing, 1619
filling, 1600
liability for error, 1248
rules, 1615
form of, 1588
label, 1612
parts of, 1588
preserving, 1619
prices, 1617
pricing, 1615
reading, 1607
service, 1340
sieve, 1674
weights, 50
troy, 50
Prescriptions and formulas, 89
for alcoholic liquors, 1248
narcotics, 1248
gravimetric, 1594
homeopathic, 1828
incompatible, 1629
metric, 1594
preservation, 1248
typical, 1804
volumetric, 1594
Preservaline, 1975
Preservation, emulsions, 1661
extracts, 453
fluidextracts, 405
infusions, 359
prescriptions, 1248
syrups, 264
Preserving cerates, 1746
ointments, 1746
prescriptions, 1619
Press, double screw, 226, 227
enterprise, 226
filter, 209
Gigot's, 225
hydraulic, 227, 228
hydrostatic, 227
lever, 227
Press, porcelain, 226
roller, 226
screw, 225
single screw, 225, 226
spiral twist, 225
wedge, 227
Presses, filter, 229
Pressing corks, 1669
Pressure filtration, 203
percolator, 244
steam under, 115, 116
without, 115
boiler, 119
Preston's salts, 1975
Previous maceration, 238
Price buyer, 1366
card, 1388
cutting, 1378
maintenance, 1379
Pricing codes, 1332
merchandise, 1332
prescriptions, 1615
Prickly ash bark, 1015
berries, 1015
Primary alcohols, 786
amine, 783
Primeverose, 893
Primrose, 1017
evening, 891
Primula, 1017
officinalis, 1017
Principles, pharmaceutical ethics, 9
proximate, 779
ultimate, 780
Prinos, 1079
verticillatus, 1079
Private banks, 1284
Privet, 1079
Egyptian, 1969
Problems, arithmetical, 74, 77, 79, 80, 81, 83, 91
percentage, 83, 84
Procainæ hydrochloridum, 835
nitras, 838
Procaine base, 838
hydrochloride, 835
hypodermic tablets, assay, 1502
solution, 836, 258
sterile solution, 1801
nitrate, 838
Processes, assay, 22
Profession and business, 1267
Professional and prescription pharmacist, 1587
prestige, 1267
Profit and loss statement, 1410, 1419
figuring, 1336, 1337
Profits, 1378
in relation to first costs and overheads, 1335
Proflavina, 851
Proflavine, 851
Proganol, 876
Prohibition Act, obligation of physician, 1262
retail pharmacist, 1261
Promissory notes, 1281
Promoting prescription service, 1340
sale of confectionery, 1346
hospital supplies, 1343
perfumers, 1351

Promoting sale of pharmaceutical products,1342
rubber goods, 1344
school supplies, 1347
stationery, 1347
toilet articles, 1351
tobacco products, 1344
soda fountain, 1347
Proof spirit, 907
Propane, 785
Propanone, 786, 1975
Propenal, 1975
Propene, 799
glycol, 786
Propheretin, 1063
Prophetin, 1063
Prophylactic ointment, **508**
Propionate, gyranyl, 1215
phenylethyl, 1217
Propionic acid, 799
Propionitrile, 934
Propionyl, ethyl, 175
-phenetidin, 940
Proponol, 934
Proportion, arithmetical, 81
Proposote, 809
Proprietary and patent medicines, 1264
medicines, 1264
remedies, report of A. Ph. A committee, 12
Propylamine, 1017
Protamins, 1170
Protan, 1094
Protargentum-Squibb, 876
Protargin, mild, 876
strong, 874, 875
Protargol, 876
incompatibility, 1649
Proteases, 902
Protective colloids, 186
Protectives, 1760
Proteids, 1170
Protein and colloidal combinations of silver, 745
extracts, bacterial, 1931
food, 1929
miscellaneous, 1930
foods, 1820
mild silver, 876
milk, dry, 1822
powdered, 1822
mixtures for diagnosis, 1934
preparations, simple, 1927
sensitization, 1894
silver, incompatibility, 1649
mild, assay, 1462
strong, 874
assay, 1462
Proteins, 1168, 1170, 1897, 1925
and protein therapy, 1925
conjugated, 1170
derived, 1170
simple, 1170
used in diagnosis, 1933
Proteoclastic enzymes, 902
Proteolytic enzymes, 902
Proteoses, 1170
Protochloride iron, syrup, 284
mercury, **753**
Protoiodide, mercury, **754**
Protolac, 1820
Protopapaverine, 1105, 1106
Protopine, 1105, 1106
Protosulphate, iron, **719**
Protoveratrine, 1142
Proximate analysis, 528
assays, 1485
principles, 779
Prune, 1090
Prunella vulgaris, 964
Prunum, 1090
Prunus, 947
amygdalus, 1063
Armeniaca, 947
domestica, 1090
laurocerasus, 1006
serotina, 991
virginiana, 990
Prussian blue, 1975
Prussic acid, antidote, 1944
diluted, **991**
Pseudobaptisin, 1156
Pseudoconhydrine, 1158
Pseudocumol, 799
Pseudo-isopyrine, 1164
Pseudojervine, 1142
Pseudomorphine, 1105, 1106
Pseudopapaverine, 1105, 1106
Pseudopelletierine, 1146
Psoralea, 1006
Psychotrine, 1147
Psychrometer, sling, 124
Ptelea, 1006
trifoliata, 1006, 1031
Pterocarpin, 844
Pterocarpus marsupium, 1096
santalinus, 843
Ptomaines, 1101, 1170, 1204
Ptyalin, 1205
Ptychotis ajowan, 963
Pudding pipe, 1975
stick, 1975
Pulfrich refractometer, 1525
Pulitzer plug, 249
Pulmonaria, 1100
officinalis, 892, 1100
Virginica, 892
Pulp capping varnish, **342**
filter, multiple, 210
Pulsatilla, 1013
tincture, **396**
Pulveres, 478, 1672
Pulverization by intervention, 155
Pulverized sugar, 896
Pulverizer, limited, 165
Pulverizing and grinding, 157
Pulverous pills, 1697
Pulvis acetanilidi compositus, **481**
ærophorus, 1975
albus romanus, 1975
aloes et canellæ, **481**
amygdalæ compositus, **484**
antimonialis, **481**
antisepticus, **481**
solubilis, **481**
aromaticus, **482**
rubefaciens, **482**
buteæ seminum, **484**
catechu compositus, **484**
cinnamomi compositus, **484**
cretæ aromaticus, **482**
cum opio, **483**
compositus, **478**
et opii aromaticus, **483**
diaphoreticus, 480
diatragacanthæ, 1975
digestivæ compositus, **484**
digestivus, 1975
effervescens, compositus, **478**
Pulvis gambir compositus, **484**
glycyrrhizæ compositus, **479**
gummosus, 1975
hydrargyri chloridi mitis et jalapæ, **483**
infantum, 1975
ipecacuanhæ et opii, **479**
Jacobi, 1975
jalapæ compositum, **480**
kaladanæ compositus, **484**
kino et opii compositus, **484**
morphinæ compositus, **484**
myricæ compositus, **483**
opii compositus, **484**
pancreaticus compositus, 483
pancreatini compositus, **483, 1176**
potassii bromidi effervescens cum caffeina, **603**
puerorum, 1975
purgans, **480**
rhei compositus, **480**
et magnesiæ anisatus, **484**
scammoniæ compositus, **484**
talci compositus, **484**
salicylicus, **484**
tragacanthæ compositus, **484**
Pumex, 702
Pumice, 702
stone, 591
Pump, brass filter, 207
Chapman's, 206
filter, 206
Richard's, 206
vacuum, 207
Pumpkin seed, 1038
oil, 1046
Punica granatum, 947, 1146
Punicine, 1146
Purchase record, 1329
Purdy's method for albumin, 1439
Pure ethyl nitrite, 919
extract glycyrrhiza, **460**
licorice root, **460**
Purging cassia, 1088
nut oil, 1046
Purification alkaloids, 1489
Purified animal charcoal, 589
antidiphtheric serum, 1900
antitetanic serum, 1903
antimony sulphide, 763
coal tar, 932
cotton, 795
extract, ergot, 1131
infusorial earth, 593
iodine, 1535
kieselguhr, 593
pepsin, 1172
petroleum benzin, 1061
siliceous earth, 593
talc, **592**
three cresols, 816
Purine, 1101
Purity and identity tests, 21
rubric, 21
Purple, brom-cresol, 1450
test solution, 1450
Cassius's, 1968, 1975
oxide, 1975
Perkin's, 841
Pus casts in urine, 1446
cells in urine, 1447
Putrefaction, 902
Putrescine, 1204
Putty, 1975

Putty powder, 1975
Putz pomade, 1975
Pycnometer, 57
Pyelography, thorium solution, 704
Pyknometer, 57
Pyorrhea astringent, **578**
Pyracine, 1975
Pyramidon, 830, 939
  incompatibility, 1649
Pyrantin, 939
Pyrene, 799, 811, 1975
Pyrethrine, 1017
Pyrethrum, 1008, 1017
  parthenium, 985, 1017
  Roman, 1008
  tincture, 401
Pyridine, 792, 811, 939, 1101
Pyroacetic ether, 1969
Pyro-acetic spirit, 1977
Pyroalcohol, 1975
Pyro-arsenic acid, 764
Pyroborate, sodium, **622**
Pyroboric acid, **590**
Pyrocatechin, 799, 823
  -monoethyl ether, 936
Pyrocatechol, 804
Pyrodin, 932
Pyrodine, 1975
Pyrœnus, 1975
Pyrogallic acid, 1095
Pyrogallol, 791, 804, 1095, 1540
  disalicylate, 1100
  -mono-acetate, 1100
  test solution, alkaline, 1549
  triacetate incompatibility, 1647
Pyrolea, 948
Pyroligneous acid, 800
  oil of birch, rectified, 805
Pyrolignite, iron, 1971
Pyrolusite, 706
Pyronine fluorescein dyes, 852
Pyrophorus, 1975
Pyrophosphate, ferric, **728**
    assay, 1468
    elixir, **338**
    quinine and strychnine elixir, **326**
    soluble, **728**
  iron and sodium, 732
  sodium, 643
Pyrophosphoric acid, 581, 585
Pyrosal, 939
Pyroxylic spirit, 809
Pyroxylin, **796**
Pyroxylinum, **796**
Pyrrol, 792
Pyrus communis, **947**
  malus, 946, 947
Pyruvic acid, 903

Q

Quadroxalate, potassium, 798
Quadruplex pills, **495**
Quai, 1163
Quaker button, 1975
  City F. No. 4 Mill, 162
  laudanum, 361, 378
Quaker's black drop, 1975
Qualitative test for glucose in urine, 1440
  tests for albumin in urine, 1438
Quantitative estimation of glucose in urine, Benedict's, 1441
  filter paper, 1533
Quantity buying, 1338
Quartz, 591
Quassation, 1975
Quassia, 1064
  amara, 1064
  extract, **470**
  fluidextract, **434**
  infusion, **362**
  tincture, **397**
Quassin, 1065
Quebrachamine, 1163
Quebrachine, 1163, 1167
Quebrachit, 1163
Quebracho, 1163
Queen's delight, 1014
  root, 1014
Quercetin, 840, 1062, 1063
Quercit, 1099
Quercitannic acid, 1097, 1099
Quercite, 883
Quercitrin, 1062, 1063, 1097
Quercitron, 845
Quercus, 883, 1099
  alba, 1099
  coccinea, 1100
  fluidextract, **435**
  infectoria, 1091
  tinctoria, 1063, 1100
  velutoria, 845
Quevenne's iron, **710**
Quicklime, **671**
  antidote, 1941
Quicksilver, 748
Quickwater, 1975
Quillaja, 1078
  emulsions, 1661
  saponaria, 1078
  tincture, **397**
Quilled receivers, 136, 137
Quinamicine, 1114
Quinamine, 1114
Quinate, piperazine, incompatibility, 1649
Quince jelly hand lotion, **1239**
  seed, 891
    lotion, **1236**
Quinic acid, 1114, 1157
Quinicine, 1114
Quinidina, 1122
Quinidinæ sulphas, 1122
Quinidine, 1114, 1122
  sulphate, 1122, 1167
  syrup, **281**
    bitterless, **281**
    tasteless, 1122
Quinina, 1114
Quininæ æthylcarbonas, 1120
  bisulphas, 1116
  dihydrochloridum, 1118
  disulphas, 1116
  et ureæ hydrochloridum, 1121
  glycerophosphas, 1121
  hydrochloridum, 1117, 1118
  hypophosphis, 1121
  salicylas, 1122
  sulphas, 1115
  sulphatis, 497
  tannas, 1119
  valeras, 1121
Quinine, 1114
  acid sulphate, 1116
  ammoniated tincture, 401
Quinine and urea chloride, 1121
  hydrochloride, 1121
    ampuls, **1797**
    assay, 1476
    incompatibility, 1649
  bisulphate, 1116
  bromide, 1118
  dihydrochloride, 1118
    ampuls, **1797**
  disulphate, 1116
  ethylcarbonate, 1120
    incompatibility, 1649
  glycerophosphate, 1121
  hydrobromide, 1118
  hydrochloride, 1117
  hypophosphite, 1121
  iron, aloe and nux vomica pills, **495**
    and strychnine elixir, **326**
    strychnine and arsenic pills, mild, **496**
      stronger, **495**
  oleate, **351**
  opium and digitalis pills, **496**
  salicylate, 1122
  salicylic ester, 1122
    incompatibility, 1649
  salts, unofficial, 1121
  strychnine and ferric pyrophosphate elixir, **326**
  sulphate, 1115
    pills, 497
  tannate, 1119
    assay, 1476
  tincture, 401
  valerate, 1121
    and strychnine elixir, **338**
Quinoidine, 1122, 1165
Quinoline, 792, 811, 933, 1101, 1165
  monohypochlorite, 1165
Quinolines, 841
Quinotannic acid, 1114
Quinovic acid, 1063, 1114
Quinovin, 1063, 1114
Quinovose, 893

R

Rabies vaccine, 1914
Racemic formulas, 782
Radial burner, Fletcher's, **99**
Radical vinegar, 1975
Radicles, unsatisfied, 784
Radish, 994
  wild, 994
Radium, 532, 661, 684, 734
  A, 685
  C, 685
Radon, 532
Radumine, 1975
Raffinose, 893
Ragroot, golden, **1013**
Raising checks, 1280
Raisins, Corinthian, **1975**
Raja Batis, 1205
Ramenti ferri, **1975**
Rancidity, 1032
Ranunculus, 1017
  bulbosus, 1017
Rape seed oil, 1046
Raphanus raphanistrum, 994
  sativa, 994
Rapid filtering apparatus, 206
Rare earth elements, 704
Rasp and file, 135

Raspberries, red, 946
Raspberry, 946
syrup, 282
Rasping, 156
Rat proofing, 1861
tail file, 135
Rational formula, 530
Rats, elimination of, 1858
Raw linseed oil, 1037
sugars, 896
whisky, 914
Raymond roller mill, 161, 166
Rayon, 794
Reactions, chemical, 537
Reading of meniscus, 53
Reagent, Fraude, 1970
Reagents, 1528
diagnostic, 853, 1568, 1897
examination of blood, 1572
gastric contents, 1571
urine, 1568
test solutions and volumetric solutions, 1528
Realgar, 764, 769, 1975
Réaumur thermometer, 102
Receiver, Florentine, 215
for light and heavy oils, 215
Receivers, 136, 137
plain, 136, 137
quilled, 136, 137
tubulated, 136, 137
Receiving bottle for percolates, 245
graduated, 245
bottles, 245
Reciprocity between boards of pharmacy, 1250
Record of purchase, 1329
Rectal suppositories, 1733
infant, 1733
Rectified oil, birch tar, 805
tar, 805
turpentine, **1019**
pyroligneous oil of birch, 805
turpentine oil, **1019**
Red ant, 1205
aromatic elixir, **318**
blood cells in urine, 1447
borax, 1967
cedar, 1005
oil, 986, 1005
cerate, 1975
Chinese, 1968
cinchona, 1113
clover blossoms, 1078
colors, 841
elixir, **318**
elm, 887
fire, 689
gum, 1026
troches, **498**
iodide, mercury, **755**
ointment, 511
wool, **1762**
lead, 737, **741**
oxide, **741**
assay, 1469
liquor, 1975
mercuric iodide, **755**
assay, 1483
incompatibility, 1648
sterile solution, **1801**
oxide, **758**, 1536
assay, 1461
ointment, **509**
sulphide, 760
Red methyl, 1451
test solution, 1451
mustard seed, 992
oil, 1046, 1975
oxide of iron, 732
pepper, 996
phenol, 846, 1451
test solution, 1451
phosphorus, 585
poppy syrup, 284
precipitate, 758
raspberries, 946
rose, 1097
saunders, 843
scarlet, 939
tartar, 1975
wine, **941**
Reddle, 1975
Reduced iron, **710**
assay, 1474
troches, 499
Reducing sugars, 893
References, 1297
Refined diphtheria antitoxin 1900
tetanus antitoxin, 1903
wool fat, 1042
Reflux distillation, 133
Refractive index, 1525
Refractometer, Abbe, 1525
Pulfrich, 1525
Zeiss butyro-, 1526
immersion, 1526
Refrigerant counterirritant, **341**
Register, cash, 1391
Registration of stills, 145
Regnault still, 143
Regulus antimonii, 1975
Re-insurance, 1286
Relation of expenses to net profit, 1425
first costs, overhead and profits, 1335
Relations to community, 1298
physicians, 1300
public, 1298
Relationship of weights and measures, 77
Remedies for children's use, 12
new and non-official, 24
proprietary, report of A. Ph. A. committee, 12
Remington still, 141
Renalina, 1196
Renaline, 1196
Rennet, liquid, 1190
Rennin, 902, 1189
and pepsin elixir, compound, **332**
Renninum, 1189
Rent per cent, 1272
Repercolation, 245
Replacing value, 530
Report form, pharmacy laboratory, 1945
on sales missed, 1383
Reptilia, class, 1205
Research laboratory, 1578
Reseda, 1225
odorata, 986
Residual titration using excess of silver nitrate, 1462
sodium hydroxide, 1460
potassium permanganate, 1474
Residual titrations involving saponification of esters, 1461
using an excess of hydrochloric acid, 1459
with excess of alkali, 1454
iodine, 1471
oxalic acid, 1472
sulphuric acid, 1457
Resin cimicifuga, 1030
guaiac, 1027
troches, 499
ipomea, **471**
jalap, **472**
Mexican scammony, 472
ointment, 512
phosphoretted, **581**
plaster, 521
podophyllum, **473**
scammony, 472, **473**
unofficial, 473
Resina, 471, 1021
draconis, 1030
elastica, 1975
empyreumatica liquida, 1975
solida, 1975
flava,
ipomœæ, **471**
jalapæ, **472**
phosphorata, **581**
pini, 1975
podophylli, **473**
scammonii, **473**
Resinæ, 471
Resinoids, eclectic, 1030
Resins, 471, 1018
empyreumatic, 799
gum, 1018
Resorcin, **823**
hexamethylene-tetramine, 936
monoacetate, 935
Resorcinol, 791, **823**, 1212, 1540
assay, 1468
compounds, unofficial, 824
incompatibility, 1646, 1649
ointment, compound, **510**
paste, mild, **516**
Lassar's, **516**
strong, **516**
stronger, Lassar's, **516**
test solution, 1549
Resorcinolphthalein, 852, 853, 1533
Responsibility under law, 1292
Retene, 799, 811
Retinol, 1030, 1975
Retort, 131
plain, 132
charging, 138
ring clamp, 138
stand, 138
tubulated, 132
Retorts, 132
charging, 137
Reversible gels, **186**
sols, 186
Rex metallorum, 1975
Rhabarberon, 1083
Rhamnetin, 840, 1063
Rhamnonigrin, 1090
Rhamnose, 893, 1062
Rhamnus amygdalinus, 1063
cathartica, 1090
fluidextract, **435**

Rhamnus cathartica syrup, 281
frangula, 1089
purshiana, 1082
extract, 457
fluidextract, 408
aromatic, 408
Rhatany, 1095
Brazilian, 1095
Para, 1095
Peruvian, 1095
Rhein, 1083
Rheotannic acid, 1083
Rheum, 1031, 1083
officinale, 1083
palmatum, 1083
Rhigolene, 785
Rhizome, May apple, 1086
Rhodinol, 1212
acetate, 1217
butyrate, 1217
formate, 1217
Rhodione, 1214
Rhodium, 532
oil, 986
Rhœadine, 1105, 1106, 1164
Rhubarb, 1083
and gentian tincture, 398
magnesia powder anisated, 484
opium mixture, compound, 295
soda mixture, 296
extract, 463
powdered, 463
fluidextract, 414
fluidglycerate, 444
infusion, 362
mixture, alkaline, 296
compound, 296
pills, 497
compound, 497
powder, compound, 480
syrup, 269
aromatic, 269
tincture, 379
aqueous, 397
aromatic, 379
sweet, 397
Rhus aromatica, 1100
glabra, 946, 1031
fluidextract, 414, 442
metopium, 892
radicans, 1080
toxicodendron, 1080
Ribbed funnel, 200
Ribes grossularia, 947
rubrum, 947
Rice, 883
Richard's pump, 206
Ricin, 1038
Ricinine, 1038
Ricinolein, 1038
Ricinus communis, 1038
Rider insurance, 1286
Riga balsam, 1967
Ring clamp, retort, 138
Riodine, 865
Rizone, 1975
Roasted coffee, 1157
assay, 1500
Rob, 1975
Roccella, 844
fuciformis, 845
tinctoria, 845
Rochelle salt, 608
Rock alum, 1966
Rock candy, 896
crystal, 1975
oil, 1056, 1973
-rose, 1016
salt, 1975
Roll sulphur, 580
ground, 582
Rolled suppositories, 1734
Roller knife, 157
mill, Raymond, 161, 166
mills, 161
press, 226
Rollers, grooved, 161
Rolling creams, 1239, 1242
Roman alum, 1966
letters, 1386
pyrethrum, 1008
vitriol, 1975
Rongalite, 1975
Roob, 1975
Room for stock, 1331
Root, aconite, 1143
alum, 1100
angelica, 969
garden, 969
belladonna, 1133
assay, 1497
fluidextract, 407
assay, 1498
bitter, 1967
blood, 1162
colchicum, 1140
convallaria fluidextract, 423
deadly nightshade, 1133
ginger, 984
Italian juice, 900
licorice, 900
extract, 460
fluidextract, 412
liquorice, 900
marsh mallow, 887
Oregon grape, 1156
Orizaba jalap, 1086
papoose, 1073
parsley, 970
pink, 1164
poke, 1078
queen's, 1014
scammony, Mexican, 1086
Spanish juice, 900
squaw, 1073
yellow, 1165
gentian, 1063
jasmine, 1159
Rosa, 1097
centifolia, 1100
gallica, 1097
Rosaniline, 853, 936, 1534
acetate, 1534
dyes, 850, 852
hydrochloride, 1534
Rose, 1097
Bulgarian, perfume, 1224
confection, 489
flavoring extract, 976
fluidextract, 414
French, perfume, 1224
honey of, 284
with sodium borate, 285
infusion, compound, 361
pale, 1100
pink, 1975
red, 1097
sachet, 1231
syrup, 281
water, 255
Rose water ointment, 503
stronger, 255
triple, 255
white, extract, 1224
perfume, 1224
Rosemary, 965
marsh, 1100
oil, 961
assay, 1461
spirit, 315
Roseol, 1212
Rosin, 471, 1021
cerate, 513
compound, 514
Georgia pine, 1021
phosphorated, 581
solution, chloroformic, 342
test, 1519
yellow pine, 1021
Rosinol, 1975
Rosmarinus officinalis, 961, 965
Rosolic acid, 939
Rosolic acid solution, 1571
Ro-Tap sifter, 169
Rotary cutter, 157
filter, Vallez, 210
grater, 156
Rotation, optical, 1524
Rotex sifter, 169
Rother's filter, 197
Rottenstone, 1975
Rottlera, 1090
Rottlerin, 1090
Rotula, 249
Rubijervine, 1142
Rubreserine, 1131
Rouge, 1975
jewelers' 1971
Rough nitre, 1973
on rats, antidote, 1944
Round cells in urine, 1446
Rousseau's densimeter, 66
Rubber, 1029
adhesive plaster, 518, 1751
dam, 1761
goods, 1344
India, 1029
joints, 136
sheeting, 1761
Rubefacient spice powder, 482
Rubia tinctorium, 845
Rubidium, 532, 595
Rubi fructus, 947
Rubigo ferri, 1975
Rubin, 853
acid, 853
Rubramentum, 1975
Rubric, purity, 21
Rubrum, scarlatinum, 850
Rubus, 1099
cuneifolius, 1099
elixir, compound, 338
fluidextract, 435
idæi fructus, 946
idæus, 946
nigrobaccus, 947, 1099
strigosus, 946
syrup, 281
villosus, 947, 1099
Ruddle, 1975
Rue, 1006, 1080
European goat's, 890
oil, 1006
Rufus's pills, 1975
Rules for operating hand mills, 163

Rules for prescription filling, 1615
Rum, 903
Rumex, 1099
crispus, 1031, 1099
fluidextract, **435**
obtusifolius, 1099
Rumicin, 1099
Rural store, 1302
Ruspini syrup iron iodide, 284
Russian blast lamp, 95
flies, 1190
leather oil, 805
Rust, 709
Ruta, 1080
graveolens, 1006, 1080
Rutaceæ products, 953
Ruthenium, 532
Rutin, 1080
Rye, 883
ergot, 1129
spurred, 1129

S

Sabadilla seed, 1164
semen, 1164
Sabadine, 1142, 1164
Sabadinine, 1142, 1164
Sabal, 1013
and sandalwood elixir, compound, **333**
fluidextract, **435**
Sabbatia, 1080
Sabina, 1006
Sabromin, 861
Saccharate, lead, 742
Saccharated casein, 1660
ferric oxide, **727**
assay, 1468
ferrous carbonate, **712**
assay, 1472
iron, soluble, syrup, **277**
oxide of iron, syrup, **277**
pepsin, **1173**
Sacchari fœx, 1975
Saccharic acid, 885
Saccharin, 833
soluble, **834**
fruits, action of ferments upon, 941
substances, 893
Saccharometer, 63
Saccharolé, 1975
Saccharomyces cerevisiæ, 904, 1543
Saccharum, **896**
acerinum, 1975
canadense, 1975
candisatum, 1975
candum, 1975
lactis, 898
officinarum, 896
saturni, 739, 1975
ustum, 844
Saccharures, 484
Sachet, carnation, **1230**
frangipanni, **1230**
heliotrope, **1231**
lavender, **1231**
lilac, **1232**
rose, **1231**
violet, **1231**
ylang-ylang, **1232**
Sachets, 1229
Sacred elixir, 1975
Safety tubes, 138
Safeway prescription cabinet, 1621
file, 1620
Safflower, 845, 1016
Saffron, 845, 1076
African, 1965
American, 845, 1016, 1975
and opium tincture, **395**
-bitter, 1076
-meadow, 1972
oil, 986
tincture, **388**
Safrene, 981
Safrol, 981, 1217
Sagapenum, 994, 1030
Sage, 965
infusion, **362**
Sago, 883
Sahli's hemometer, 1572
Saigon cassia, 971
cinnamon, 971
Saim, 1975
Saint Germain tea, **486**
Ignatius bean, 1160
John Long's liniment, **349**
John's-wort, 1016
Victor's balsam, 369
Sajodin, 862
Sal absinthii, 1975
acetosellæ, 1975
æratus, 1975
alembroth, 751, 1975
gauze, **1762**
wool, **1763**
amarum, 1975
ammoniac, 651, **656**
ammoniacum martiale, 1975
volatile, 1975
Anglicum, 1975
antihystericum, 1975
argenti, 1975
Armeniacum, 1976
artis, 1976
Benjamin, 1976
benzoin, 1976
Carolinum effervescens, **477**
factitium, **474**
catharticus amarus, 1976
Anglicanus, 1976
Glauberi, 1976
chalybis, 1976
communis, 1976
cornu cervi, 1976
culinaris, 1976
de duobus, 1976
digestivum, 614
diureticus, 1976
enixum, 1976
essentiale tartari, 1976
febrifugum, 614, 1976
fossilis, 1976
fuliginis, 1976
gemmæ, 1976
Kissingense factitium, **475**
effervescens, **477**
lactis, 1976
lithii citratis effervescens, **647**
magnesia vitriolata, 1976
magnesii sulphatis effervescens, **670**
marinum, 1976
martis, 1976
microcosmicum, 1976
mirabile, 634
Sal mirabile Glauberi, 1976
nitrum, 1976
ossium, 1976
panchrestum, 1976
perlatum, 1976
petræ, 1976
polychrestum, 609
Seignetti, 1976
polychrestus, 1976
Glaseri, 1976
potassii bromidi effervescens, 477
compositum, **603**
prunella, 1976
rupellensis, 1976
sapientæ, 751, 1976
Saturni, 1976
scientiæ, 1976
sedativus Hombergi, 1976
Sedlicensis, 1976
sennerti, 1976
seydschutzense, 1976
soda, 625, 1976
succini, 1976
tartar, 604
tartari, 1976
essentiale, 1976
thermarum (Carolinarum), 1976
urinæ, 1976
Vichyanum factitium, **475**
effervescens, **477**
cum lithio, 477
vegetabile, 1976
vitæ, 1976
vitrioli, 1976
narcoticum, 1976
volatile, 1976
liquid, 1976
vomitorium vitrioli, 1976
Salacetol, 939
Salæratus, 601
Salamander's blood, 1976
Salantol, 939
Salaries per cent, 1272
Sale of commodities, 1327
confectionery, 1346
hospital supplies, 1343
perfumes, 1351
pharmaceutical products, 1342
rubber goods, 1344
school supplies, 1347
service, 1327
stationery, 1347
tobacco products, 1344
toilet articles, 1351
Salep, 892
Sales analysis, 1382
approach, 1382
by suggestion, 1383
telephone, 1382
closing, 1382
demonstration, 1382
expense, etc., relations, 1424
management, 1381
missed, 1383
organization, 1377
pre-approach, 1382
price calculation, 1585
special, 1380
Salesman, 1377
Salesmanship, 1376
Sal-ethyl, 828
Salia effervescentia, 475
factitia, 474

Salicin, 1062, 1063, 1070, 1080
Salicinum, 1070
Salicitrin, 828
Salicylacetate, antipyrine, 939
Salicyl aldehyde, 1063
-alpha-methyl-phenyl hydrazine, 932
Salicylamide, 939
Salicylate, alphanaphthol, 932
ammonium, **657**
assay, 1456
amyl, 1214, 1226
antipyrin, 939
incompatibility, 1649
betanaphthol, 933
bismuth, basic, **773**
calcium, 683
cinchonidine, 1165
eserine, 1132
ethyl, 828, 935, 1215, 1226
ferric, 732
solution, **730**
formin, 939
guaiacol, 936
hexamethylenamine, incompatibility, 1649
isobutyl, 1216
lithium, **648**
assay, 1456
magnesium, 670
mercuric, **756**
assay, 1461
incompatibility, 1648
methyl, 1226
assay, 1461
petroxolin, **353**
monoglycol, 828
phenocoll, incompatibility, 1648
phenyl, **826**
incompatibility, 1646, 1648
physostigmine, 1132
potassium, 616
quinine, 1122
santalyl, 998
sodio-theobromine, incompatibility, 1646
sodium, **632**
assay, 1457
elixir compound, 334, **338**
strontium, 688
urotropine, 939
zinc, 698
Salicylated creosote mull, **522**
mercury, 758
mixture of iron, **730**
Salicylates and benzoates, alkali, assay, 1514
tonga elixir, **336**
incompatibility, 1649
tests, 826
Salicylic acid, 811, **824**, 1540
assay, 1456
and cannabis indica plaster, 521
compounds, unofficial, 828
glycerogelatin, **515**
incompatibility, 1649
mull, **522**
ointment, 511
pencils, **524**
plaster, 521
wool, **1762**
strong, **1762**
aldehyde, 1214
collodion, compound, **344**
Salicylic ester, quinine, incompatibility, 1649
plaster, compound, 521
elastic, 521
stronger compound, 521
wool, **1762**
Saliformin, 939
incompatibility, 1649
Saligallol, 1100
Saligenin, 838, 1062, 1063
Saligeninum, 838
Salinaphthol, 933
Salipyrine, 939
incompatibility, 1649
Saliretin, 1063
Salitannol, 939
Salix, 1070, 1080
alba, 1080
Salmester, 828
Salmiac, 1976
Salochin, 939
Salochinin, 1122
Salocoll, incompatibility, 1648
Salol, **826**
camphor, 939
coating, 1683, 1731
guaiacol, 936
Salt, preparing, 1974
Rochelle, **608**
rock, 1975
Saturn, 1976
Seidlitz, 666
Seignette, 1976
solution, normal, 627, **1795**
physiological, **1795**
sore throat, 1976
sorrel, 798
antidote, 1941
sour, 945
spirit, 554, 555, 1977
tartar, **604**, 1976
tin, 736, 1976
Vichy, artificial, 475
vomiting, 1978
water baths, 113
Saltpetre, **611**
Chili, 557
Salts, 534, 535
"Salts," 1976
acid, 536
alkali, of organic acids, assay, 1514
artificial, 474
basic, 536
bath, **1232**
bitter, 1967
calcium, tests for, 671
double, 536
granular effervescent, 475
lithium, 644
mineral, 1168
mixed, 536
normal, 536
potassium, 596
Preston's, 1975
smelling, **656**, 1232
sodium, 617
vinegar, 1978
vomiting, 1978
Salvarsan, 869
incompatibility, 1645
Salve, Deshler's, **514**
mother's, **508**
mulls, 521
Salvia, 965
officinalis, 965, 985
Salzburg vitriol, 1976
Samarium, 532
Sambucus, 1005
canadensis, 1005
Salol, incompatibility, 1646
Salophen, 939
incompatibility, 1649
Saloquin, 1122
Saloquinine, 939
incompatibility, 1649
Salt cake, 1976
Carlsbad, artificial, **474**
crab orchard, 666, 670
Derosne's, 1968
Epsom, **665**
freezing, 1970
fruit, 1976
Glauber's, **633**
horse, 1971
herapath's, 1976
Kissingen, artificial, **475**
lemon, 945
lithium citrate, effervescent, **647**
marine, 1972
Mars, 1976
microcosmic, 1972, 1976
Mohr's, 1973
mordant, 1976
pink, 1974
potassium bromide, effervescent, 477
compound, **603**
Sambucus nigra, 985, 1005
Sampling and analysis of vegetable drugs, 1520
Sand, 591
acid, 1976
bath, 112
filters, 204
sugar, 1977
Sandalwood, 997
and sabal elixir, compound, **333**
saw palmetto elixir, compound, **333**
tincture, **398**
fluidextract, **436**
oil, 997
Australian, 998
West India, 998
products, unofficial, 998
white, 997
yellow, 997
Sandarach, 1030
Sandiver, 1976
Sandyx, 1976
Sanguinaria, 1162
canadensis, 1031, 1162, 1167
fluidextract, **436**
syrup, **284**
tincture, **398**
Sanguinarine, 1162, 1164, 1165, 1167
Sanguis, 1204
Santal, 844
oil, 997, 1219
assay, 1461
Santalal, 998
Santalic acid, 844
Santalin, 844
Santalol, 998, 1219
Santalolis salicylas, 998
Santalum album, 997
rubrum, 843
Santalwood oil, 997

Santalyl salicylate, 998
Santonin, 1063, 1070
and calomel tablets, **501**
troches,
tablets, **501**
compound, **501**
troches, 499
compound, 499
Santoninum, 1070
Santoniretin, 1063
Santyl, 998
Sapo, 1054
medicatus, 1976
mollis, **1055**
Sapogenin, 1078
Sapon wood, 845
Saponaria officinalis, 1063, 1080
Saponetin, 1063
Saponification value, 1519
Saponin, 1063, 1078
Sappan, decoction, **363**
Saprine, 1204
Sarothaminine, 1163
Sarsaparilla, 1071
decoction, compound, **363**
milder, **363**
stronger, **363**
fluidextract, **415**
compound, **436**
syrup, compound, **269**
Sassafras, 981
medulla, 890
oil, 981
pith, 890
mucilage, **287**
variifolium, 890, 981
Sassy bark, 1164, 1166
Satin spar, 1976
Saturated hydrocarbons, 784
solution, 171
potassium iodide, **610**
Saturates, tablet, 1703
Saturating power, 530
Saturatio, 1976
Satureja hortensis, 986
Saturn, extract, 739
salt, 1976
Saturni, acetum, 1965
Saturnus, 1976
Saunders, red, 843
Savin, 1006
oil, 1006
Savings banks, 1284
postal, 1284
Savory flavoring extract, 976
oil, summer, 986
Saw palmetto and sandalwood elixir, compound, **333**
tincture, **398**
berries, 1013
Sawdust, 1758
Saxin, 1976
Saybolt universal viscosimeter, 1526
Scale, ball, 45
hand spring, 1773
laboratory, manufacturing, 45
paraffin, 1974
pepsin, 1172
with graduated parallel beam and sliding weight, 44
Scales, box prescription, 46
counter, 45
hand, 43
Scales, specific gravity hydrometer, 62
Scammonin, 1086
Scammony, compound powder 484
resin, 472, **473**
Mexican, 472
root, Mexican, 1086
Scandium, 532
Scarlatinal antitoxin, 1904
Scarlet fever antitoxin, 1904
disinfection, 1882
immunity test, 1935
streptococcus antitoxin, concentrated, 1904
Dochez method, 1906
toxin, 1916
red, 939
medicinal Biebrich, 850
sulphonate, 850
Scheele's green, 769
hydrocyanic acid, 992
Schick test, 1934
Schmiedeberg's digitalin, 1065
Schoenite, 615
School supplies, 1347
Schweinfurth's green, 769, 1976
Scilla, 1068
Scillain, 1069
Scillin, 1069
Scillipicrin, 1069
Scillitoxin, 1069
Scoop sifter, 168
Scoparin, 1163
Scoparius, 1163
fluidextract, **436**
Scope and history of pharmacy, 1
Scopola, 1164
Scopolaminæ hydrobromidum, 1136
Scopolamine, 1133, 1164
bromide, 1136
hydrobromide, 1136
preparation, unofficial, 1136
stable, 1136
Scopomannit, 1136
Scored paper, 237
Scotch soda, 1976
Scouring powders, 1052
Screw press, 225
double, 226, 227
single, 225, 226
Scurvy grass, common, 994
Scutellaria, 964
fluidextract, **437**
lateriflora, 964, 1031
Scytodepsicum, acidum, 1965
Seal, golden, 1144
oil, 1205
Sea-onion, 1976
Sebum, 1976
Secacornin, 1131
Secale cereale, 883
cornutum P. I., 1129
Secalis cornuti extractum fluidum, P. I., **410**
Secondary alcohols, 786
amine, 783
Sedatin, 940
Sedative water, **298**
Sediments from acid urine, 1447
alkaline urine, 1447
in urine, unorganized, 1448
Seed, angelica, 969
European, 969
caraway, 965
cardamom, 983
celery, 970
colchicum, 1140
assay, 1497
coriander, 967
cotton oil, 1037
emulsions, 1657
fennel, 966
larkspur, 1159
-maw, 1972
mustard, 992
red, 992
pumpkin, 1038
quince, 891
lotion, **1236**
sabadilla, 1164
stramonium, 1164
Seeds, ambretta, 1966
flea, 1970
lupin, yellow, 1167
Seidlitz powder, **478**
measure, 1674
salt, 666
Seignette salt, 1976
Selenicereus grandiflorus, 1157
Selenite, 1976
Selenium, 532
Selenous acid, 1540
Self heal, 964
-balancing centifuge, 229
registering thermometers, 105
Selling merchandise, 1376
modern methods, 1378
price calculation, 1336
Semen arecæ, 1100
contra, 1976
cynæ, 1976
sanitum, 1976
Semencina, 1976
Semina strychni, 1976
Seneca snakeroot, 1072
Senecio, 1013
aureus, 1013
fluidextract, **437**
gracilis, 1031
Senega, 1072
fluidextract, **416**
infusion, **362**
snakeroot, 1072
syrup, **270**
tincture, 401
Senegin, 1072
Seneka oil, 1973
Senna, 1083
Alexandria, 1083
American, 1079
aromatic syrup, **282**
bladder, 1090
confection, **489**
fluidextract, **417**
infusion, **362**
compound, **361**
mixture, compound, 297
syrup, **270**
compound, **284**
tincture, compound, 401
Tinnevelly, 1083
Sennanigrin, 1084
Sennarhamnetin, 1084
Sensitization, protein, 1894
Sensitized bacterial vaccines, 1897, 1920

Separation of fluids from solids, 189
immiscible liquids, 214
Separator, Mitchell's, 215
pear-shaped, 214
Separatory funnel, open, 214
Sepia, 1976
Sepiolite, 1976
Serenoa serrulata, 1013
Sericose, 1976
Sericum oleatum, 249, 1760
Series, thionic, 580
Serine, 1170
Serology, definition, 2
Serobacterin, acne, 1921
cholera, 1921
coli, 1921
meningococcus, 1921
Neisser, 1921
pertussis, 1921
pneumococcus, 1921
staphylococcus, 1921
streptococcus, 1921
typhoid, 1921
Serobacterins, 1897, 1920
mixed, 1921
Serpentaria, 999
fluidextract, **437**
oil, 986
tincture, **399**
Serpentine, 661
Serum, anti-anthrax, 1907
antianthracicum, 1907
antidiphtheric, purified, 1900
antidiphthericum purificatum, 1900
antidysenteric, 1908
antidysentericum, 1908
anti-gas-gangrene, 1906
antigonococcic, 1910
antimeningococcic, 1908
antimeningococcicum, 1908
antipneumococcic, 1909
antipneumococcicum, 1909
antistreptococcic, 1910
antistreptococcicum, 1910
antitetanic, 1904
crude, 1904
purified, 1903
antitetanicum, 1904
purificatum, 1903
blood, 1576
equinum, 1910
horse, normal, 1910
mercurialized, 878
Serums, 1897
antibacterial, 1906
unofficial, 1907
Service buyer, 1366
prescription, 1340
store, 1327
Sesame oil, 1044
brominized, 861
Sesamum indicum, 891, 1044
Sesquicarbonate, sodium, 643
Sesquichloride, iron, **714**
Sesquiterpenes, 791
Seven-barks, 1077
Sevum, 1976
benzoinatum, **1044**
præparatum, 1043
Shaker, mechanical, 1486
Shark oil, 1205
Sharp and Dohme capsule filler, 1681
Sharples centrifugal filter, 210
Shaving soap, 1052
Sheep dip, 814, **816**
Shelf bottles, 1603
Shepherd's purse, 994
Sherry wine, 941
Shield root, 1007
Shikimol, 1976
Short buchu, 998
"Shorts", 1330
Show card brush, 1384
layout, 1389
letters and numbers, 1387
pens, 1385
typical, 1389
writing, 1384
Show cases, 1316
Shrubby trefoil, 1006
Siam benzoin, 1024
Sideros, 1976
Sidonal, incompatibility, 1649
Sierra Leone pepper, 996
Sieve, prescription, 1674
Sieves, specifications for standard, 170
Sifter and mixer, Jones', 167, 168
enclosed, 168
Hunter's, 168
Ro-tap, 169
Rotex, 169
scoop, 168
Sifting, 166
Sign writing, 1384
Signa, 1590
Signature, 1279
Sikes' hydrometer, 64
Silex, 1976
Silica, 591
gel, 204
Silicate, magnesium, 591, 670
potassium, 616
sodium, **592**, 643
solution, **592**
Silicates, 591
tests, 591
Siliceous earth, purified, 593
earths, 204
Silico-fluoride, sodium, 643
Silicon, 532, 588, 591
compounds, unofficial, 591
dioxide, 591
Siliquio dulcis, 1976
Silk, artificial, 794
cellulose acetate, 795
oiled, 1760
sutures, 1767
Silkworm gut, 1767
Silocel, 1976
Silver, 532, 737, 744, 1540
acetate, 747
ammonium nitrate test solution, 1549
arsphenamine, 873
bromide, 747
casein, 1203
incompatibility, 1649
chloride, 747
chromate, 747
citrate, 747
coater, 1721
coating, 1721
colloidal, 188, 877
incompatibility, 1646
compounds, colloidal, 877
organic, 874
cyanide, 747
Silver, German, 735, 1970
glance, 744
ichthyol, 936
incompatibility, 1647
iodide, 747
lactate, 747, 1203
nitrate, **745**, 1540
antidote, 1944
assay, 1462
ethylenediamine, 932
fused, **746**
assay, 1462
incompatibility, 1649
mitigated, 747
molded, **746**
sterile solution, **1801**
tenth-normal, 1560
test solution, 1549
oleate, 1047
oxalate, 747
oxide, 747
incompatibility, 1649
phosphate, 747
protein, incompatibility, 1649
mild, 876
assay, 1462
strong, 874
assay, 1462
salts, tests, 744
unofficial, 747
sulphate, 747, 1540
test solution, 1549
sulphethylate, 939
vitellin, incompatibility, 1649
Silverfish, elimination of, 1852
Silvol, 876
Simaruba, 1080
officinalis, 1080
Simple cerate, **513**
elixir, **315**
ointment, **502**
protein, 1170
solution, 171
solutions (aqueous), 257, 258
syrup, **265**
Sinalbin, 993
Sinapine sulphate, 993
Sinapis alba, 993, 1046
nigra, 992, 1063
Sinapismus, 249, 525
Sindon oleata, 249, 1760
Single beam, equal arm balances, 42
unequal arm balances, 45
entry bookkeeping, 1391, 1402
jar mill, 158
phase solution, 171
screw press, 225, 226
Sinigrin, 992, 1063
Sinistrin, 1069
Sinks, 1326
Siomine, 866
Siphon, 191
Sirup, **265**
Sirups, 261
Sisymbrium nasturtium, 994
Skate oil, 1205
Skatol, 1218
Skin creams, 1239
food, **1241**
Skullcap, 964
Skutterudite, 736
Slab and muller, 154
Slag wool, 1976

Slaked lime, 1536
Slicing, 156
"Slightly soluble", 175
Sling psychrometer, 124
Slippery elm, 887
bark, 887
cataplasm, 518
poultice, 518
Slocum's lozenge board, 1698
Sludge acid, 1976
Small calorie, 92
centrifuge, 229
vacuum still, 126
Smallpox disinfection, 1881
vaccine, 1912
dried, 1914
Smalt, 1976
Smaltite, 736
Smaragdin, 95
Smelling salts, **656**, 1232
dry, 1232
liquid, 1232
solidified, 1232
Smilax, 1031
medica, 1071
officinalis, 1071
ornata, 1071
Smith-Rosen test for bile in urine, 1443
Smith's reagent, 1569
solution of bromine, **575**
Smithsonite, 690
Smoke, 92
oil, 1973
Smyrna galls, 1091
Snakeroot, black, 1009
fluidextract, **409**
Canada, 985
Seneca, 1072
Senega, 1072
Texas, 999
Virginia, 999
Snow, carbon dioxide, 588
Soap, 1054
boiling kettle, 1050
castile, olive oil, 1054
compound pills, 498
curd, 1052
disinfectant, 1052
dry-cleaning, 1052
floating, 1052
green, 1055
tincture, **346**
grit, 1052
hard water, 1052
liniment, **346**
camphorated, **348**
liquid, 1052
marine, 1052
milled, 1052
mottled, 1052
plaster, **520**, 521
shaving, 1052
soft, 1052, **1055**
liniment, **346**
compound, **348**
toilet, manufacture, 1051
transparent, 1052
Soaps, 1032, 1049
Soapstone, 591, 592
Soap-tree bark, 1078
Soapwort, 1080
Socaloin, 1080
Socotrine aloe, 1080
Sod oil, 1973, 1976
Soda, 617
Soda and mint solution, **640**
rhubarb mixture, **296**
caustic, **617**, 618
antidote, 1941
chlorinated, solution, **569**
assay, 1468
surgical, **570**
assay, 1468
extra, 622
fountain, 1311, 1348
depreciation, 1420
mint, **640**
and charcoal, tablets, 1717
solution, 258
tablets, **501**
sal, 625
solution, **618**
tartarizata, 609
water, 588
Sodiarsphenamina, 873
Sodii acetas, **619**
ammonii et hydrogenii phosphas, 642
arsenas, **635**, 769
exsiccatus, **636**, 769
benzoas, **620**
benzosulphinidum, **834**
bicarbonas, **620**
bicarbonatis, 499
biphosphas, **631**
bisulphis, 642
boras, **622**
bromidum, **623**
cacodylas, **624**
carbonas monohydratus, **624**
chloras, 642
chloridum, **626**
choleas, 1205
citras, **627**
cyanidum, 643
diæthybarbituras, 924
et argenti thiosulphas, 642
platini chloridum, 643
ethylas, 643
ethylsulphas, 643
glycerophosphas, **638**
glyco-taurocholas bovis, 1184
hydroxidum, **617**
hypophosphis, **638**
indigotindisulphonas, **849**
iodidum, **628**
nitras, 643
nitris, **628**
nitro-prussidum, 643
perboras, **640**
phenolas, 643
phenolsulphonas, 643
phosphas, **629**
effervescens, **630**
exsiccatus, **631**
pyrophosphas, 643
salicylas, **632**
silicas, 643
silicofluoridum, 643
stannas, 643, 736
sulphas, **633**
sulphis exsiccatus, 643
tartras, 643
thiosulphas, **634**
valeras, 643
Sodio-acetate theobromine, incompatibility, 1650
-benzoate, caffeine, 1152
assay, 1456, 1476
-salicylate, caffeine, **1153**
assay, **1476**
Sodio-salicylate theobromine, 1154
assay, 1456, 1477
-theobromine salicylate, incompatibility, 1646, 1650
Sodium, 532, 617
acetate, **619**, 1540
anhydrous, 1540
assay, 1456
test solution, 1549
acid sulphite, 1540
ammonium hydrogen phosphate, 642
and aluminum fluoride, 579
calcium glycerophosphates, elixir, **320**
hypophosphites, syrup, **274**
manganese citrate, **706**
platinum chloride, 643
potassium tartrate, **608**
silver thiosulphate, 642
antimony thioglycollate, 874
arsanilate, 939
arsenate, **635**, **769**
assay, 1469
exsiccated, **636**, 769
assay, 1469
solution, 257, 258, **637**, 769
assay, 1469
diluted, 258, **637**, 769
assay, 1469
sterile solution, **1801**
arsenphenolamine, 873
arsphenamine, 873
barbital, 924
barbitone, 924
benzoate, **620**
assay, 1457
incompatibility, 1649
biborate, 622
bicarbonate, **620**, 1540
assay, 1455
sterile solution, **1802**
tablets, **501**
troches, 500
biphosphate, **631**
assay, 1543, 1463
bisulphite, 642, 1540
test solution, 1549
bitartrate, 1540
test solution, 1550
borate, **622**, 1540
and honey of rose, **285**
assay, 1459
compound solution, 258
honey, **285**
solution, compound, **641**
bromide, **623**, 1540
assay, 1462
elixir, **334**
cacodylate, **624**
ampuls, **1798**
assay, 1459
carbonate, anhydrous, 1541
incompatibility, 1649
monohydrated, **624**, 1541
assay, 1455
test solution, 1550
-cellulose dithiocarbonate, 794
chlorate, 642
chloride, **626**, **1541**
assay, 1463
solution, physiological, **627**, **1795**

Sodium chloride sterile solution, 1802
choleate, 1205
citrate, 627
assay, 1456
solution, 258, 641
assay, 1456
sterile solution, 1802
citro-tartrate solution effervescent, 260
cobaltic nitrite test solution, 1550
cyanide, 643, 1541
test solution, 1550
diethylbarbiturate, 924
diethylmalonylurea, 924
dihydrogen phosphate, 631
ethylate, 643, 939
ethylsulphate, 643
fluoride, 579
glycerinophosphate, 638
glycerophosphate, 638
assay, 1459
hippurate, 1029
hydrate, 617
hydroxide, 617, 1541
antidote, 1941
assay, 1459
dekanormal, 1561
double-normal, 1562
fiftieth-normal, 1563
half-normal, 1563
hundredth-normal, 1564
normal, 1562
solution, 257, 618, 1570
assay, 1459
tenth-normal, 1563
test solution, 1550
special, 1550
hypobromite solution, 1570
test solution, 1550
hypophosphite, 638
assay, 1464,
elixir, 338
syrup, 284
hyposulphite, 634
incompatibility, 1649
syrup, 284
indigodisulphonate, 841
indigotindisulphonate, 849
iodide, 628
assay, 1462
sterile solution, 1802
metanilate, 811
naphthionate, 811
nitrate, 643
nitrite, 628, 1541
assay, 1475
nitroferricyanide, 1541
nitroprusside, 643, 1541
test solution, 1550
oleate, 1047
acid, 1047
orthophosphate, 643
oxalate, 1541
paratoluene sulphonchloramide, 855
perborate, 640
assay, 1474
phenobarbital, 926
phenolate, 643
phenolsulphonate, 643
phosphate, 629, 1541
assay, 1463
compound solution, 258
effervescent, 630

Sodium phosphate exsiccated, 631
assay, 1463
solution, compound, 642
test solution, 1550
tribasic, 643
phosphotungstate test solution, 1550
picramate, 811
pyroborate, 622
pyrocatechin monoacetate, 936
pyrophosphate, 643
salicylate, 632
assay, 1457
and sodium iodide with colchicine, sterile solution, 1802
elixir, 334
compound, 334, 338
narcein sodium, 1165
sterile solution, 1802
salts, 617
unofficial, 642
sesquicarbonate, 643
silicate, 592, 643
solution, 260, 592
silico-fluoride, 643
stannate, 643, 736
sulphate, 633
assay, 1479
sulphide, 1541
test solution, 1550
exsiccated, 643, 1542
sulpho-oleate, incompatibility, 1650
sulphovinate, 643
tartrate, 643
neutral, 1542
test solution, 1550
tetraborate, 622
tetrabromphenolphthalein, 848, 861
tetraiodophthalein, 848
thiosulphate, 634, 1542
assay, 1470
incompatibility, 1649
sterile solution, 1803
tenth-normal, 1564
test solution, 1550
two-hundredth-normal, 1565
triphosphate, 643
tungstate, 1542
valerate, 643
Sofos, 631
Soft coal, 93
soap, 1052, 1055
liniment, 346
compound, 348
zinc glycerogelatin, 515
paste, 517
Unna's, 517
Soilime, 1976
Sol, 1976
Solanaceous drugs, 1132
Solaneine, 1159
Solanidine, 1159, 1163
Solanine, 1159, 1163, 1167
Solanum, 1163
carolinense, 1163
Dulcamara, 1159
fluidextract, 437
tuberosum, 1542
Solar oil, 1973
Solarson, 873

Solid anethol, 968
official preparations made without percolation or maceration, 474
opodeldoc, 348
petrox, 353
petroxolin, 353
preparations made by percolation, 451
top gas stove, 100
Solidago odora, 985
Solidified alcohol, 95
copaiba, 488
dispensing, 1672
solution, 171
Solids, specific gravity, 66, 78
Soloid nizin, 698
Solorgentum-Squibb, 876
Sols, reversible, 186
Solubilities, method for determining, 182
Solubility, 1526
aromatic chemicals, 1226
as a test, 175
chemicals, 173
table, 176
"Soluble", 175
antiseptic powder, 481
barbital, 924
ferric citrate, 716
oxide, 727
phosphate, 719
assay, 1467
pyrophosphate, 728
glass, 616, 643, 1976
gluside, 834
guncotton, 796
luminal, 926
manganese citrate, 706
assay, 1481
glycerophosphate, 707
assay, 1481
manganous glycerinophosphate, 707
oxide iron, syrup, 277
saccharated iron, syrup, 277
saccharin, 834
Solute, 171
Solutio chloroformicæ, 342
mastiches chloroformica composita, 342
resinæ chloroformica, 342
Solution, 171
acid phosphates, 258, 682
acriflavine, 1775
aids in effecting, 1652
albuminized iron, 724
alkaline aromatic, 257, 340
antiseptic, 340
aluminum acetate, 258, 702
assay, 1478
diluted, assay, 1478
acetico-tartrate, 259
subacetate, 258, 703
ammonia, anisated, 312
ammonium acetate, 257, 652
assay, 1457
citrate, 259
amylene-chloral, 932
antiseptic, 257, 339
pepsin, 258
aromatic pepsin, 258
arsenic and mercuric iodides, 257
chloride, 765
Clemens', 259

Solution, arsenic hydrochloric, 765
arPearson's, 637
senous acid, 257, 765
assay, 1471
and mercuric iodide, 768
assay, 1462, 1471
iodides, incompatibility, 1649
atropine sulphate, 259
sterile, 1798
basic ferric sulphate, 731
bismuth, 258, 775
Boulton's, 578
brain extract, 1203
bromine, 259, 575
Smith's, 575
Burow's, 702
calcium cacodylate, sterile, 1798
chloride, 1569
sterile, 1799
hydroxide, 257, 672
carmine, 258, 843
Carrel-Dakin, 570
chemical, 171
chlorinated lime, 1569
potassa, 260
soda, 257, 569
assay, 1468
surgical, 257, 570
assay, 1468
chlorine compound, 258, 573
chromic acid, 259
circulatory, 173
coal tar, 258, 812
cochineal, 258
colloidal, 171
copper sulphate, 1570
cresol, compound, 257, 814
assay, 1484
crude cresol, compound, 815
Dakin's, modified, 570
dental anesthetic, 836
dextrose, sterile, 1799
Dobell's, 641
Donovan's, 768
incompatibility, 1649
double-normal, 1453
epinephrine hydrochloride, 257, 1196
assay, 1509
eutectic, 964, 987
ferric acetate, 259
chloride, 257, 259, 714
assay, 1467
strong, 259
citrate, 258, 725
assay, 1468
hypophosphite, 259
nitrate, 259
oxychloride, 259
oxysulphate, 259
salicylate, 158, 730
subsulphate, 258, 731
assay, 1468
sulphate, 723
tersulphate, 257
ferrous chloride, 259
fiftieth-normal, 1453
fire proofing, 1371
formaldehyde, 257, 929, 1775
assay, 1454
with soap, 259
Fowler's, 766
antidote, 1941, 1943
Solution, Fowler's, incompatibility, 1650
gases in liquids, 182
glycerophosphates, compound, 328
gold and arsenic bromide, 258, 769
bromide and arsenic, 769
guaiac, 1569
gutta percha, 259, 1029
Harrington's, 1774
hexamethylenamine, sterile 1799
hydrastine, colorless, 1145
compound, 258, 1145
hydrochloric acid, 1775
hydrogen dioxide, 257, 548
assay, 1474
mixed with phenol, incompatibility, 1649
peroxide, 548
hypophosphites, 260
compound, 258, 682
indigo carmine, sterile, 1799
iodine and zinc phenolsulphonate, 258, 578
carbolized, 578
compound, 257, 576
assay, 1468, 1476
phenolated, 258, 578
iron acetate, 259
albuminate, 258, 724
and ammonium acetate, 257
assay, 1457, 1467
citrate, 722
arsenite, sterile, 1799
cacodylate, sterile, 1799
chloride, 257, 259
strong, 259
citrate, 258
sterile, 1800
hypophosphate, 259
nitrate, 1259
oxychloride, 259
oxysulphate, 259
peptonate, 258, 729
and manganese, 258, 730
perchloride, 714
protochloride, 259
salicylate, 258
subsulphate, 258
tersulphate, 257, 723
assay, 1467
Labarraque's, 569
lead acetate, 1570
subacetate, 257, 738
assay, 1473
diluted, 257, 258, 742
assay, 1473
incompatibility, 1650
Locke-Ringer's, 1547
Lugol's, 576
lutein, sterile, H. W. and D., 1202
Magendie's, 1109
magnesium bicarbonate, 260
citrate, 257, 666
assay, 1481
sulphate, effervescent, 260, 670
sterile, 1800
mastic, chloroformic, compound, 342
mercuric chloride, 260
iodide, 1775
nitrate, 259
Solution mercuric nitrate acid 260
oxycyanide, 1775
mercury and potassium iodide, 259
cacodylate, sterile, 1800
cyanide, sterile, 1800
oxycyanide, sterile, 1800
salicylate, sterile, 1801
succinimide, sterile, 1801
mint and soda, 640
Monsel's, 731
molecular, 171
morphine acetate, 260
hydrochloride, 260, 1109
tartrate, 260
Nægelis, 1973
normal salt, 257
Obermeyer's, 1569
oxysulphuret of calcium, 681
pancreatic, 1176
pancreatin, 258, 1176
paraformaldehyde, assay, 1454
pepsin, 258, 1174
antiseptic, 258, 1174
aromatic, 258, 1174
peptonized iron, 729
and manganese, 730
persulphate of iron, 731
phenolated iodine, 258
phosphates, acid, 258, 682
compound, 683
phosphorus, 258, 587
Thompson's, 587
pituitary, 1193–1195
assay, 1510
extract, 1195
potassa, 599
potassium arsenite, 257, 766
assay, 1471
incompatibility, 1650
citrate, 257, 607
assay, 1455
dichromate, 1775
hydroxide, 257, 599
assay, 1459
iodide, 258, 610
assay, 1463
saturated, 610
permanganate, 260
procaine hydrochloride, 258, 836
sterile, 1801
red mercuric iodide, sterile solution, 1801
rosin, chloroformic, 342
rosolic acid, 1571
salt, normal, 627, 1795
physiological, 1795
saturated, 171
silver nitrate, sterile, 1801
simple, 171
single phase, 171
soda, 618
and mint, 258, 640
sodium arsenate, 257, 258, 637, 769
assay, 1469
diluted, 258, 637, 769
assay, 1469
sterile, 1801
bicarbonate, sterile, 1802
borate, compound, 258, 641

Solution sodium chloride, physiological, 257,627, 1795
sterile, 1802
citrate, 258, 641
assay, 1456
sterile, 1802
citro-tartrate, effervescent, 260
hydroxide, 257, 618, 1570
assay, 1459
hypobromite, 1570
iodide, sterile, 1802
phosphate, compound, 258, 642
silicate, 260, 592
sterile, 1802
and sodium iodide with colchicine, sterile, 1802
sulphurated lime, 681
thiosulphate, sterile, 1803
solids, 171
standard, 1449
strychnine acetate, 260, 1129
Hall's, 1129
hydrochloride, 260
sulphate, sterile, 1803
sulphurated lime, 258
tar, alkaline, 260, 804
tenth-normal, 1453
test, bromcresol, purple, 1450
cochineal, 1450
litmus, 1450
methyl orange, 1450
red, 1451
phenolphthalein, 1451
phenol red, 1451
thromboplastin, Armour, 1203
Hess, 1203
true, 171
two-hundredth-normal, 1453
Vleminckx's, 681
volumetric, 1449
wax, 1726
zinc and aluminum, compound, 260
chloride, 257, 692, 1568
assay, 1463
and iron, compound, 260
phenolsulphonate and iodine, 578
Solutions, 256, 1651
alcoholic, 305
aqueous, 250
arsphenamine, 869
chemical (aqueous), 257, 258
chloroform, 342
density, 172
ethereal, 343
extemporaneous, 1651
compounding, 1651
glycerin, 300
oleaginous, 345
simple, (aqueous), 257, 258
sterile, 1779, 1790
unofficial, 1798
test, 1528, 1544
unofficial, 259
volumetric, 1528, 1552
Solutol, 814
Solvay's process, 621
Solvella, 249
Solvent, 171
Solvents, 174
hydroalcoholic, 174
Solvents, immiscible, 174
new, 175
volatile, 1210
Solveol, 814
Solvin, 1976
Somnal, 939
Sophol, 1205
Sophora, speciosa 1164, 1167
Sophorine, 1164, 1167
Sorbose, 893
Sore throat salt, 1976
Sorghum vulgare, 1063
Sorrel, salt, 798
antidote, 1941
Sour salt, 945
Sources of supply, 1337
Southern prickly ash bark, 1015
Soxhlet apparatus, 133
Soy bean gruel flour, 1824
Sozal, 939
Soziodol, 939
Sozoiodolic acid, 1965
Sozolic acid, 939, 1965
Spadium stearite, 1976
Spanish flies, 1190
juice root, 900
white, 1976
Spar, fluor, 1970
heavy, 686
satin, 1976
Sparadrap, 1976
"Sparingly soluble", 175
Sparteine, 1163
sulphate, 1167
Spathum fluoricum, 1976
Spatula, powder, 1675
Spatulas, 153
Spearmint, 960
flavoring extract, 976
herb, 960
leaves, 960
oil, 960
assay, 1483
spirit, 311
water, 255
Special assay methods, 1482
copper measure, 51
form glass condenser, 133
iodo applicators, 578
legislation, 1249
percolators, 241
sales, 1380
Species, 485
ad infusum pectorale, 486
emollient, 485
emollientes, 485
laxantes, 486
laxativæ, 486
laxative, 486
pectoral, 486
pectorales, 486
Specific gravity, 55, 78, 1526
absolute, 55
apparent, 55
balance, Westphal's, 65
beads, 65
bottle, 57, 1954
Nicol's, 66
Gannal's method, 65
hydrometers, 58
scales of, 62
liquids, 57, 78
pipette, 66
practical applications of, 80
solids, 66, 78
tube, graduated, 67
Specific gravity volume, 69, 80
bottle, 69
Specifications for standard sieves, 170
Speculative account, 1407
Spelter, 1976
Spelltrum, 1976
Spencer microscope, 1435
Sperm oil, 1205
Sperma mercurii, 1977
Spermaceti, 1186
ointment, 511
Spice poultice, 482, 517
powder, rubefacient, 482
Spiegeleisen, 1977
Spiegler-Jolle's reagent, 1568
Spigelia, 1164
fluidextract, 442
marilandica, 1164
Spigeline, 1164
Spignet, 1002
Spike lavender oil, 961
Spikenard, American, 1002
Spina cervina, 1977
Spiræa, 1100
tomentosa, 1100
Spiral twist press, 225
Spirit, ammonia, 314
anisated, 312
aromatic, 307, 651
anise, 308
ants, 311
bitter almond, 312
cajuput, 315
camphor, 308
assay, 1482
cardamom, compound, 313
chloroform, 309
cinnamon, 309
colonial, 94, 809
columbian, 94, 809
ether, 312
compound, 312
ethyl nitrite, 305, 919
assay, 1482
formic acid, 311
glonoin, 310
glyceryl trinitrate, 310
assay, 1476
juniper, compound, 315
lamp, 94
lavender, 310
compound, 375
lemon, 315
methylated, 94
Mindererus, 257, 652
mustard, 314
myrcia, compound, 313
nitre, 1977
sweet, 305, 919
nitroglycerin, 310
nitrous ether, 305, 919
orange, compound, 308
peppermint, 310
perfumed, 313, 1228
phosphorus, 315, 581
potato, 1974
proof, 907
pyro-acetic, 1977
pyroxylic, 809
rosemary, 315
salt, 554, 555, 1977
spearmint, 311
turpentine, 1977
vanillin, compound, 314
volatile oils, 314

Spirits, 305
cologne, 906
hartshorn, 651
turpentine, 1018
unofficial, 314
Spiritus, 305, 1977
acidi formici, **311**
ætheris, **312**
compositus, **312**
nitrici, 307
nitrosi, 305, 307, **919**
æthylis nitritis, **305**, 919
ammoniæ, **314**
anisatus, **312**
aromaticus, **307**, **651**
fetidus, **314**
amygdalæ amaræ, **312**
anisi, **308**
armoraciæ compositus, **315**
aurantii compositus, **308**
cajuputi, **315**
camphoræ, **308**
cardamomi compositus, **313**
chloroformi, **309**
cinnamomi, 309
formicarum, **311**
frumenti, **309**, 914
glycerylis nitratis, **310**
inflammabilis, 1977
juniperi, 1977
compositus, **315**
lavandulæ, **310**
lethalis, 1977
limonis, **315**
menthæ piperitæ, **310**
viridis, **311**
Mindereri, 1977
muriatico-æthereus martiatus, 1977
myrciæ compositus, **313**
nitri dulcis, **307**, 1977
duplex, 1977
fumans, 1977
Glauberi, 1977
nitrico-æthereus, 1977
odoratus, **313**, **1228**, 1977
oleorum volatilium, **314**
phosphori, **315**, **581**
pyroxylicus, 1977
rosmarini, **315**
sacchari, 1977
salis fumans, 1977
volatilis oleosus, 307
sinapis, **314**
vanillini compositus, **314**
veneris, 1977
vini ætherius, **917**
gallici, 916
vitis, 311, 916
vitrioli, 1977
dulcis, 1977
Spirosal, 828
Spodium, 1977
Spodumene, 644
Spongy pepsin, 1172
Spontaneous evaporation, **127**
Spray, aromatic oil, **354**
eucalyptol, **354**
menthol, **354**
compound, **355**
thymol, **355**
Sprays, 354
Spreading plasters, **1753**
Spritz bottle, 189
Spurge olive, 1008
pill-bearing, 1028
Spurred rye, 1129
Squalis carcharias, 1205
Squamous cells in urine, **1446**
Squaw root, 1073
vine, 1029
Squibb's diarrhea mixture, **295**
mercurial shaker, 749
urinometer and jar, 63
well tube percolator, 241
Squill, 1068
antidote, 1944
assay, 1505
compound pills, 498
digitalis and mercury pills, **494**
fluidextract, **415**
oxymel, **285**
syrup, **270**
compound, **270**
tincture, **380**
vinegar, **449**
Squire's infusion mug, 358
Squirrel corn, 1158
Stachyose, 893
Stainless iodine ointment, **509**
Stains and accessories for study of microörganisms, 1573
Stand, funnel, 139, 201
percolator, 245
retort, 138
Standard fluidextract cannabis, 1507
ergot, 1509
powdered pituitary, 1194, 1511
sieves, specifications, 170
solution, 1449
thermometers, U.S.P.X., 106
Standardization, physiological, definition, 2
Standards for plasters, 521
Stannate, sodium, 643, 736
Stanni chloridum, 736
hydroxidum, 736
sulphidum, 736
Stannic acid, 736
salts, 736
Stannous chloride, 736, **1542**
test solution, 1550
acid, 1550
hydroxide, 736
salts, 736
sulphide, 736
Stannum, 736
cinereum, **1977**
indicum, 1977
glaciale, 1977
Staphisagria, 1165
antidote, 1944
fluidextract, **442**
oil, 1046
ointment, 512
Staphisagrine, **1167**
Staphylococcus bacterin, 1919
serobacterin, 1921
vaccine, 1919
Star anise flavoring extract, 976
oil, 968
grass, 1073
Starch, **882**, 884
and boric acid poultice, **518**
cataplasm, 518
corn, **882**
glycerite, **300**
gum, 1977
incompatibility, **1650**
Starch, iodized, **568**
-potassium iodide test solution, 1551
potato, 1542
poultice, 518
powder, 1725
sugar, 894
syrup, 894
test solution, **1551**
Starches, 893
Starwort, 1079
State banks, 1284
laws, 1292
Statement, assets and liabilities, 1410
finances for druggists, 1426
profit and loss, 1410, 1419
Statements, financial, 1420
Statice, 1100
limonium, 1100
Stationery, 1347
Stavesacre, 1165
Steam bath open, 115
baths, 114
boiler, 117
coil, horizontal, 118
kettle, 118
upright, 118
zig-zag, 118
distillation, 133
distributor, 115
kettle, 117
enameled, 118
glass-lined, 118
on trunnions, 117
over naked fire, 118
tilting, 117
pressure without use of boiler, 119
superheated, table of temperatures, 116
under pressure, use of, 115, 116
use of in pharmaceutical operations, 114
without pressure, use of, 115
Stearate, zinc, **694**
assay, 1458
ointment, **511**
Stearic acid, 1047
coating, 1722
Stearin, 1032
Stearite spadium, 1976
Stearophanic acid, 1965
Stearoptene, 948
Stearoptenes from volatile oils 986
Steatina, 249
Steatins, 521
Steatite, 1977
Steel, 709
drops, 1977
mixture, 1977
tincture, 1977
Steer's opodeldoc, 1974
Stereochemic formulas, 780
Stereochemical formula, 530
Stereoisomerism, 781
Stereoisomers, 782
Sterile solution atropine sulphate, **1798**
calcium cacodylate, **1798**
chloride, **1799**
dextrose, **1799**
hexamethylenamine, **1799**
indigo carmine, **1799**

Sterile solution, iron arsenite, 1799
cacodylate, 1799
citrate, 1800
lutein H. W. and D., 1202
magnesium sulphate, 1800
mercury cacodylate, 1800
cyanide, 1800
oxycyanide, 1800
salicylate, 1801
succinimide, 1801
procaine hydrochloride, 1801
red mercuric iodide, 1801
silver nitrate, 1801
sodium arsenate, 1801
bicarbonate, 1802
chloride, 1802
citrate, 1802
iodide, 1802
salicylate, 1802
and sodium iodide with cochicine, 1802
thiosulphate, 1803
strychnine sulphate, 1803
solutions, 1779, 1790
unofficial, 1798
Sterility testing, 1794
Sterilization, 1779
by means of chemical agents, 1787
extemporaneous, 1786
Sterilized distilled water, 254, 1795
Sterilizer, Arnold steam, 1782
dry heat, 1781
Sterilizers, 1783
Sterilizing ampuls, 1794
Sterling ointment pot, 1747
Sterno, 95
Stibio-kali tartaricum, 1977
Stibium, 761, 1977
Sticks, bitter, 1967
Stilbene, 1024
Stili acidi salicylici, 524
dilubiles, 524
medicamentorum, 524
Still, Regnault, 143
Remington, 141
small vacuum, 126
vacuum, 126
water, Barnstead, 142
Stokes' automatic, 142
Stillingia, 1014
fluidextract, 437
compound, 438
sylvatica, 1014, 1031
syrup, compound, 282
Stills, metal, 141
pharmaceutical, 141
registration, 145
Stilus acidi salicylici dilubilis, 524
disolubilis, 249, 524
unguentis, 249, 524
Stipites dulcamaræ 1977
Stirrer, bent horn, 126
double, 126
horn, 126
porcelain, 126
wooden, 126
Stirrers, use, 125
Stock depreciation, 1421
pharmaceuticals, 1614
room, 1331
-turnover, 1272, 1334
Stoichiometry, 538
Stokes' automatic water still, 142
expectorant, 296, 1969
granulator, 1707
liniment, 349
rotary tablet machine, 1710
suppository molds, 1740
Stomach drops, 384
Stomachic drops, bitter, 384
tincture, 384
Stone crocks for filtration, 208
pumice, 591
Stoneware filters, 204
Stopper wrench, 552
Stoppered funnel tube, 138
Storax, 1025, 1219
assay, 1476
calamita, 1977
liquid, 1025
Store arrangement, 1307
atmosphere, 1308
front, expense proposition, 1424
fronts, 1309
layout, 1310, 1317
location, 1302, 1303
name, 1306
value, 1307
Storesin, 1026
Stoughton's elixir, 373, 1969
great cordial elixir, 373
Stovaine, 838
incompatibility, 1650
Stovarsol, 874
Stove, alcohol, 95
electric, 101
gas, 100
gasolene, 96
pocket alcohol, 95
solid top gas, 100
wickless blue flame coal oil, 96
Strainer, Hippocrates' sleeve, 193
Strainers, canton flannel, 194
cotton cloth, 194
flannel, 194
felt, 193
hard rubber, 194
muslin, 194
woolen, 193
Straining, 193
Stramonii semen, 1164
Stramonium, 1138
antidote, 1941, 1944
assay, 1499
extract, 463
assay, 1498
pilular, 463
powdered, 464
fluidextract, 438
ointment, 510
tincture, 380
seed, 1164
oil, 1046
tincture, 401
assay, 1499
Strawberry, 947
Strength of official acids, 553
of tinctures, 365
Strengthening plaster, 521
Streptococcus antitoxin scarlet fever, concentrated, 1904
Dochez method, 1906
bacterin, 1919
Streptococcus serobacterin, 1921
toxin, scarlet fever, 1916
vaccine, 1919
Strike, 1977
Strong acids, handling, 552
mercurial ointment, assay, 1462
protargin 874, 875
resorcinol paste, 516
salicylic acid wool, 1762
silver protein, 874
assay, 1462
solution, ferric chloride, 259
iron chloride, 259
Stronger ammonia test solution, 1544
water, 651
assay, 1455
compound decoction sarsaparilla, 363
salicylic plaster, 521
ether, 917
mercurial ointment, 504
pills, iron, quinine, strychnine and arsenic, 495
resorcinol paste, Lassar's, 516
rose water, 255
tincture colchicum corm, 388
assay, 1500
iodine, 393
assay, 1469
Strontii bromidum 689
carbonas, 689
chloridum, 689
hydroxidum, 689
iodidum, 689
lactas, 689
nitras, 689
oxidum, 689
salicylas, 688
sulphas, 689
Strontium, 532, 661, 688
bromide, 689
carbonate, 689
chloride, 689
hydroxide, 689
iodide, 689
lactate, 689
nitrate, 689
oxide, 689
salicylate, 688
assay, 1456
salts, tests, 688
unofficial, 689
sulphate, 689
Strophanthi tinctura P. I., 381
Strophanthin, 1069
crystallized, 1068
Strophanthinum, 1069
Strophanthus, 1069
antidote, 1944
assay, 1505
extract, 470
hispidus, 1069
Kombe, 1069
seed, 1069
tincture, 381
Structural formula, 530
Structure of a perfume, 1220
Strychni semen P. I., 1126
tinctura P. I., 377
Strychnina, 1126
Strychninæ glycerophosphas, 1128
nitras, 1127

Strychninæ sulphas, 1128
valeras, 1128
Strychnine, 1126
acetate solution, 260, **1129**
aloin and belladonna pills, 493
compound, **493**
and quinine valerate elixir, 338
bismuth and pepsin elixir, **331**
iron and cinchona alkaloids, elixir, **324**
glycerophosphate, 1128
hydrochloride solution, 260
iron and cinchona alkaloids, elixir, **324**
and quinine elixir, **326**
quinine and arsenic pills, mild, **496**
stronger, **495**
nitrate, 1127
tablets, assay, 1502
quinine and ferric pyrophosphate, elixir, **326**
solution, Hall's, **1129**
sulphate, 1128
sterile solution, **1803**
tablets, assay, 1502
valerate, 1128
elixir, **338**
Strychnos castelnæi, 1533
crevauxii, 1533
ignatia, 1126
ignatii, 1160
nux vomica, 1126
toxifera, 1533
Stupa, 249
Stypteria, 699, 1977
Styptic collodion, **344**
cotton, **796**
gauze, **1762**
wool, **1762**
Stypticin, 1112
Styptol, 939, 1112
Styracin, 1026
Styracol, 936, 1977
incompatibility, 1650
Styrax, 1025
benzoin, 1024
Styrol, 1026
Styrolene alcohol, 1222
Styrone, 1977
Subacetate aluminum, solution, **703**
cupric, **744**
lead, cerate, **514**
diluted solution, **742**
assay, 1473
solution, **738**
assay, 1473
incompatibility, 1650
Subcarbonate, bismuth, **770**
assay, 1477
Subchloride, mercury, **753**
Sub-coating, 1727
Subcutaneous tuberculin test, 1935
Subcutin, 939
Subgallate, bismuth, **771**
assay, 1477
Subiodide, sulphur, 584
Sublamine, 940
incompatibility, 1650
Sublimate, 146
corrosive, **752**
Sublimate, corrosive, antidote, 1942
gauze, **1761**
wool, **1763**
Sublimates, cakes, **146**
crystal, 147
powder, 146
Sublimation, 120, 146
Sublimed sulphur, **581**
assay, 1480
Subliming apparatus, 146
Subnitrate, bismuth, **772**
assay, 1477
Subsalicylate, bismuth, **773**
assay, 1477
mercuric, **756**
Subscription, 1590
Subsulphate, ferric, solution, **731**
assay, 1467
mercuric, yellow, 759
Succata, 1977
Success formula, 1269
Succi spissati, 451
Succinate, benzyl, 933
dibenzyl, 933
Succinic acid, 786, 940
dioxide, 932
Succinimide, mercuric, 879
Succinum, 1030, 1977
Succinyl, 940
Succolata, 1977
Succus citri, 947
et pepsinum, **1177**
pomorum, 946
Sucrol, 1977
Sucrose, 893, **896**, 1542
assay, 1484
Sucrosum, **896**
Suet, benzoinated, 1044
mutton, 1043
prepared, 1043
Suffitus, 1977
Sugar, **896**
acid, 1965
barley, 897
beet, **896**
bread, 894
cane, **896**
coating, extemporaneous, 1721
pills, 1722
tablets, 1722
color, 1977
confectioners' granulated, 896
corn, 894, 1968
druggists' standard, 896
fruit, 1970
grape, **894**
honey, 1971
lead, **737**
loaf, 896
lozenge, 896
lump, 896
malt, Borcherdt's, 1821
milk, 898
percolation, 245
percolator, Hardesty, 263
pulverized, 896
sand, 1977
special standard granulated, 896
reactions, 1570
starch, 894
XXXX, 896
Sugarless coating, 1730
Sugars, 893
and saccharine substances, 893
aromatic, 897
non-reducing, 893
oil, 484, 485
raw, 896
reducing, 893
Suggestive selling, 1383
Suint, 596, 1042, 1977
Suits' pressure percolator, 244
Sullivan transfer file, 1618
Sulphaminol, 940
Sulphanilate, zinc, 698
Sulphanilic acid, 811, 940, 1542
test solution, 1551
Sulpharsphenamina, 873
Sulpharsphenamine, 873
Sulphas americanus australus, 1977
Sulphate, aluminum, **701**
assay, 1478
ammonium, 660
aniline, 1530
antimony, 763
atropine, 1134
barium, **686**
bebeerine, 1165
cadmium, 705
calcium, 683, 1531
exsiccated, 683
cerium, 705
chromic, 734
cinchonidine, 1124
cinchonine, 1123
codeine, 1110
tablets, assay, 1502
copper, **743**
antidote, 1942
assay, 1466
cupric, **743**, 1532
ammonium, 744
anhydrous, 1532
ferric ammonium, 732, 1533
basic, solution, **731**
solution, **723**
ferrous, **719**, 1533
assay, 1474
dried, **720**
exsiccated, **720**
assay, 1474
granulated, **721**
precipitated, **721**
lead, 742
lithium, 648
magnesium, **665**, 1536
assay, 1480
effervescent, **670**
solution, effervescent, 670
manganese, 709, 1536
mercuric, 760
incompatibility, 1650
morphine, 1108
solution, 1109
tablets, assay, 1502
nickel, 735
potassium, **615**, 1540
assay, 1479
quinidine, 1122, **1167**
quinine, 1115
acid, 1116
silver, **747**, **1541**
sinapine, **993**
sodium, **633**
assay, 1479

Sulphate, sparteine, 1167
strontium, 689
strychnine, 1128
tablets, assay, 1502
uranous, 734
uranyl, 734
zinc, **695**
antidote, 1944
assay, 1479
Sulphates, 581
soluble, incompatibility, 1650
tests for, 581
Sulphethylate, potassium, 939
silver, 939
Sulphhydric acid, 1965
Sulphide, allyl, 994
antimony, purified, 763
barium, 688
antidote, 1941
cadmium, 705
calcium, 683
crude, 683
ferrous, 732
hydrogen, 580, **581**, 1535
mercuric, black, 760
red, 760
nickel, 735
potassium, 616
sodium, 1541
stannous, 736
zinc, 698
Sulphides, 580
tests for, 581
Sulphite, ammonium, 660
calcium, 684
magnesium, 670
potassium, 616
sodium, acid, 1540
exsiccated, 643, 1542
Sulphites, 581
tests for, 581
Sulphocarbolate, zinc, **696**
Sulphocarbolic acid, 938
Sulphocyanate, potassium, 616, 993, 1540
Sulphocyanide, allyl, 993
ammonium, 660
Sulphonal, **921**
incompatibility, 1650
Sulphonate, potassium guaiacol, 940
scarlet red, 850
Sulphonated bitumen, 866
assay, 1457, 1480
collodion, **344**
ointment, **507**
petroxolin, **352**
Sulphonethylmethane, **922**
incompatibility, 1650
Sulphonmethane, **921**
incompatibility, 1650
Sulphonmethanum, **921**
Sulpho-oleate sodium, incompatibility, 1650
Sulphophenic acid, 938
Sulphosalicylic acid, 1542
Sulpho-salts, 580
Sulphovinate, sodium, 643
Sulphovinic acid, 935
Sulphur, 532, 580, 1542
and cream of tartar tablets, **502**
troches, 499
and potassium bitartrate tablets, **502**
troches, 499
Sulphur, antimoniatum fuscum, 1977
auratum, 1977
balsam, 1967
candles as a disinfectant, 1873
confection, 489
dioxide, 580
as a disinfectant, 1870
liquid as a disinfectant, 1872
flour, 582
flowers, **581**
iodide, **584**, 1467
liver, **596**
lotum, **582**
lozenge, 499
milk, 583
nigrum, 1977
ointment, **506**
alkaline, **510**
compound, **511**
præcipitatum, **583**
precipitated, **583**
assay, 1480
roll, 580
ground, 582
stibiatum rubeum, 1977
rubrum, 1977
subiodide, 584
sublimatum, **581**
sublimed, **581**
assay, 1480
trioxide, 580
troches, 500
vegetable, 1978
vivum, 1977
washed, **582**
assay, 1480
Sulphurated antimony, 763
lime, 683
solution, 258, **681**
petroxolin, **353**
compound, **353**
potassa, **596**
assay, 1482
zinc paste, **517**
Unna's, **517**
Sulphureted hydrogen, 580
Sulphuric acid, **558**, 580, 1542
antidote, 1940
aromatic, **561**
assay, 1454
assay, 1453
concentrated, 1542
diluted, **562**, 1542
assay, 1453
evaporating, 128
fiftieth-normal, 1567
fuming, 1543
half-normal, 1566
incompatibility, 1650
Nordhausen, 560
normal, 1565
tenth-normal, 1566
test solution, 1551
anhydride, 580
ether, **917**
Sulphuris, 499
et potassii bitartratis, 499
iodidum, **584**
Sulphurous acid, 580, 1543
anhydride, 580
Sulphydrate, calcium, 684
ethyl, 787
Sumac berries, 946
Sumach, sweet, 1100
Sumatra benzoin, 1024
Sumbul, 967
extract, **469**
fluidextract, 442
tincture, **399**
Summer pressed, oils, 1033
savory oil, 986
Sun cholera mixture, **295**
Sundew, 1027
Superbine, 1164
Super-concentrated diphtheria antitoxin, 1902
Superheated steam temperatures, table of, 116
Supernatant liquid, 216
Superscription, 1588
Supplies, sources, 1337
Suppositor, 1743
Suppositoria, 523, 1733
acidi carbolici, **523**
tannici, **523**
belladonna, **523**
boroglycerini, **523**
glycerini, **523**
iodoformi, **523**
morphinæ, **523**
plumbi composita, **523**
Suppositories, 523, 1733
belladonna, 523
board for cutting, 1742
boroglycerin, **523**
carbolic acid, 523
compressed, 1740
dispensing, 1744
glycerin, **523**
glycerinated gelatin, 1737
hand-made, 1734
ichthyol, 1742
iodoform, 523
lead compound, 523
molded, 1736
morphine, 523
oil of theobroma, 1734
rectal, 1733
infant, 1733
rolled, 1734
shapes, 1734, 1735
tannic acid, 523
unofficial, 523
urethral, 1744
vaginal, 1733
Suppository box, 1744
capsules, 1743
molds, 1738
shaping, 1743
Supracapsulin, 1196
incompatibility, 1646
Supranephane, 1196
Suprarenal glands, desiccated 1197
products, unofficial, 1197
Suprarenalin, 1196
incompatibility, 1646
Suprarenaline, 1195
Suprarenals, dried, 1197
Suprarenalum siccum, 1197
Suprarenine, 1195
Surface evaporation, economical, 127
Surgeons' adhesive plaster, 1751
Surgical dressings, 1756
care, 1761
gauze, 1757
pituitrin, 1195

Surgical solution, chlorinated soda, 257, **570**
assay, 1468
Sus scrofa, 1040, 1172, 1175
Suspended percolator, 242
Suspensoid, 186
Suture, obstetrical catgut, 1773
Sutures, absorbable, 1766
and ligatures, 1766
dispensing, 1777
arterial, 1773
cervix, 1773
circumcision, 1773
gastroenterostomy, 1773
horsehair, 1767
linen, 1767
non-absorbable, 1766
silk, 1767
skin, 1773
wire, 1768
Swallow oil, 1973
Swedish balsam, 369
Sweet almond, 1034
oil, 1034
bark, 1005
basil flavoring extract, 976
oil, 986
birch oil, 982
brake, 1007
cicely oil, 986
clover, yellow 1077
elm, 887
fern, 1100
marjoram flavoring extract, 976
oil, 986
oil, 1973, 1977
orange oil, 954
peel, 953
tincture, **367**
potato, 883
spirit of nitre, **305**, **919**
sumach, 1100
tincture rhubarb, **397**
violet oil, 986
Sweetwood, 900
Swertia chirayta, 1074
Swift's B mill, 163
mill, 162
Sydenham's laudanum, **395**
Sylvacrol, 1014
Sylvestrene, 1022
Sylvite, 613
Symbol, chemical, 529
Symbolic characters in Latin prescriptions, 1589
formula, 17, 20
Symphytum officinale, 891
Synonym, 17, 19
Synthesis, 528
Synthetic anise oil, 969
oil, cassia, 972
cloves, 974
wintergreen, 982
perfumery, 953
compounds, 1217
material, 1210
Synthetics, 811
Syphon, 191
diagram, 191
Syringa vulgaris, 986
Syringe glass, 214
Syrup, **265**
acacia, **283**
and morphine, **284**
almond, **283**
Syrup, althea, **272**
ammonium hypophosphite, **272**
aromatic, **283**
asarum, compound, **273**
bromides, **273**
buchthorn berries, **281**
calcium and sodium hypophosphites, **274**
hydrochlorophosphate, **283**
hydroxide, 283
hypophosphite, **274**
iodide, **274**
lactophosphate, **275**
and iron, **275**
cascara, aromatic, **283**
chloral, **283**
cimicifuga, compound, **283**
cinnamon, **275**
citric acid, **264**
cocoa, **273**
coating, 1727
codeine, **283**
coloring solutions for, 1726
corn, **894**
Cuisinier, 1977
Dover's powder, **279**
Easton's, **276**
eriodictyon, aromatic, **276**
ferric hypophosphite, **284**
ferrous chloride, 284
iodide, **267**, **718**
assay, 1462
phosphate, 284
figs, compound, **277**
garlic, **272**
ginger, **271**
glucose, **284**
glycyrrhiza, **277**
hive, **270**
Coxe's, **270**
hydriodic acid, **265**, **577**
assay, 1462
hypophosphites, **277**
compound, **278**
iodotannic, 278
iodotannin, **278**
ipecac, **267**
and opium, **279**
iron and manganese iodide, **284**
iodide, Ruspini, 284
lactophosphate, 284
protochloride, 284
krameria, **279**
lactucarium, **284**
lemon, **284**
licorice, **277**
lime, **283**
manna, **279**
morphine and acacia, **284**
orange, **266**
flowers, **266**
orgeat, **283**
pectoral, **284**
phosphates, compound, **279**
of iron, quinine and strychnine, **276**
with quinine and strychnine, **280**
pine tar, **268**
poppy, 284
protochloride iron, 284
quinidine, **281**
bitterless, **281**
Syrup, quinidine tasteless, 1122
raspberry, **282**
rhamnus cathartica, **281**
red-poppy, 284
rhubarb, **269**
aromatic, **269**
rose, **281**
rubus, **281**
saccharated oxide of iron, **277**
sanguinaria, **284**
sarsaparilla, compound, **269**
senega, **270**
senna, **270**
aromatic, **282**
compound, **284**
simple, **265**
sodium hypophosphite, **284**
soluble oxide, iron, **277**
saccharated iron, **277**
squill, **270**
compound, **270**
starch, 894
stillingia, compound, **282**
tar, 268
thyme, **282**
compound, **283**
tolu, **271**
trifolium, compound, **283**
white pine, compound, **280**
with morphine, compound, **280**
wild cherry, **268**
yerba santa, aromatic, **276**
Syrupi, 261
Syrups, 261
percolation in making, 263
preparation, 261
preservation, 264
unofficial, 283
Syrupus, **265**
acaciæ, **283**
acidi citrici, **264**
hydriodici, **265**, **577**
allii, **272**
althææ, **272**
ammonii hypophosphitis, **272**
amygdalæ, **283**
aromaticus, **283**
asari compositus, **273**
aurantii, **266**
florum, **266**
balsamicus, 1977
bromidorum, **273**
cacao, 273
præparati, **273**
calcii hydrochlorophosphatis, **283**
hypophosphitis, **274**
et sodii hypophosphitum, **274**
iodidi, **274**
lactophosphatis, **275**
et ferri, **275**
calcis, **283**
cascaræ aromaticus, **283**
chloral, **283**
cimicifugæ compositus, **283**
cinnamomi, **275**
codeinæ, **283**
communis, 1977
corrigens, **276**
diocodii, 1977
empyreumaticus, 1977
eriodictyi aromaticus, 276
ferri et mangani iodidi, **284**
hypophosphitis, **284**

Syrupus, iodidi, 267, 718
Ruspini, 284
lactophosphatis, 284
oxidati solubilis, 277
phosphatis, 284
protochloridi, 284
quininæ et strychninæ phosphatum, 276
saccharati solubilis, 277
ficorum compositus, 277
ficus, 277
fuscus, 1977
glucosi, 284
glycyrrhizæ, 277
Hollandicus, 1977
hypophosphitum, 277
compositus, 278
iodotannicus, 278
ipecacuanhæ, 267
et opii, 279
krameriæ, 279
lactucarii, 284
limonis, 284
mannæ, 279
morphinæ et acaciæ, 284
papaveris, 284
phosphatum compositus, 279
cum quinina et strychnina, 280
picis liquidæ, 268
pini, 268
pini albæ compositus, 280
cum morphina, 280
strobi compositus, 280
cum morphina, 280
pruni virginianæ, 268
quinidinæ, 281
rhamni catharticæ, 281
rhei, 269
aromaticus, 269
rhœados, 284
rosæ, 281
rubi, 281
idæi, 282
sanguinariæ, 284
sarsaparillæ compositus, 269
scillæ, 270
compositus, 270
senegæ, 270
sennæ, 270
aromaticus, 282
compositus, 284
sodii hypophosphitis, 284
spinæ cervinæ, 281
stillingiæ compositus, 282
thymi, 282
compositus, 283
tolu, 271
tolutanus, 271
trifolii compositus, 283
zingiberis, 271
Syrupy glucose, 894
phosphoric acid, 562
System, decimal, 30
metric, 29, 73
notation, 529
Systems in crystallography, 218

T

Tabacum, 1165
Tabellæ, 499, 1701
carbonis animalis, 500
hydrargyri chloridi mitis, 500
phenolphthaleini, 500
santonini, 501
Tabellæ santonini compositæ, 501
sodii bicarbonatis, 501
sulphuris et potassii bitartratis, 502
Table, alcoholometric, 909
cost of fractions of dozen, 1355
for conversion of Saybolt or Engler viscosity into kinematic viscosity, 1527
for figuring profits, 1336, 1337
of temperatures of superheated steam, 116
of weight and volume relations, 70
showing cash discounts, 1335
profit per cent, 1335
solubilities, 176
Tables of equivalents of linear measures, 39
of weights and measures, 33
Tablet compressor, 1704
machine, Eureka, 1709
single punch, 1710
Stokes' rotary, 1710
saturates, 1703
triturate machines, 1701
triturates, molded, 1701
Tablets, 499, 1701, 1726
acetanilid, 1712
and sodium salicylate compound, 1712
compound, 1582
acid sodium phosphate, 1714
alkaline antiseptic, 1715
alkaloidal, assaying, 1501
aloe and mastic, 1715
aloin, belladonna, strychnine and cascara, 1716
ammonium salicylate, compound, 1713
animal charcoal, 500
apomorphine hydrochloride, tolerance, 1501
arsenous acid, 1713
aspirin, 1714
atropine sulphate, 1714
bacillus bulgaricus, 1182
bichloride, 500
Blaud's mass, 1719
Bulgara, 1180
Bulgarian bacillus, 1181
calomel, 500
and santonin, 501
and soda, 1718
charcoal, 500
coating, 1720
cocaine hydrochloride, assay, 1501
codeine sulphate, assay, 1502
compressed, 1704
corrosive sublimate, 500
mercuric chloride, poison, assay, 1479
cream of tartar and sulphur, 502
Dakin-Dunham, 936
galactenzyme, 1182
hypodermic, assay, 1501
tolerances, 1501
iron, quinine and strychnine, 1716
junket, 1190
lactic bacillary, 1182
mild mercurous chloride, 500
molded, 1701
Tablets, morphine sulphate, assay, 1502
pepsin and capsicum, compound, 1718
phenolphthalein, 500
poison, corrosive mercuric chloride, 500
potassium bitartrate and sulphur, 502
re-coating, 1730
santonin, 501
and calomel, 501
compound, 501
soda-mint, 501
and charcoal, 1717
sodium bicarbonate, 501
strychnine nitrate, assay, 1502
sulphate, assay, 1502
sugar coating, 1722
sulphur and cream of tartar, 502
and potassium bitartrate, 502
trituration, 1831
veronal, 923
sodium, 924
Tabletta, 249
Tabloids, 1704, 1977
Tachiol, 1977
Tailed cubebs, 995
pepper, 995, 1977
Tailings and gruffs, 170
Talbot's iodoglycerole, 304
Talc, 591, 661
native, 592
powder, borosalicylate, 484
compound, 484
purified, 592
Talcum powder, 593
violet, 1235
white borated, 1235
with zinc stearate, 1236
powders, 1235
purificatum, 592
Tamarind, 947
Tamarindus indica, 947
Tanacetin, 1017
Tanacetum, 1017
vulgare, 986, 1017
Tannalbin, incompatibility, 1645
Tannate, albumin, 1094
incompatibility, 1645
bismuth, 776
pelletierine, 1146
quinine, 1119
assay, 1476
Tannic acid, 1092, 1543
derivatives, official, 1092
unofficial, 1094
glycerite, 300
incompatibility, 1650
ointment, 503
suppositories, 523
test solution, 1551
troches, 498
Tannigen, 1093
incompatibility, 1650
Tannin, 1092
diacetyl, incompatibility, 1650
formaldehyde, 1100
glycerite, 300
nucleo-proteid, 1094
Tannoform, 940, 1100

Tannopin, incompatibility, 1650
Tannyl acetate, 1093
Tansy, 1017
  oil, 986
Tantalum, 532
Tapioca, 883
  flake, 883
  pearl, 883
Tar, 799
  birch, rectified oil, 805
  coal, 810, 811
    colorless, 932
    purified, 932
    solution, **812**
  glycerite, **303**
  oil, juniper, 805
    mixture, 297
    rectified, 805
  ointment, **506**
    compound, **508**
  pine, **804**
    syrup, **268**
  solution, alkaline, 260, 804
  syrup, **268**
  water, 804
Taraktogenos Kurzii, 1035
Taraxacum, 1079
  elixir, compound, **335**
  extract, **469**
  fluidextract, **438**
  officinale, 1079
Tare, 57
  can, 1594
Tarred gauze, **1762**
Tartar, 601
  cream of, **601**
  emetic, **762**
    antidote, 1941
    Mynsicht's, 762
  oil, 1973
  red, 1975
  salt of, **604**, 1976
Tartaric acid, 787, **942**, 1543
    assay, 1453
    test solution, 1551
Tartarus, 1977
  boraxatus, 1977
  natronatus, 1977
  tartarisatus, 1977
  vitriolatus, 1977
Tartrate, ammonium and potassium, 660
  antimony and potassium, **762**
  antimonyl potassium, **762**
  bismuth and potassium, 775
  cupric, 744
  dimethyl-piperazine, incompatibility, 1647
  ferric and potassium, 732
  iron and ammonium, 732
  manganese, 709
  potassium, 616
    and antimony, assay, 1470
    sodium, **608**, 1538
      assay, 1456
  sodium, 643
    and potassium, **608**
    neutral, 1542
Tartrated antimony, **762**
Tartrates, tests, 942
Tartrazine, 841
Tasteless tincture ferric chloride, **389**
  iron, **389**
  syrup quinidine, 1122
Tax, income, 1289
Taxus, 1080
  baccata, 1080
Tea, breast, **486**
  Dutch, 1969
  oil, 986
  Paraguay, 1100
  St. Germain, **486**
Teaberry oil, 982
Teel oil, 1044
Tegeneria domestica, 1205
Tela, 249
Telephone, 1382
Tellurium, 532
Temperature corrections for alcoholometric table, 912
Temperatures of superheated steam, table, 116
Tenaculum, 194
Tensile strength machine, 1752
Tension of vapors, 122
Tenth-normal barium hydroxide, 1554
  bromine, 1555
  iodine, 1556
  oxalic acid, 1557
  potassium dichromate, 1557
    permanganate, 1559
    thiocyanate, 1560
  silver nitrate, 1560
  sodium hydroxide, 1563
    thiosulphate, 1564
  solution, 1453
  sulphuric acid, 1566
Terbium, 532
Terebene, 1020
Terebenum, 1020
Terebinthina, 1021
  canadensis, 1030
  cocta, 1977
Terminalia, 1100
Ternary compounds, 534
Terpenes, 791, 948
  oxidized, 1018
  true, 948
  unofficial, 985
Terpilenol, 1977
Terpin hydrate, 1020
    and codeine elixir, **335**
    and creosote elixir, compound, **336**
    elixir, **335**, 339
Terpinene, 955
Terpineol, 978, 1212, 1226
Terpini hydras, 1020
Terpinol, 1030
Terpinyl acetate, 1217, 1226
Terra alba, 1977
  blanche, 1977
  cariosa, 1977
  foliata, 1977
    mineralis, 1977
    tartari, 1977
  fullonica, 1977
  fullonum, 1977
  Japonica, 1977
  ponderosa, 1977
  rubra, 1977
  silicea purificata, 593
  sigillata, 1977
Tersulphate iron, solution, **723**
    assay, 1467
Tertiary alcohols, 786
  amines, 783
Test, arsenic, 1512
    Bettendorf's, 1513
Test, blood in urine, 1447
  boiling point, 122
  Calmette, 1935
  Detre-differential, 1936
  Dick, 1935
  glucose in urine, qualitative, 1440
  heavy metals, 1519
  Mendel and Mantoux, 1935
  Moro and Doganoff, 1935
  nitrates, 551
  nitrites, 551
  paper, Congo red, 1571
    lead acetate, 1547
    mercuric bromide, 1547
    phenolphthalein, 1451
    turmeric, 1551
  rosin, 1519
  Schick, 1935
Test solution, albumin, 1544
    ammonia, 1544
      alcoholic, 1544
      stronger, 1544
    ammonium carbonate, 1544
      chloride, 1544
      molybdate, 1544
      oxalate, 1544
      polysulphide, 1544
      sulphide, 1544
    aniline sulphate, 1544
    barium chloride, 1544
      hydroxide, 1545
      nitrate, 1545
    bromcresol purple, 1450
    bromine, 1545
    cadmium chloride, 1545
    calcium chloride, 1545
      hydroxide, 1545
      sulphate, 1545
    chloral, 1545
    chlorinated soda, 1545
    chlorine, 1545
    cobaltous chloride, 1545
    cochineal, 1450
    cupric acetate, 1545
      ammonium sulphate, 1545
      oxide, 1546
      sulphate, 1546
    diphenylamine, 1546
    ferric ammonium sulphate, 1546
      chloride, 1546
    ferrous sulphate, 1546
      acid, 1546
    formaldehyde, 1546
    fuchsin-sulphurous acid, 1546
    gelatin, 1546
    gold chloride, 1546
    hydrogen dioxide, 1546
      sulphide, 1546
    hypophosphorous acid, 1546
    indigo carmine, 1546
    iodine, 1546
      and potassium iodide, 1546
    iodobromide, 1546
    lead acetate, 1547
      alcoholic, 1547
      basic, 1547
    litmus, 1450
    magnesia mixture, 1547
      sulphate, 1547

Test solution, manganese sulphate, 1547
mercuric bromide, alcoholic, 1547
chloride, 1548
nitrate, 1548
potassium iodide, 1548
alkaline, 1548
sulphate, 1548
mercurous nitrate, 1548
metaphenylenediamine hydrochloride, 1548
methyl orange, 1450
red, 1451
naphthylamine acetate, 1548
oxalic acid, 1548
palladous chloride, 1548
phenol disulphonic acid, 1548
red, 1451
phenolphthalein, 1451
phloroglucinol, 1548
picric acid, 1549
platinic chloride, 1549
potassium acetate, 1549
carbonate, 1549
chromate, 1549
dichromate, 1549
ferricyanide, 1549
ferrocyanide, 1549
hydroxide, 1549
alcoholic, 1549
iodide, 1549
permanganate, 1549
sulphate, 1549
sulphocyanate, 1549
thiocyanate, 1549
pyrogallol, alkaline, 1549
resorcinol, 1549
silver ammonium nitrate, 1549
nitrate, 1549
sulphate, 1549
sodium acetate, 1549
bisulphite, 1549
bitartrate, 1550
carbonate, 1550
cobaltic nitrite, 1550
cyanide, 1550
hydroxide, 1550
special, 1550
hypobromite, 1550
nitroprusside, 1550
phosphate, 1550
phosphotungstate, 1550
sulphide, 1550
tartrate, 1550
thiosulphate, 1550
stannous chloride, 1550
acid, 1550
starch, 1551
-potassium iodide, 1551
sulphanilic acid, 1551
sulphuric acid, 1551
tannic acid, 1551
tartaric acid, 1551
trinitrophenol, 1549, 1551
turmeric, 1551
solutions, 1544, 1528
tuberculin, 1935
Wolff-Eisner, 1935
Testicular (orchic) substance, 1203
Testing hydrometers, 62
Tests, clinical, 1568
Tests for acetates, 800
albumin in urine, 1438
aluminum salts, 698
ammonium salts, 649
antimony salts, 761
arsenic, 764
barium salts, 686
bicarbonates, 621
bismuth salts, 770
borates, 590
bromates, 574
bromides, 574
cadmium salts, 705
calcium salts, 671
carbonates, 589, 621
cerium compounds, 704
chlorates, 567
chlorides, 567
chromium salts, 733
citrates, 944
cobalt salts, 736
copper compounds, 743
glycerophosphates, 678
gold salts, 777
hypophosphites, 564, 586
identity and purity, 21
iodides, 575
iron salts, 710
lactates, 1183
lead compounds, 737
lithium, 644
magnesium salts, 661
manganous compounds, 706
mercury compounds, 747
nickel compounds, 735
phosphates, 586
platinum salts, 777
potassium salts, 596
salicylates, 826
salts of barium, 686
silicates, 591
silver salts, 744
strontium salts, 688
sulphates, 581
sulphides, 581
sulphites, 581
tartrates, 942
thiosulphates, 635
tin compounds, 736
zinc salts, 690
of a balance, 43
general, U. S. P. and N. F., 1512
turbidimetric, 1520
Tetanine, 1204
Tetanocannabinine, 1000
Tetanus antitoxin, 1903
concentrated, 1903
crude, 1904
refined, 1903
unconcentrated, 1904
unrefined, 1904
Tetraborate, sodium, 622
Tetrabromphenolphthalein, sodium, 848, 861
Tetrabromphthalein, sodium, 848
Tetrachloride, carbon, 785, 860, 1532
as a solvent, 174
Tetrachlormethane, 785
Tetra-iodo-phenolphthalein, 938
bismuth, 935
Tetraiodophthalein sodium, 848, 865
Tetraiodopyrrol, 937
Tetramethylbenzene, 791
Tetra-methyl-mono-nitro-thionin chloride, 854
Tetramethylthionine chloride, 848
Tetranitol, 934
Tetrasaccharides, 893
Tetronal, 940
Tetroses, 893
Tetroxide, antimony, 761
Teucrium, 1017
marum, 1017
Texas snakeroot, 999
Thaleichthys pacificus, 1205
Thalline, 1167
Thallium, 532
Thanatol, 936
Thapsia plaster, 521
Thea sinensis, 986, 1154, 1150
Theatrical cold cream, 1240
Thebaicum, 1977
Thebaine, 1105
Theft insurance, 1288
Theine, 1150, 1167
Theobroma cacao, 1040, 1044, 1154, 1167
oil, 1040
Theobrominæ sodio-acetas, 1155
sodio-salicylas, 1154
Theobromine, 1154, 1155, 1161, 1167
methyl, 1972
sodio-acetate, incompatibility, 1650
sodio-salicylate, 1154
assay, 1456, 1477
incompatibility, 1650
Theocalcin, 1155
Theocin, 1154
sodium acetate, 1155
Theophyllina, 1154
Theophyllinæ sodio-acetas, 1155
Theophylline, 1154
Theophyllin sodio-acetate, 1155
Theoretical pharmacy, 1
Theory of inorganic chemistry, 527
of organic chemistry, 779
Therapeutic incompatibility, 1627
Theriaca, 1977
Theriacale, acetum, 1965
Andromachi, 1977
Thermal units, British, 92
Thermit, 1977
Thermodin, 940
Thermometer, Beckmann type, 105
centigrade, 102
clinical, 105
Fahrenheit, 102
paper scale, 102
Réaumur, 102
wet and dry, 123
Thermometers and hydrometers, 91
care of, 103
choice of, 103
differential, 105
handling of, 103
self-registering, 105
standard, U. S. P. X, 106
Thiazines, 841

Thigenol, incompatibility, 1650
Thiocarbamide, allyl, 993
Thiocol, 809, 940
Thiocyanate, potassium, 1540
Thioglycollamide, antimony, 874
Thioglycollate, antimony sodium, 874
Thiolin, 1977
Thiolinic acid, 1965
Thionic series, 580
Thiophene, 792
Thiosinamin, 994
Thiosulphate, calcium, 684
sodium, **634**, 1542
assay, 1470
incompatibility, 1649
Thiosulphates, tests for, 635
Thiosulphuric acid, 580
Thioxydiphenylamine, 940
Thistle top funnel tube, 138
Thomas balsam, 1977
Thomsonian number six, **386**
Thompson's solution of phosphorus, **587**
Thoria, 704
Thorianite, 704
Thorite, 704
Thorium, 532, 690, 704
nitrate, 704
-sodium citrate, 704
solution for cystography, 704
for pyelography, 704
Thoroughwort, 1011
Thread counter, 1758
Three bromides, elixir, **319**
cresols, purified, 816
Thrombin, 902
Thromboplastin hypodermic, Squibb, 1203
Lederle, 1203
solution, Armour, 1203
Hess, 1203
Squibb, 1203
Thuja, 1005
fluidextract, **439**
occidentalis, 986, 1005, 1063
oil, 986
Thujetin, 1063
Thujigenin, 1063
Thujin, 1005, 1063
Thujone, 1016
Thulium, 532
Thus gum, 1018, 1021, 1970
Thymacetin, 940
Thyme, 962
flavoring extract, 976
fluidextract, **439**
garden, 962
oil, 962
assay, 1483
syrup, **282**
compound, **283**
Thymol, **963**
blue, 543
iodide, **864**
assay, 1465
Thymolis iodidum, **864**
Thymolol, 1978
spray, **355**
Thymus, 962
gland, desiccated, 1203
vulgaris, 962, 963
Thyroglobulin, 1198
Thyroid, 1198
assay, 1465
Thyroideum, 1198
siccum, 1198
glands, desiccated, 1198
Thyroxin, 1199
assay, 1465
crude, 1200
Thyroxinum, 1199
Tilia, 986, 1017
americana, 1017
Tilting steam kettle with stirrer 117
Tin, 532, 735, 736, 1543
butter, 1967
compounds, tests for, 736
oleate, 1047
salt, 736, 1976
salts, unofficial, 736
Tincal, 622, 1978
Tinctura aconiti, **366**
aloes, **383**
et myrrhæ, **383**
alstoniæ, **400**
amara, **384**
antimonii, **384**
antiperiodica, **384**
sine aloe, **385**
arnicæ, **385**
radicis, **400**
aromatica, **385**
asafœtidæ, **366**
aurantii amari, **367**
dulcis, **367**
balsamica, 369
belladonnæ, **367**
foliorum, **367**
benzoini, **368**
composita, **368**
berberidis, **400**
bryonia, **386**
buchu, **400**
cacti grandiflori, **386**
calendulæ, **386**
calumbæ, **369**
camphoræ composita, 379
cannabis, **400**
cantharidis, **369**
capsici, **369**
et myrrhæ, **386**
caramellis, **400**
cardamomi, **370**
composita, **370**
cascarillæ, **400**
chiratæ, **400**
chloroformi et morphinæ composita, **400**
cimicifugæ, **387**
cinchonæ, **370**
composita, **371**
cinnamomi, **387**
cocci, **400**
cocculi, **387**
colchici, **372**
cormi, **388**
seminis, **372**
croci, **388**
cubebæ, **388**
daturæ seminum, **400**
delphinii, **388**
digitalis, **372**
ergotæ ammoniata, **401**
ferri chloridi, **373**, 716
ætherea, **389**
citrochloridi, **389**
malatis crudi, **390**
pomata, **390**
gallæ, **390**
Tinctura gambir composita, **373**
gelsemii, **390**
gentianæ composita, **373**
guaiaci, **391**
ammoniata, **391**
hamamelidis, **401**
hiera, 1978
humuli, **391**
hydrastis, **392**
hyoscyami, **374**
ignatiæ, **392**
iodi, **374**
decolorata, **392**
fortior, **393**
iodidorum, **392**
ipecacuanhæ, **393**
et opii, **394**
jalapæ, **394**
composita, **394**
japonica, 1978
kaladanæ, **401**
kino, **375**
et opii composita, **401**
krameriæ, **375**
lactucarii, **401**
lavandulæ composita, **375**
limonis, **376**
corticis, **376**
lobeliæ, **376**
ætherea, **401**
matico, **401**
melampodii, 1978
moschi, **401**
myrrhæ, **376**
nucis vomicæ, **377**
oliveri corticis, **401**
opii, **377**
ammoniata, **401**
benzoica, **379**
camphorata, **378**
crocata, **395**
P. I., **395**
deodorati, **377**
et gambir composita, **395**
paracoto, **401**
passifloræ, **396**
pectoralis, 395, 401
persionis, **396**
composita, **396**
physostigmatis, **401**
picrorhizæ, **401**
pimpinellæ, **401**
podophylli, **401**
indici, **401**
pruni virginianæ, **401**
pulsatillæ, **396**
pyrethri, **401**
quassiæ, **397**
quillajæ, **397**
quininæ, **401**
ammoniata, **401**
rhei, **379**
aquosa, **397**
aromatica, **379**
dulcis, **397**
et gentianæ, **398**
sabal et santali, **398**
sanguinariæ, **398**
saponis viridis composita, **348**
scillæ, **380**
senegæ, **401**
sennæ composita, **401**
serpentariæ, **399**
stomachica, 1978
stramonii, **380**, **401**
strophanthi, **381**

Tinctura, sumbul, 399
thebaica, 1978
tolu, 381
tolutana, 381
tonica nervina Bestuscheffi, 389
valerianæ, 382
ammoniata, 382
vanillæ, 399
veratri viridis, 382
viburni opuli composita, 399
zedoariæ amara, 401
zingiberis, 382
Tincturæ, 364
ætherea, 400
herbarum recentium, 400
medicamentorum recentium 400
Tincture, aconite, 366
assay, 1506
aloe, 383
and myrrh, 383
alstonia, 400
antacrid, 1978
antimony, 384
antiperiodic, 384, 1978
without aloe, 385
arnica, 385
root, 400
aromatic, 385
asafetida, 366
balsamic, 369
bark, 371
belladonna, 367
benzoin, 368
compound, 368
berberis, 400
Bestuscheff's, 389
bitter, 384
orange peel, 367
bloodroot, 398
bryonia, 386
buchu, 400
cactus grandiflorus, 386
calendula, 386
calumba, 369
cannabis, 400
cantharides, 369
capsicum, 369
and myrrh, 386
caramel, 400
cardamom, 370
compound, 370
cascarilla, 400
catechu, compound, 373
chirata, 400
chloroform and morphine, compound, 400
cimicifuga, 387
cinchona, 370
assay, 1499
compound, 371
assay, 1499
cinnamon, 387
cocculus, 387
cochineal, 400
colchicum, 372
assay, 1499
corm, stronger, 388
assay, 1500
crude malate of iron, 390
cubeb, 388
cudbear, 396
compound, 396
datura seeds, 400
digitalis, 372
Tincture, Dover's powder, 394
ergot, ammoniated, 401
ferrated extract of apple, 390
ferric chloride, 373, 716
assay, 1468
ethereal, 389
assay, 1467
tasteless, 389
citrochloride, 389
gambir and opium compound 395
compound, 373
gelsemium, 390
gentian and rhubarb, 398
compound, 373
ginger, 382
golden seal, 392
green soap, 346
guaiac, 391
ammoniated, 391
compound, 391
Dewees', 391
hamamelis, 401
henbane, 374
hop, 391
Huxham's, 371
hydrastis, 392
assay, 1500
hyoscyamus, 374
assay, 1499
ignatia, 392
assay, 1500
Indian podophyllum, 401
iodides, 392
iodine, 374
assay, 1469, 1476
Churchill's, 393
decolorized, 392
stronger, 393
assay, 1469
ipecac, 393
assay, 1500
and opium, 394
iron, 373
malate, crude, 390
tasteless, 389
jalap, 394
compound, 394
Jamaica ginger, 382
kino, 375
and opium compound, 401
krameria, 375
lactucarium, 401
larkspur, 388
lavender, compound, 375
lemon, 376
lobelia, 376
ethereal, 401
matico, 401
musk, 401
myrrh, 376
and aloe, 383
and capsicum, 386
nutgall, 390
nux vomica, 377
assay, 1499
Oliver's bark, 401
opium, 377
ammoniated, 401
assay, 1499
and gambir, compound, 395
and ipecac, 394
camphorated, 378
denarcotized, 377
deodorized, 377
Tincture, opium with saffron, 395
assay, 1500
pale catechu, compound, 373
paracoto, 401
passion flower, 396
pectoral, 401
physostigma, 401
picrorhiza, 401
pimpinella, 401
podophyllum, 401
pulsatilla, 396
pyrethrum, 401
quassia, 397
quillaja, 397
quinine, 401
ammoniated, 401
rhubarb, 379
and gentian, 398
aqueous, 397
aromatic, 379
sweet, 397
saffron, 388
sandalwood and saw palmetto, 398
sanguinaria, 398
saw palmetto and sandalwood, 398
senega, 401
senna, compound, 401
serpentaria, 399
squill, 380
steel, 1977
stomachic, 384
stramonium, 380, 401
assay, 1499
strophanthus, 381
sumbul, 399
sweet orange, 367
tolu, 381
triturations, 1828
valerian, 382
ammoniated, 382
vanilla, 399
veratrum, Norwood's, 382
viride, 382
viburnum, compound, 399
Warburg's, 384
without aloe, 385
wild cherry, 401
witch hazel, 401
zedoary, bitter, 401
Tinctures, 364
ethereal, 400
fresh drugs, 400
homeopathic, 1827
strength of, 365
unofficial, 400
Tinned-copper funnel, 201
Tinnevelly senna, 1083
Title insurance, 1288
Tinstone, 736
Titanium, 532
Title, official English, 18
Latin, 17
Titration, 1451
of an excess of ferrous sulphate with potassium permanganate, 1475
with oxalic acid, used as reducing agent, 1475
Titrations, residual, with excess of alkali, 1454
with potassium dichromate, 1472

Titrations with sodium thiosulphate, 1465
Trade acceptances, 1281
names, 1265
Trademarks, 1264
Tragacanth, 886
compound powder, 484
cream, **1236**
glycerite, **303**
gum, 886
hand lotion, **1236**
mucilage, **286**
Tragacantha, 886
Trailing arbutus, 1100
Tralles' hydrometer, 63
Transparent soap, 1052
Transient location, 1303
Trap bulb, 134
Traumaticine, 1978
Treacle, 1978
Venice, 1978
Tree, toothache, 1015
Trèfle, 1225
Trefoil, 1214
marsh, 1079
shrubby, 1006
Trehalose, 893
Triacetate, pyrogallol, incompatibility, 1647
Triacetin, 175
Trial balance, 1407
Tribasic sodium phosphate, 643
Tribromhydrin, 994
Tribromide, allyl, 994
Tribromocarbolate, bismuth, 940
Tribromphenate, bismuth, 776
Tribromphenol, 940
bismuth, 940
incompatibility, 1645
Tribrom-tertiary-butyl alcohol, 861
Trichloracetic acid, **802**
assay, 1453
Trichloraldehyde, 857
Trichloride, antimony, 763
Trichlormethane, 785, 858
Trichlorphenol, 940
Trichlortertiarybutyl alcohol, 861
Trichocephalus dispar, 860
Tricresylphosphate, 175
Triethylamine, 1204
Trifolium, 1078
fibrinum, 1978
fluidextract, **439**
compound, **439**
pratense, 1078
syrup, compound, **283**
Trigonella fœnum-græcum, 892
Trihydroxybenzene, 1095
Trillium, 1015
erectum, 1015
fluidextract, **440**
pendulum, 1031
Trimethene, 788
Trimethylamine, 1204, 1978
Trimethylbenzene, 791
Trinitrate, glyceryl, spirit, **310**
assay, 1476
Trinitrin, 1049
Trinitrophenol, **822**, 1543
test solution, 1549, 1551
Trioleate, glyceryl, 1033
Trional, **922**
incompatibility, 1650
Trioses, 893
Trioxide, antimony, 761
arsenic, **764**, 767, 1530
assay, 1470
incompatibility, 1645
chromium, **733**, 1532
assay, 1466
incompatibility, 1646
phosphorous, 586
sulphur, 580
Trioxymethylene, **930**
Trip, 1978
Tripalmitate, glyceryl, 1033
Triphenin, 940
Triphenylmethane dyes, 850, 852
Triphenylphosphate, 175
Triphosphate, 643
sodium, 643
Triple orange flower water, **252**
rose water, **255**
Triplex pills, **493**
Tripoli, 1978
Tripolite, 1978
Trisaccharides, 893
Trisodium phosphate, 643
Tristearate, glyceryl, 1033
Trisulphide, antimony, 763
arsenic, 769
boron, **590**
Triticum, 901
fluidextract, **440**
vulgare, 883
Tritopine, 1105, 1107
Triturate machine, Colton's, 1702, 1703
automatic, 1703
Triturates, molded tablet, 1701
Trituration, 151
mortar, 151
tablets, 1831
Triturationes, **485**
Triturations, **485**
homeopathic, 1828
tincture, 1828
Trivalent arsenic compounds 867
Troches, 498, 1690, 1697
ammonium chloride, **498**
antacid, **499**
benzoic acid, **499**
bismuth, compound, **499**
carbolic acid, **499**
catechu, **499**
compound menthol, **499**
solution, **500**
compressed, 1704
cubeb, **499**
cutting, 1699
elm, **498**
eucalyptus gum, **498**
kino, **499**
extemporaneous preparation, 1700
gambir, **499**
guaiac resin, **499**
krameria, **499**
and cocaine, **499**
morphine, **499**
and ipecac, **499**
peppermint, **499**
phenolphthalein, **499**
potassium chlorate, **499**
red gum, **498**
reduced iron, **499**
santonin, **499**
Troches, santonin and calomel, **499**
compound, **499**
sodium bicarbonate, **500**
sulphur, **500**
and cream of tartar, **499**
and potassium bitartrate, **499**
tannic acid, **498**
unofficial, **499**
wood charcoal, 499
Trochiscation, 155
Trochiscator, 155
Trochisci, 498, 1697
acidi benzoici, **499**
carbolici, **499**
tannici, **498**
ammonii chloridi, **498**
antacidi, **499**
bismuthi compositi, **499**
carbonis ligni, **499**, 500
catechu, **499**
cubebæ, **499**
eucalypti gummi, **498**
ferri redacti, **499**
gambir, **499**
guaiaci resinæ, **499**
kino eucalyptus, **499**
krameriæ, **499**
et cocainæ, **499**
mentholis compositi, **499**
menthæ piperitæ, **499**
morphinæ, **499**
et ipecacuanhæ, **499**
phenolphthaleini, **499**, 500
potassii chloratis, **499**
santonini, **499**, 501
compositi, 499, 501
sodii bicarbonatis, **500**, 501
sulphuris, **500**
et potassii bitartratis, **500**, 502
ulmi, 498
Troemner's analytical balance, 1430
weights, 1431
prescription balance, 46
Troopers' ointment, 1973
Tropacocaine hydrochloride, 1167
incompatibility, 1650
Tropæolin, 940
-D, 1450
Tropeine, benzol, 1165
Tropine, 1101, 1135
Troy prescription weights, 50
weight, 28, 49
weights, cup, 49
True cinnamon, 971
digitalin, 1065, 1066
solution, 171
terpenes, 948
Trust companies, 1284
Tryparsamide, 874
Trypsin, 902, 1175, 1178
Armour, 1178
Fairchild, 1178
incompatibility, 1648
Tryptophane, 1170
Tobacco, 1165
cutter, 157
Indian, 1155
products, 1344
poison, 1974
Toilet articles, 1351
cold cream, 1240

Toilet cold cream (true), 1239
cream, 1236, 1237, 1240
lotion, 1238
soap manufacture, 1051
waters, 1228
Toison's solution, 1572
Tolene, 1024
Tolerances for hypodermic tablets, 1501
Tolidine, 811
Tolu, 1023, 1219
balsam, 1023
coating, 1722
syrup, 271
tincture, 381
Toluene, 175, 791, 811, 1543
Toluic acid, 811
Toluidenes, mixed, 811
Toluifera balsamum, 1023
pereiræ, 1024
Toluol, 799, 1543
Tonga, 1163
and salicylates, elixir, 336
fluidextract, 439
Tongs, crucible, 111
Tonic pills, Aitkin, 496
Tonka flavoring extract, 976
oil, 1046
Tonquin musk, 1204, 1218
Tonquinol, 1978
Tooth powder, 486
oxidizing, 486
Toothache drops, 356
remedy, 356
tree, 1015
Top odors, 1220
Tops, broom, 1163
Tormentil, 1100
Tormentilla, 1100
erecta, 1100
Torrefaction, 111
Torricellian tube, 122
Torsion balances, 46
prescription balance, 47
Total extraction method, 1486
Tous-les-mois, 1978
Toxalbumins, 1170
Toxicodendric acid, 1080
Toxicology, 1939
definition, 1
Toxin-antitoxin, 1915
mixture, 1897
diphtheria, 1916
Toxin, streptococcus, scarlet fever, 1916
Toxins, 1897, 1915
used in diagnosis, 1934
Toxitabellæ hydrargyri chloridi, 500
Toxoid, diphtheria, 1916
Toxoids, 1897, 1915
Tsuchyia's reagent, 1568
Tube filling machine, 1749
funnel, 138
improvised, 138
stoppered, 138
thistle top, 138
safety, 138
Torricellian, 122
Tuberculin, B. E., 1923, 1924
dried, 1924
B. F., 1923, 1924
Denys, 1923
disks for conjunctival test, 1936
Tuberculin for Von Pirquet test, 1936
intracutaneous, 1936
old, O. T., 1936
ointment for Moro reaction, 1936
O. T., 1923, 1924
residue, 1923
test, conjunctival, 1935
cutaneous, 1935
intracutaneous, 1935
percutaneous, 1935
subcutaneous, 1935
T. R., 1923, 1924
dried, 1924
Tuberculins, 1897, 1922
used in diagnosis, 1935
Tuberculosis disinfection, 1885
Tuberose, 1225
oil, 986
Tubes, collapsible, 1747
glass, bending, 134
cutting, 134
safety, 138
Tubulated distilling flasks, 133
receivers, 136, 137
retort, 132
Tucom oil, 1046
Tulip tree bark, 1079
Tully's powder, 484
Tumenol, 940
Tumenolsulphonic acid, 1965
Tungstate, sodium, 1542
Tungsten, 532
Tunnels, 200
Turbidimetric tests, 1520
Turionis pini, 1978
Turkey corn, 1158
Turlington's balsam of life, 369
drops, 369
Turmeric, 845, 883, 1543
test paper, 1551
solution, 1551
Turnera, 1011
aphrodisiaca, 1011
diffusa, 1011
Turner's cerate, 507
Turn-over, 1272, 1334
Turnsol, 1978
Turpentine, 1021
Canada, 985, 1030, 1531
larch, 1030
liniment, 349
acetic, 349
oil, 1018
emulsion, 288
rectified, 1019
spirit, 1977
spirits, 1018
Venice, 1030
Turps, 1019, 1978
Tusche, 1978
Tushy-stone, 1978
Tussilago farfara, 1076
leaves, 1076
Tussol, 940
Tutenag, 1978
Tutia, 1978
Tutty, 1978
Twaddell's hydrometer, 64
Twine, 1674
holder, 1573
reel, 1673
Two-hundredth-normal sodium thiosulphate, 1565
solution, 1453
Type process A, fluidextracts, 403
B, fluidextracts, 403
C, fluidextracts, 404
D, fluidextracts, 405
M, tinctures, 366
P, tinctures, 365
processes, aromatic waters, 252
for alkaloidal assays, 1494
Typical business transactions, 1395
Typhoid bacterin, 1919
fever, disinfection, 1878
serobacterin, 1921
vaccine, 1919
mixed, 1920
Typhus fever, disinfection, 1888
Tyramine, 1198
hydrochloride, 1131, 1198
Tyrosine, 1170
Tyrotoxicon, 1204

U

Uisge-beatha, 906
Ulmus, 887
fulva, 887
Ultimate analysis, 528, 780
principles, 780
Ultramarine, 1978
Umbelliferæ plants, 970
products, aromatic, 965
Umber, 1978
Unconcentrated tetanus antitoxin, 1904
Unction, 1978
Undecylic alcohol, 1211
aldehyde, 1213
Unequal arm, double beam balances, 45
single beam balances, 45
Unguenta, 502, 1745
extensa, 249
Unguentum, 502
acidi borici, 502
salicylici, 511
tannici, 503
aconitinæ, 511
Ægyptiacum, 1978
aquæ rosæ, 503
atropinæ, 511
belladonnæ, 503
bituminis sulphonati, 507
calaminæ, 507
calaminare, 507
camphoræ, 507
cantharidini, 511
capsici, 507, 511
cerussæ acetatæ, 1978
cetacei, 511
chaulmoogræ, 511
chrysarobini, 504
cocainæ, 511
creosoti, 511
salicylatum extensum, 522
diachylon, 506
diapompholygos, 1978
eucalypti, 511
fuscum, 508
gallæ, 504
cum opio, 511
hamamelidis, 511
hydrargyri, 504
ammoniati, 504

Unguentum hydrargyri, choridi corrosivi, extensum, 522
mitis, 508
compositum, 511
dilutum, 505
fortius, 504
iodidi rubri, 511
mite, 505
nitratis, 509
dilutum, 511
oleatis, 512
oxidi flavi, 505
rubri, 509
subchloridi, 512
iodi, 505
denigrescens, 509
iodoformi, 506
lanæ compositum, 512
matris, 508
myrobalani, 512
cum opio, 512
myrrhæ, 1978
nervinum, 1978
ophthalmicum, 1978
opodeldoc, 346
paraffini, 512
phenolis, 506
picis compositum, 508
liquidæ, 506
pini, 506
plumbi iodidi, 508
oleatis, 506
subacetatis, 512
potassii iodidi, 508
quercinum, 1978
refrigerans, 503
resinæ, 512
resorcini compositum, 510
resorcinolis compositum, 510
salicylatum extensum, 522
scytodepsicum, 1978
sinapis, 510
staphisagriæ, 512
stramonii, 510
sulphuris, 506
alkalinum, 510
compositum, 511
veratrinæ, 511
zinci extensum, 522
oleatis, 512
oxidi, 507
stearatis, 511
Unicaria gambir, 1100
Unicorn root, 1073
Units, British thermal, 92
Unna pencils, 524
Unna's soft zinc paste, 517
sulphurated zinc paste, 517
Unofficial agar preparation, 887
alkaloidal drugs, 1163
alkaloids and their salts, 1165
aluminum salts, 703
ammonium salts, 659
amylaceous substances and derivatives, 883
animal products and derivatives, 1203
antibacterial serums, 1907
antimony compounds, 874
salts and preparations, 763
antitoxins, 1904
arsenic compounds, 769, 873
astringent substances, 1100
atropine derivatives, 1135
barium salts, 687
Unofficial benzoic acid compounds, 837
bile salts and compounds, 1184
bismuth salts, 775
boron compounds, 590
bromine preparations, 861
cadmium salts, 705
caffeine preparation, 1153
calcium salts, 683
camphor preparations, 988
cerium salts, 705
chromium salts, 734
cinchophen derivatives, 1125
coal-tar dyes, 850
collodions, 344
confections, 489
copper salts, 744
creosote compounds, 809
decoctions, 363
digestive enzymes, 1176
diphtheria antitoxin, 1902
drugs containing cathartic principles, 1090
elixirs, 337
emulsions, 290
ergot preparations, 1130
extracts, 470
fermentation products, 941
fixed oils, 1045
fluidextracts, 442
fruits, 947
glycerin preparation, 444
glycerites, 304
glycyrrhiza preparation, 901
gold salts, 778
granular effervescent salts 477
guaiacol compounds, 809
hexamethylenamine compound, 931
infusions, 361
inorganic acids, 566
iodine compounds, 865
iodoform preparations, 864
ipecac preparations, 1148
iron salts, 732
lactic acid producing organisms, 1179
lead salts and preparations, 742
liniments, 349
lithium salts, 648
lotions, 299
magma, 297
magnesium salts and preparations, 670
manganese salts, 709
mercury compounds, 878
salts, 759
mixtures, 297
mucilages, 287
mucilaginous substances, 891
nickel salts, 735
ointments, 511
oleates, 351, 1047
oleoresins, 447
opium derivatives, 1112
organic compounds, 932
pancreas product, 1200
phenolphthalein dyes, 846
pills, 497
pituitary preparations, 1195
plants of Labiatæ, 964
plasters, 520
potassium salts, 615
poultices, 518
Unofficial powders, 484
preparations, miscellaneous, 524
quinine salts, 1121
resin, 473
resorcinol compounds, 824
salicylic acid compounds, 828
sandalwood products, 998
scopolamine preparation 1136
silicon compounds, 591
silver salts, 747
sodium salts, 642
solutions, 259
spirits, 314
sterile solutions, 1798
strontium salts, 689
suppositories, 523
suprarenal products, 1197
syrups, 283
tannic acid derivatives, 1094
terpenes, 985
tinctures, 400
tin salts, 736
troches, 499
uranium salts, 734
vegetable colors, 845
vinegars, 450
viruses, 1914
volatile oils, 970
waters, 256
zinc salts, 697
Unorganized sediments in urine, 1448
Unrefined tetanus antitoxin, 1904
Unsaponifiable fats, 1056
matter, 1520
Unsatisfied radicles, 784
Unsaturated hydrocarbons, 784
Unusual doses in prescriptions, 1590
Upressit ointment pot, 1747
Upright steam coil, 118
Uranii nitras, 734
Uraninite, 734
Uranite, 734
Uranium, 532, 706, 734
glass, 734
nitrate, 734
salts, unofficial, 734
Uranous sulphate, 734
Uranyl acetate, 734
sulphate, 734
Urao, 1978
Urasol, 940
Urea and quinine hydrochloride, 1121
carbamide, 1205
estimation, 1570
hydrochloride and quinine assay, 1476
in urine, 1441
Urease, 902
Ureometer, 1442
Urethane, 934
phenacetin, 940
incompatibility, 1646
phenyl, 935
Urethral suppositories, 1744
Urginea, compound pills, 498
maritima, 1068
vinegar, 450
Urinalysis, 1433
report, 1433

Urine, abnormal constituents, 1435
acetone in, 1443
Lange's test, 1443
acid, sediments, 1447
alkaline sediments, 1447
amount, 1436
appearance, 1436
Benedict's quantitative estimation of glucose, 1441
benzidine test for blood, 1447
bile content, 1443
blood-cell casts, 1446
b-oxybutyric acid, 1443
casts, 1445
chemical constituents, 1438
test for blood, 1447
chlorides, 1443
Volhard's method, 1443
color, 1436
composition, 1434
cylindroids, 1446
diacetic acid, 1443
Gerhardt's test, 1443
examination, 1436
epithelial casts, 1446
cells, 1446
erythrocytes, 1447
examination, reagents, 1568
fatty casts, 1446
granular casts, 1445
guaiac test for blood, 1448
hyaline casts, 1445
indican content, 1442
irregular cells, 1446
leukocytes, 1447
microscopic examination, 1444
normal constituents, 1434
odor, 1436
physical properties of, 1436
pus casts, 1446
cells, 1447
qualitative test for albumin 1438
glucose, 1440
reaction, 1437
red blood cells, 1447
round cells, 1446
sample, label, 1434
specific gravity, 1437
squamous cells, 1446
total solids, 1438
unorganized sediments, 1448
urea content, 1441
waxy casts, 1446
Urinometer, 63, 1437
and jar, Squibb's, 63
Uritone, 931
Urobilin, 1568
Urobilinogen, 1569
Urotropin, incompatibility, 1648
Urotropine, 931
salicylate, 939
Urson, 1097, 1098
U. S. drum filter, 208
Use of adapter, 137
blowpipe, 109
grommets, 130
hoods, 129, 130
steam in pharmaceutical operations, 114
under pressure, 115, 116
without pressure, 115
stirrers, 126
Uses of heat, 109
Usquebaugh, 904
Ustilago, 1080
Uva ursi, 1063, 1097
fluidextract, **417**

V

Vaccine, acne bacillus, 1918
antirabic, 1914
cholera, 1918
colon bacillus, 1918
gonococcus, 1918
Jennerian, 1912
meningococcus, 1918
pertussis, 1919
plague, 1919
pneumococcus, 1919
rabies, 1914
smallpox, 1912
dried, 1914
staphylococcus, 1919
streptococcus, 1919
typhoid, 1919
mixed, 1920
virus, glycerinated, 1912
Vaccines, autogenous, 1922
bacterial, 1897, 1917
mixed, 1920
sensitized, 1897, 1920
Vaccinum rabies, 1914
variolæ, 1912
Vaccu filter. 207
Vacuum apparatus, 126
distillation, 144
dryer, 127
filter, 207
filtration, 206
pump, 207
still, 126
small, 126
Vaginal suppositories, 1733
Valence, 530
Valeraldhyde, 978, 979
Valerate, ammonium, **659**, 660
elixir, **317**
amyl, 932, 1214
bismuth, 776
ethyl, 935, 1215
ferric, 732
guaiacol, 936
methyl, incompatibility, 1650
quinine, 1121
and strychnine elixir, **338**
sodium, 643
strychnine, 1128
elixir, **338**
zinc, 698
Valerene, 932
Valerian, 1000
garden, 1000
fluidextract, **440**
tincture, **382**
ammoniated, **382**
Valeriana, 1000
officinalis, 1000
Valerianate, ammonium, **659**
Valeridin, 940
Valerydin, 940
Valeryl diethylamide, 940
Validal, incompatibility, 1650
Valine, 1170
Vallet's mass, **487**, **713**
Vallez rotary filter, 210
Valuation of store, 1307
accounts, 1426
Valve funnel, 202
Valyl, 940
Vanadate, ammonium, 1529
Vanadium, 532
Vandyke brown, 1978
Vanilla, 976, 1219
bean, 976
crystals, 977
flavoring extract, 976
percolator, Hardesty's, 244
planifolia, 976
tincture, **399**
Vanillin, 973, 976, 977, 1025, 1214, 1219
elixir, compound, **336**
spirit, compound, **314**
Vanillinum, 977
Vanishing cream, 1239, **1241**
Vapor, 249
Vaporole, 1978
Vaporis, 525
siccus, 249
Vaporization, 120
Vapors, tension of, 122
Varnish, pulp capping, **342**
Vargol, 876
Vaseline, 1059
Vebea, 1029
Vegetable alkali, 618, 1966
cathartic pills, **494**
colors, official, 842
unofficial, 845
drugs, acid-insoluble ash, 1522
ash, 1522
foreign organic matter, 1521
moisture, 1522
preparation for analysis, 1521
sampling and analysis, 1520
gum, 1978
mercury, 1161
sulphur, 1978
Venetian red, 1978
Venice turpentine, 1030
Venereal disease control, pharmacist's attitude toward, 1864
Venus, 1978
crystals of, 1978
vitriol, 560
Veratramarin, 1142
Veratria, 1142
Veratridine, 1142, 1164
Veratrina, 1142
Veratrine, 1142, 1164
crystallized, 1142
ointment, **511**
oleate, **351**
Veratroidine, 1167
Veratrum album, 1142, 1166
nigrum, 1165
sabadilla, 1164
tincture, Norwood's, 382
viride, 1142, 1167
antidote, 1944
fluidextract, 442
tincture, **382**
Verbasci flores, 891
folia, 891
Verbascum phlomoides, 891
thapsiforme, 891
thapsus, 891
Verbena, 1080
fluidextract, 442
hastata, 1080
oil, 986
Verdigris, 744
Vermilion, 760, 1978
Verona orris, 1003
Veronal, **923**

Veronal elixir, 923
incompatibility, 1645
sodium, 924
tablets, 924
tablets, 923
Veronica virginica, 1089
Vert de violette, artificial, 1216
Vertical autoclave, 1784
Vertivert, 1219
Vervain balsam, 369
blue, 1080
Very fine powder, 170
"Very slightly soluble", 175
"Very soluble", 175
Vessels used in precipitation 216
Veterinary white lotion, 298
Vibrator feeder, 165
Viburnin, 1014
Viburnum, 1014
lentago, 1014
opulus, 1014, 1031
elixir compound, 337
fluidextract, 441
prunifolium, 1014
elixir, 337
extract, 470
fluidextract, 441
tincture, compound, 399
Vichy salt, artificial, 475
effervescent, 477
Vicianose, 893
Vienna powder, 1978
Vinaigre des quatres voleurs, 450
Vine, passion, 1162
Vinegar, 800, 947
acid, 1965
aromatic, 449
cantharides, 450
essence, 1969
Indian squill, 450
naphtha, 1978
of the four thieves, 450
opium, 361, 450
radical, 1975
salts, 1978
squill, 449
urginea, 450
Vinegars, 449
unofficial, 450
Vinetine, 1156
Vinum, 249
adustum, 1978
album, 941
antimonii, 384
carnis et ferri, 321
colchici cormi, 388
ipecacuanhæ, 393
rubrum, 941
xericum, 941
Viola odorata, 986
tricolor, 1080
Violet, 1225
methyl 6 B, 854
oil, sweet, 986
Paris, 6 B, 854
perfume, 1224
sachet, 1231
talcum powder, 1235
Violette, vert de, artificial, 1216
Virginia lungwort, 892
snakeroot, 999
Virgin's bower, 1016
milk, 1972, 1978
Viride æris, 1978
Virus, vaccine glycerinated, 1912
Virus, vaccinicum, 1912
Viruses, 1897
in living attenuated form and killed viruses, 1912
unofficial, 1914
Viscolizer, 1659
Viscose, 794
Viscosimeter, Engler, 1526
Saybolt universal, 1526
Viscosity, 1526
Viscum album, 1030, 1978
Vitalait culture bacillus acidophilus, 1182
Bulgaricus, 1182
starter, 1182
Vitamin A, 1168
assay, cod liver oil, 1188
B, 1168
C, 1168
D, 1168
E, 1168
fertility, 1169
Vitamins, 1168
Vitellin, 1187, 1205
silver, incompatibility, 1649
Vitis vinifera, 941
Vitriol, blue, 560, 743
elixir, 561
green, 560, 720
Mynsichti elixir, 561
of Mars, 560
of Venus, 560
oil, 560, 561
Roman, 1975
Salzburg, 1976
white, 560
Vitriols, 560
Vitriolum cupri, 1978
Romanum, 1978
Viverra, 1204
civetta, 1219
Vleminckx's lotion, 681
solution, 681
Volatile alkali, 1966
ether-soluble extractive, 1523
liniment, 347
liquids, filtration, 202, 203
percolator, 445
oil, mustard, 993
assay, 1463
oils, 948, 1209
antidotes, 1943
distillation, 951
heavy metals test, 1519
preparation, 950
spirit, 314
stearoptenes, 986
unofficial, 970
ointment, 1973
solvents, 1210
Volhard method for chlorides in urine, modified, 1443
Volume, 76
and weight relations table, 70
combination, 539
fixed, evaporation to, 129
specific, 69, 80
bottle, 69
Volumes, 28
Volumetric assay methods, 1449
involving precipitation, 1461
flask, 1552
prescriptions, 1594
solution, 1449
alkaline cupric tartrate, 1554
Volumetric solutions, 1528, 1552
normal, 1553
Vomiting salt, 1978
Von Pirquet test, 1935
tuberculin, 1936
Vouacapoua araroba, 1084
Voucher checks, 1280

W

Wadding, cellulose, 1758
Wade's drops, 369
Wafer capsules, 1685
Wahoo bark, 1088
Wake robin, 1015
Wallflower, 994, 1225
Want book, 1330
Warburg's pills, 494
without aloe, 494
tincture, 384
without aloe, 385
Ward's balsam, 369
Warming plaster, 520
Wash, ammoniated camphor, 298
black, 299
bottle for gases, 182
eye, 341
lead, and opium, 299
mouth, 339, 341
nasal, 341
opium and lead, 299
yellow, 299
Washed sulphur, 582
assay, 1480
Washes, 339
eye, 260
Washing bottles, 1666
continuous, 189
displacement, 189
Water, 544, 545
ammonia, 649
assay, 1455
stronger, 651
assay, 1455
anise, 252
as a solvent, 174
avens, 1016
bath, 113
brass, 362
baths, salt, 113
bitter almond, 256
bromine, 1545
camphor, 253
carbolic acid, 256
cherry laurel, 256
chlorine, 573, 1545
chloroform, 253
cinnamon, 254
Cologne, 1228
creosote, 256
dill, 256
distilled, 254, 547
drinking, 546
elder flower, 1005
fennel, 254, 970
Florida, 1229
glass, 592, 643, 1978
hamamelis, 256
heater, 100
hemlock, 970
Hungary, 962
-in-oil emulsions, 1655
incompatibility, 1650
-jacketed, gas heated air bath, 114
lavender, 1229

Water, lead, **742**
lily, 1100
lime, **672**
assay, 1455
orange flower, **252**
peppermint, **255**
phenolated, **256**
plantain, 1005
oil, 1005
potable, 546
rose, **255**
ointment, **503**
stronger, **255**
triple, **255**
sedative, **298**
soda, 588
spearmint, **255**
sterilized distilled, 254, **1795**
still, Barnstead, 142
Stokes' automatic, 142
stronger rose, **255**
-soluble B vitamin, 1168
C vitamin, 1168
extractive, 1523
tar, 804
triple orange flower, **252**
rose, **255**
witchhazel, **256**
Watermelon seed oil, 1046
Waters, 250
aromatic, **252**
type processes, **252**
toilet, 1228
unofficial, 256
Wax, dental, 356
earth, 1969
fossil, 1970
mineral, 1972
Montau, 1973
myrtle bark, 1004
paraffin, 1059
solution, 1726
white, 1192
yellow, 1191
Waxed paper, 1760
Waxes, paraffin, 785
Waxy casts in urine, 1446
Wedge press, 227
Weed, consumptive's, 1008
Jamestown, 1138
jimson, 1138
Weighing and measuring, 41
Weight, 26, 74
and measure, 26
and volume relations, table, 70
apothecaries, 28, 77
avoirdupois, 28
metric, 77
percolating, 238
systems, English, 74
troy, 28
Weights, 28
aluminum grain, 50
wire, 50
and measures, 73
equivalents, 33
relationship, 77
avoirdupois, 48
block, 48, 49
cup troy, 49
cylindrical, 49
metallic, 48
metric, 49, 77
block, 49
iron, 49
molecular, 537
prescription, 50
Weights, Troemner's analytical, 1431
troy, 49
prescription, 50
Well tube percolator (Squibb), 241
West India sandalwood oil, 998
Westphal's specific gravity balance, 65
Wet and dry thermometer, 123
Whale oil, 1205
Wheat, 883
Whiskey, 914
Whisky, **309**, 904, 914
raw, 914
Whitall-Tatum suppository machine, 1741
White acid, 1965
agaric, 1026
arsenic, **764**
ash bark, 1080
cedar, 1005
Charlton, 1968
Chinese, 1968
cinnamon, 1002, 1978
constant, 1968
copperas, 1978
dextrin, 889
Dutch, 1969
English, 1969
ferric phosphate, 732
flake, 742, 1970, 1978
French, 1970
gentian, 1006, 1970
Griffith's, 1970
lead, 742, 1978
liquor, 1978
lotion, 299, **597**
veterinary, **298**
mineral oil, 1057
mustard, 993
oil, 1046
nix, 1978
oak bark, 1099
Paris, 1974
pearl, 1974, 1978
permanent, 686, 1974, 1978
petrolatum, 1059
petroleum jelly, 1059
pine bark, 1029
compound syrup, **280**
with morphine, **280**
precipitate, **751**
ointment, **504**
rose extract, 1224
perfume, 1224
sandalwood, 997
Spanish, 1976
vitriol, 560
wax, 1192
wine, 941
zinc, 1978
Whiting, 676
Whole ovary, 1201
Wholesale druggists, 1337
firm financing, 1274
Wickless blue flame coal oil stove, 96
Wiener trank, 361
Wigger's ether, 935
Wild basil, 964
black cherry bark, 991
chamomile, 1012
cherry, 991
fluidextract, **434**
infusion, **362**
syrup, 268
tincture, 401
Wild cinnamon, 1002
ginger, 985
indigo, 1156
mustard, 994
radish, 994
yam root, 1027
Wiley mill, 166
Wilkinson's ointment, **511**
Willow, 1080
herb, 892, 1100
poplar buds, 1005
Wind flower, 1013
Window display calendar, 1369
planning, 1370
displays, 1368
Wine, burned, 903
colchicum seed, **372**
measure, 28
red, 941
sherry, 941
white, 941
Wines, 941
low, 914
Wintera, 1006
Wintergreen flavoring extract, 976
oil, 982
artificial, 982
incompatibility, 1649
synthetic, 982
Winter pressed oils, 1033
Winter's bark, 1006
oil, 1006
Wire, iron, 710
sutures, 1768
weights, aluminum, 50
Wismuth, 770
Wister's lozenge, 1700
Witchhazel, distilled extract, **256**
leaves, 1098
tincture, 401
water, **256**
Withering's infusion, **360**, 1069
Witherite, 686
Wolff-Eisner test, 1935
Wood, 93
alcohol, 809
antidote, 1943
bitter, 1064, 1967
charcoal, 204, **589**
troches, 499
gum, 978
naphtha, 809
oil, 1029
sandal, fluidextract, **436**
wool, 1758
Wooden stirrer, 126
Woods, perfumed, 1209
Woody but, 978
Wool, biniodide of mercury, **1762**
blue, **1763**
boracic acid, **1762**
boric, **1762**
acid, **1762**
capsicum, **1762**
carbolized, **1762**
double cyanide, **1762**
fat, 1042
hydrous, 1043
refined, 1042
ferric chloride, **1762**
glass, 1534
lead acetate, 1547
hamamelis, **1762**
iodine, **1763**
iodised, **1763**

Wool, iodoform, **1763**
menthol, **1763**
compound, **1763**
mercuric chloride, **1763**
iodide, **1762**
mercury and zinc cyanide, **1762**
mineral, 1972
perchloride of iron, **1762**
mercury, **1763**
red iodide of mercury, **1762**
sal alembroth, **1763**
salicylic, **1762**
acid, **1762**
strong, **1762**
styptic, **1762**
sublimate, **1763**
wood, 1758
Woollen strainers, 193
Working capital, 1272
Workman's compensation insurance, 1289, 1398
Worm condenser, glass, 141
metallic, 141
condensing, 140
Wormseed, American, 1005
oil, American, 1000
Wormwood, 1016
oil, 986
Wort, flea, 1970
Woulff's bottle, 175, 182
Wound elixir, 369
Wourari, 1164
Wrapping counter, 1312
Wrench, stopper, 552
Wright's stain, 1572
Writing advertising copy, 1372
show cards, 1384
Wrought iron, 709

X

Xanthaline, 1105, 1106
Xanthone, 840
Xanthophyll, 840
Xanthoproteic acid, 558
Xanthorhamnin, 1063
Xanthorrhiza, 1165
Xanthoxyli fructus, 1015
Xanthoxylum, 1015
americanum, 1015
clava-Herculis, 1015
fluidextract, **441**
Xenon, 532
Xeroform, 776, 940
Xerophthalmia, 1168
Xylene, 175, 791, 811, 940, 1543
musk, 1218
Xylenol, 811
Xylol, 799, 940
musk, 1218
Xylose, 885, 893

Y

Yara yara, 1216
Yarrow, 1016
oil, 1016
Yearly record, 1417
Yeast, compressed, 904, 1543
Yellow arsenic, 1978
butter, 853
chrome, 1968
cinchona, 1113
colors, 841
dock, 1099
fever, disinfection, 1888
gentian root, 1063
Yellow iodide, mercury, **754**
assay, 1472
jasmine root, 1159
jessamine, 1159
antidote, 1944
King's, 1971
lotion, **299**
lupin seeds, 1167
melilot, 1077
mercuric oxide, **756**
assay, 1461
incompatibility, 1648
ointment, **505**
subsulphate, 759
mercurous oxide, **754**
incompatibility, 1648
mustard, 993
parilla, 1164
Paris, 1974
pine rosin, 1021
precipitate, 1978
root, 1165
sandalwood, 997
sweet clover, 1077
wash, **299**
wax, 1191
Yellowish eosin, 853
Yellows, naphthol, 841
Yerba santa, 1008
aromatic, elixir, **325**
fluidextract, **411**
syrup, aromatic, **276**
Yew, 1080
Ylang-ylang, 1225
oil, 986
sachet, **1232**
Yohimbi bark, 1165, 1167
Yohimbine, 1167
Yolk, egg, fresh, 1187
Young fustic, 1970
Ytterbium, 532
Yttrium, 532

Z

Zaffre, 1978
Zanetti's hydrometer, 64
Zanzibar capsicum, 996
chillies, 996
Zea, 1016
fluidextract, **441**
Mays, 882, 1016, 1080
Zedoaria, 984
Zedoary, 984
bitter tincture, 401
oil, 986
Zeiss butyro refractometer, 1526
Zeiss immersion refractometer, 1526
Zig-zag steam coil, 118
Zinc, 532, 690, 1543
acetate, **691**
assay, 1478
mixture, 1569
aluminum, solution compound, 260
blende, 690
bromide, 697
butter, 1967
carbonate, precipitated, 697
chloride, **692**
assay, 1463
solution, 257, **692**, 1568
assay, 1463
cyanide, 697
dioxide, 697
ferrocyanide, **697**
flowers, **1970**
Zinc fluorescein, 852
glycerogelatin, firm, **515**
soft,
iodide, 697
-iron solution compound, 260
lactate, 697
mull, **522**
ointment, **507**
oleate, **351**, 698
ointment, 512
oxide, **693**, 1543
assay, 1457
ointment, **507**
plaster, 521
paste, **517**
Lassar's, **517**
soft, **517**
Unna's, **517**
sulphurated, **517**
Unna's, **517**
permanganate, 698
peroxide, 697
phenolsulphonate, **696**
and iodine solution, **578**
assay, 1479
phosphide, 698
potassium cyanide, 697
salicylate, 698
salts, tests for, 690
unofficial, 697
stearate, **694**
assay, 1458
ointment, **511**
talcum powder, **1235**
sulphanilate, 698
sulphate, **695**
assay, 1479
antidote, 1944
sulphide, 698
sulphite gauze, **1762**
sulphocarbolate, **696**
valerate, 698
elixir, 339
white, 1978
Zinci acetas, **691**
bromidum, 697
carbonas præcipitatus, 697
chloridum, **692**
cyanidum, 697
dioxidum, 697
et potassii cyanidum, 697
ferrocyanidum, 697
iodidum, 697
lactas, 697
oxidum, **693**
permanganas, 698
phenolsulphonas, **696**
phosphidum, 698
salicylas, 698
stearas, **694**
sulphas, **695**
sulphanilas, 698
sulphidum, 698
valeras, 698
Zingiber, 984
officinale, 984, 985
Zingiberaceæ products, 983
Zirconium, 532
Zittmann's decoction, milder **363**
stronger, **363**
Zizyphus vulgaris, 892
Zoölogy, definition, 1
Zootic acid, 1978
Zooticum, 1978
Zylonite, 1978
Zymase, 902
Z. Z., 1978

3 5132 00348 4482
University of the Pacific Library